Delta-Mendota Canal Subsidence Correction Project Environmental Assessment/ Initial Study

Final



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BUREAU OF RECLAMATION

SAN LUIS & DELTA-MENDOTA WATER AUTHORITY

October 2024

Mission Statements

The U.S. Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated Island Communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

The mission of the San Luis & Delta-Mendota Water Authority is to operate the Delta-Mendota Canal and related facilities reliably and cost-effectively, and to support member agencies in restoring and protecting adequate, affordable water supplies for agricultural, municipal and industrial, and environmental uses.

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Chapter 1 Introduction

This Environmental Assessment (EA) and Initial Study (IS) for the Delta-Mendota Canal (DMC) Subsidence Correction Project (Project) was prepared by U.S. Department of the Interior, Bureau of Reclamation (Reclamation), and San Luis & Delta-Mendota Water Authority (SLDMWA). SLDMWA is a California Joint Powers Authority that is responsible for the operation, maintenance, and replacement (OM&R) of certain Reclamation Central Valley Project (CVP) facilities, including the DMC, pursuant to Transfer Agreement Contract No. 8-07-20-X0354-X with Reclamation.

This joint EA/IS document satisfies the requirements of (1) the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] Section 4321 et seq.), the Council on Environmental Quality (CEQ) 2022 NEPA implementing regulations (40 Code of Federal Regulations [C.F.R.] Section 1500–1508), and the Department of the Interior's NEPA regulations (43 C.F.R. Part 46); and (2) the California Environmental Quality Act (CEQA), and the Governor's Office of Planning and Research regulations to implement CEQA (Sections 15000–15387 of the California Code of Regulations). The CEQ NEPA implementing regulations define a 'lead agency' as the federal agency with primary responsibility for complying with NEPA on a Proposed Action; Reclamation is the NEPA lead agency for the Project, responsible for preparing the EA. State CEQA Guidelines define a 'lead agency' as the public agency that has the principal responsibility for carrying out or approving a proposed project; SLDMWA is the CEQA lead agency for the Project, responsible for preparing the IS.

This EA/IS describes the potential direct, indirect, and cumulative effects from constructing the Project. This EA/IS also identifies measures that were incorporated to avoid or substantially reduce Project-related impacts.

1.1 Project Background and History

The DMC is a 116-mile-long canal that conveys water from the Sacramento–San Joaquin River Delta (Delta) region near Tracy, California to the Mendota Pool near Mendota, California. This canal is one of the major components of the CVP and is considered critical infrastructure. The DMC was designed by Reclamation in the late 1940s and early 1950s consistent with the then-current design standards and standard industry practices. The upper segment of the DMC is lined with four-inch unreinforced concrete. At Mile Post (MP) 98.64 (Station Number 5201+00), the concrete lining is replaced by earthen lining, which continues for the lower 18 miles of the DMC. During design, Reclamation found that the expansive properties of the clay soil surrounding the lower segment of the canal would be detrimental to a concrete lining. In addition, high groundwater in areas of the lower 18-mile segment would require an elaborate drainage system to be installed underneath any potential concrete lining. Therefore, Reclamation decided to use suitable clay soil from canal excavation to form an earthen lining for the lower segment of the DMC (Reclamation 1959).

The DMC was originally designed to convey a spatially variable flow capacity rate, with a maximum capacity of 4,600 cubic feet per second (cfs) at the upstream end with a reduction to the minimum capacity of 3,210 cfs at the downstream end. Since its original construction, the DMC has been affected by subsidence generated by groundwater pumping within the Central Valley and along the length of the canal. When subsidence occurs directly under a canal, the entire canal prism drops vertically, while the controlled water surface elevation remains the same; this results in a reduction in available freeboard. Reclamation performed construction on the canal to remediate subsidence issues in 1969 and 1977. However, subsidence has continued, and the DMC is no longer able to convey the original design flows while operating in accordance with Reclamation Safety Standards and Guidelines. These limits on conveyance capacity have introduced operational constraints that can affect deliveries to south-of-Delta CVP contractors. To fully optimize CVP storage and support Reclamation's contract deliveries to south-of-Delta CVP contractors, the capacity of the DMC must be restored. The Project is proposed to restore conveyance capacity and avoid constraints on the operation of the CVP, as well as address operational safety concerns generated by subsidence.

1.2 Need for Proposal and Project Objectives

1.2.1 Project Purpose and Need

As a result of subsidence, the available freeboard for the canal lining and the canal embankment, and clearances between maximum water surface elevations and many structures crossing the DMC, no longer meet Reclamation standards. The combination of reduced freeboard and impacted structures requires that SLDMWA operate the DMC at a lower water surface elevation, which reduces the capacity to convey water supply deliveries to contractors dependent on that supply. The continued, safe, and reliable operation of the DMC is critical to the users it serves, and the economies it supports. The purpose and need of Reclamation's Proposed Action is to restore the originally authorized conveyance capacity of the DMC (the design capacity conveys a variable flow rate decreasing from 4,600 cfs at the upstream end to 3,210 cfs at the downstream end).

In compliance with CEQ's Economic and Environmental Principles, Requirements, and Guidelines for Water- and Land-Related Resources Implementation Studies and Reclamation's Directive and Standards CMP 09-02 Water and Related Resources Feasibility Studies, Reclamation and SLDMWA are evaluating the feasibility of alternatives that would restore the lost conveyance capacity in the DMC caused by regional subsidence. Reclamation is completing a feasibility report to identify, evaluate, and select an alternative that can support the delivery of CVP supplies needed by CVP contractors dependent on the DMC that would otherwise be adversely impacted by limits on its conveyance capacity generated by regional subsidence.

1.2.2 CEQA Primary Goals and Objectives

Under CEQA, a lead agency must identify the objectives sought by the proposed project when that project requires an Environmental Impact Report (EIR) (CEQA Guidelines Section 15124(b)). Although a statement of project objectives is not required under CEQA for an IS, the additional information provided in this section is consistent with CEQA Guidelines. The primary goal for the Project is to restore conveyance capacity in the DMC lost to regional subsidence. The objectives of the Project are as follows:

1. To restore the long-term reliability and quantity of CVP supplies delivered to south-of-Delta contractors dependent on the DMC currently affected by reduced deliveries limited by the canal's reduced conveyance capacity.
2. To support the safe long-term operation of the DMC consistent with its design for freeboard and clearances between maximum water surface elevations and structures crossing the canal.

1.2.2.1 Additional Goals and Objectives

The Project is being designed and implemented to achieve the primary goals and objectives listed above. CEQA Guideline 15124(b) states that the goals and objectives may also outline Project benefits. The additional benefits of the Project are as follows:

- Restore capacity of the DMC for the short-term conveyance of transferred water[1] to provide increased water supply reliability and operational flexibility to south-of-Delta CVP contractors and potentially convey surface water supplies for other contractors.
- Design and maintain the restored capacity of the DMC for a service life of at least 50 years to avoid potential future reductions in conveyance capacity resulting from continued subsidence forecast following Project implementation.

[1] Environmental compliance for the transfer actions including sellers making water available and the conveyance of transferred water to south-of-Delta CVP contractors is analyzed outside this EA/IS in separate environmental compliance documents, including but not limited to the Long-Term Water Transfers environmental document, available here: https://www.usbr.gov/mp/nepa/nepa_project_details.php?Project_ID=18361.

1.3 Document Structure

A description of the affected environment/existing conditions in the study area is presented in Chapter 3. To consider environmental impacts of the proposed Project pursuant to both NEPA and CEQA, Chapter 4 includes the analysis of possible impacts to resources using an IS checklist adapted from the CEQA Guidelines, Appendix G. Discussion of potential impacts for the No Action/No Project Alternative and Proposed Action/Proposed Project are addressed in more detail following each checklist section. Chapter 5 provides an analysis of cumulative effects, by resource area, of the Proposed Action/Proposed Project taken together with other past, present, and reasonably foreseeable probable future projects (or actions) as required by the NEPA implementing regulations (40 C.F.R. 1508.1(g)(3)). Chapter 6 includes additional discussions for consideration pursuant to NEPA, Department of the Interior regulations, and Reclamation guidelines. Appendix A provides supplemental information, including a list of preparers, acronyms, and references.

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Chapter 2 Project Description

2.1 No Action/No Project Alternative

Under NEPA, the No Action Alternative describes future circumstances without the Proposed Action and includes predictable actions by persons or entities, other than the federal agency involved in a project action, acting in accordance with current management direction or level of management intensity. Under CEQA, an evaluation of the No Project Alternative is not required in an Initial Study (IS)/Mitigated Negative Declaration (MND). If the requirements of an EIR are triggered, the No Project Alternative also describes the future without the project and may include some reasonably foreseeable changes in existing conditions and changes that would reasonably be expected to occur in the foreseeable future if the project were not approved. The purpose of the No Action Alternative and the No Project Alternative is to provide decision-makers a comparison of the potential impacts of approving a project against the potential impacts of not approving the project.

Under the No Action/No Project Alternative (subsequently identified as the No Action Alternative), the existing conditions of the DMC would remain unchanged, and the conveyance capacity would be reduced from original design capacity during operation to meet Reclamation Design Standards No. 3 (Reclamation 2014). Currently, 30 of the existing 115 bridges along the DMC are considered deficient because they do not have one foot of clearance above the Maximum Water Surface Elevation when the canal is operated at design flow (MWSEL). However, the number of deficient bridges is expected to reach 45 when taking future subsidence conditions into consideration. Under the No Action Alternative, deficient bridges would be partially submerged when the canal is operated at the design flow, resulting in safety risks. To operate the canal safely and in accordance with Reclamation safety standards under the No Action Alternative, flow in the canal would need to be restricted further below its current operating flows, with a maximum, permanent flow reduction in the DMC estimated at 1,457 cfs (44-percent reduction) from original design capacity. Subsidence modeling was completed by Reclamation using the HydroGeoSphere San Joaquin Valley Groundwater Model to forecast the anticipated level of subsidence along the DMC through 2070. The simulated subsidence rates along the DMC were used to estimate forecasted design flows under future conditions. Figure 2-1 details the current and anticipated reduction of the canal capacity compared to the designed capacity.

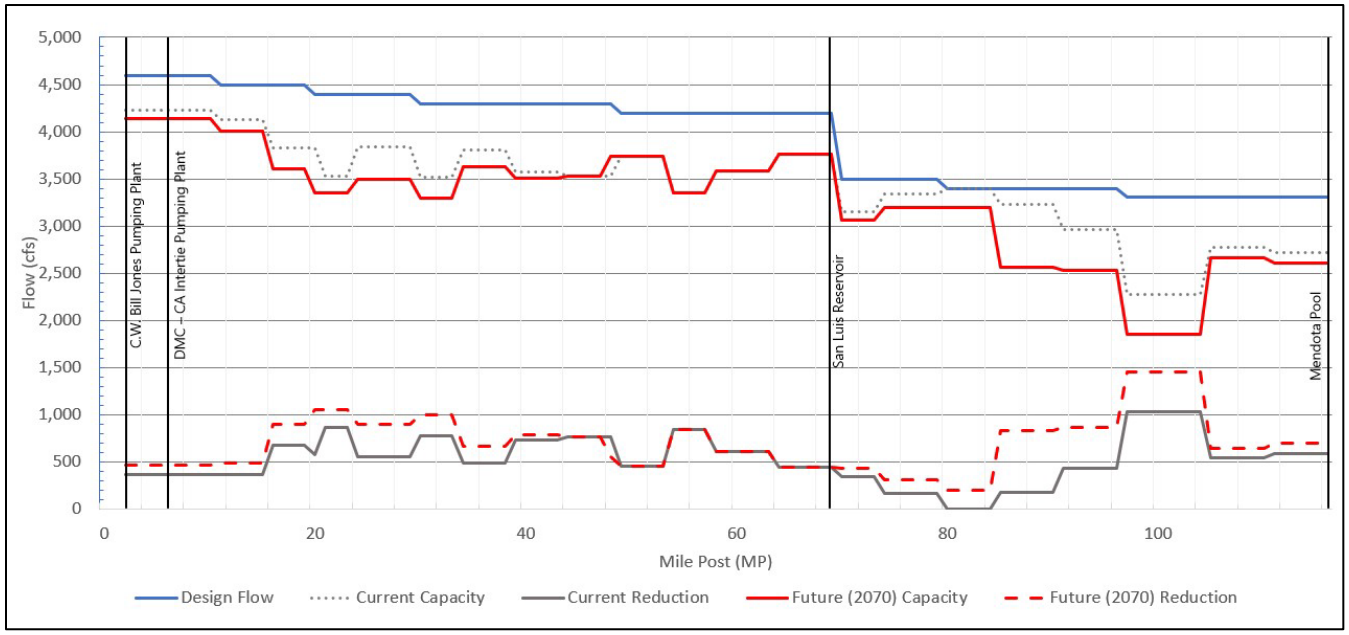


Figure 2-1. Design Flows, Reduction in Flow, and Actual Flow Capacities in the DMC for Current and Future (With Future Subsidence) Conditions

The No Action Alternative evaluates the reduced capacity of the DMC under (1) current conditions as of 2020, (2) under forecasted 2035 conditions, and (3) under forecasted 2070 conditions in the Project area. The No Action Alternative is analyzed consistent with the 2019 United States Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) Biological Opinions for the Reinitiation of Consultation on the Long-Term Operation (ROC on LTO) of CVP and State Water Project (SWP) (USFWS 2019; NMFS 2019), Reclamation's 2020 ROC on LTO Record of Decision (ROD) (Reclamation 2020) and the 2018 Addendum to the Coordinated Operation Agreement CVP/SWP Finding of No Significant Impact (FONSI)/ROD that are assumed to also reasonably represent future anticipated operational conditions. The 2019 USFWS and NMFS Biological Opinions for ROC on LTO, 2020 ROD for ROC on LTO, and the 2018 Addendum to the Coordinated Operation Agreement CVP and SWP FONSI/ROD assume a DMC conveyance capacity reflecting the original design capacity. As noted previously, the No Action Alternative assumes a reduced capacity of the DMC consistent with existing conditions. The No Action Alternative assumes pumping at the Harvey O. Banks Pumping Plant, DMC – California Aqueduct Intertie Pumping Plant (Intertie Pumping Plant), California Aqueduct, and the San Luis (Volta) wasteway would be the same as existing operations.

2.2 Raise Deficient Structures Alternative (Proposed Action/Proposed Project)

The Raise Deficient Structures Alternative has been selected as the Proposed Action (under NEPA) and the Proposed Project (under CEQA). Appendix B, Plan Formulation Technical Memorandum, details the other action alternatives (including a non-structural alternative) that were considered and explains the Proposed Action/Proposed Project (subsequently identified as the Proposed Action) selection process. Under the Proposed Action, the DMC would be modified to satisfy current Reclamation safety standards, including freeboard requirements for the canal lining and embankment. The deficient lining, embankment, and impacted structures of the canal would be raised to restore the canal to its originally authorized conveyance capacity. The proposed modifications of the canal and related structures would be in accordance with current federal, state, and local design guidelines and standards.[2] The proposed design of the Proposed Action takes into consideration future subsidence (forecasted 2070). Construction requirements under the Proposed Action are described below; more details regarding construction methods and locations of work along the canal can be found in Appendix C.

- Raising deficient canal concrete lining by installing new concrete lining above the existing lining along approximately 80 miles of the DMC. The locations where canal lining raises would occur are presented in Figure 2-2.
- Raising the earthen embankment at deficient bank segments of the canal by adding fill material from existing borrow sites along 50 miles of canal right-of-way (ROW). The locations where embankment raises would occur are presented in Figure 2-2.
- Stabilizing the canal banks along the 18-mile earthen-lined segment of the canal (MP 98.64 to 116.59), which requires lowering the water depth in the earthen-lined segment of the canal by up to six feet during construction.
- Repairing distressed concrete lining above and below the water's surface.
- Replacing 45 impacted vehicle bridges and 36 impacted pipeline crossings. The locations where this work would take place are presented in Figure 2-2.
- Modifying 17 check structures and wasteways and 82 turnouts.
- Modifying drainage structures.

[2] Relevant guidelines/standards include Reclamation's Design Standards (Reclamation 2012; 2014; 2018), Reclamation's Engineering and Operation and Maintenance (O&M) Guidelines for Crossings (Reclamation 2008), and Reclamation Earth Manual (Reclamation 1998).

Appendix C provides a detailed description of construction methods for each component proposed under the Proposed Action.

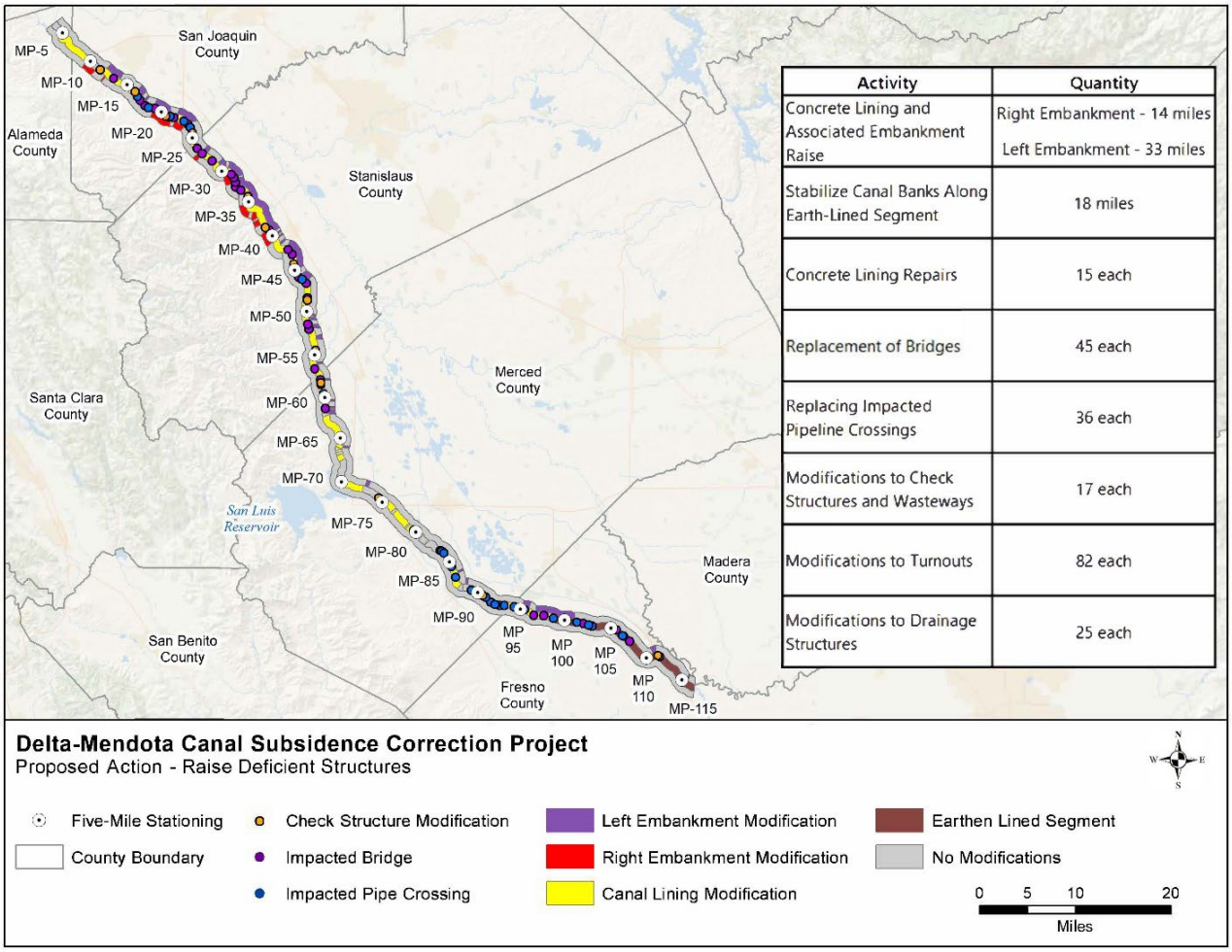


Figure 2-2. Construction Details Under the Proposed Action

2.2.1 Construction Equipment and Schedule

Construction staging and stockpiling would occur within canal ROW, within the immediate vicinity of the construction activity, and would be limited to the duration of the construction activity. In addition to the construction staging area, 54 borrow areas (approximately 227.7 acres total) have been identified within the canal ROW for excavation of embankment material and backfill material. The staging areas would be returned to pre-construction condition and the borrow areas would be smoothed out to the surrounding elevation of the Operation and Maintenance (O&M) service road after the Proposed Action is completed.

Table 2-1 summarizes the construction equipment list by construction activity proposed under the Proposed Action. Construction equipment would access the construction sites and stockpiling areas through existing left and right bank service roads.

Table 2-1. Construction Equipment Assumptions under the Proposed Action

Construction Activity	Equipment List
Concrete Lining and Associated Embankment Raise	1 Small Dozer, 2 Loaders, 1 Small Excavator, 1 Compacter, 1 Skid Steer, 7 Water Trucks, and 2 Dump Trucks
Stabilize Canal Banks Along Earthen-Lined Segment	2 Small Dozers, 5 Loaders, 1 Small Excavator, 2 Roller Compacters, 1 Plate Compactor, 1 Grader, 7 Water Trucks, and 2 Dump Trucks
Concrete Lining Repairs	1 Excavator, 2 Dump Trucks, 1 Skid Steer
Replacement of bridges	1 Crane, 1 Sawcut, 1 Dozer, 1 Compactor, 1 Excavator, 1 Drill Rig, 1 Skid Steer, 1 Paver, 1 Tractor, 4 Water Trucks, and 6 Dump Trucks
Replacing Impacted Pipeline Crossings	1 Small Excavator, 1 Skid Steer, 1 Crane, 1 Loader, 2 Dump Trucks
Modifications to Check Structures and Wasteways	2 Cranes and 3 Lifts
Modifications to Turnouts	2 Cranes, 1 Skid Steer, and 2 Dump Trucks
Modifications to Drainage Structures	2 Excavators, 2 Skid Steers, 1 Dump Truck

Note: Construction activities listed above could occur concurrently.

Construction duration for the Proposed Action is assumed to be seven and a half years. Work would be performed seven days per week, 12 months per year. Work during the weekdays (Monday through Friday) would be performed in one 10-hour work shift that would occur between 7:00 a.m. and 7:00 p.m. Work during the weekends (Saturday and Sunday) and federal holidays would be performed in one eight-hour shift that would occur between 9:00 a.m. and 5:00 p.m. It is assumed, for the purpose of this EA/IS, that construction would start in March 2025. The major assumptions for the schedule development of the Proposed Action, as well as the anticipated construction duration of construction activities, are detailed in Table C-7 in Appendix C.

2.2.2 Operations

2.2.2.1 Operations During Construction

Some drawdowns of the canal water surface would be needed to support the low-flow construction activities; however, no outages would be required, thus providing flexibility in completing construction activities while minimizing impacts to water deliveries. The proposed concrete lining and associated embankment raise low-flow construction actions in the upper DMC would be completed above water surface and would not impact flows. Proposed concrete lining repairs of the canal in the upper DMC would require underwater work and would also be completed without drawdown to flows. Modification to check structures in the upper DMC would require flows in the upper DMC to be held at levels not to exceed two thirds of current capacity (i.e., 66 percent of current capacity) between November through February of the construction duration.

The proposed embankment raise low-flow construction action in the lower DMC would be completed above water surface and would not impact flows. Proposed concrete lining repairs of the lined canal would require underwater work and would also be completed without drawdown to flows in the lower DMC. Similar to the upper DMC, modification of check structures along the lower DMC would require flows to be held at two thirds of current capacity (i.e., 66 percent of current capacity). Repairs and stabilization activities along the earthen-lined segment of the lower DMC would require water levels to be drawn down by six feet from November through February, which is equivalent to an average reduction of approximately one third of the canal's current capacity in that segment. During these construction actions, limits on water levels in the earthen-lined segment of up to six feet could result in a water surface elevation in the Mendota Pool higher than the DMC, depending on inflow rates into Mendota Pool from the San Joaquin River. If these conditions were to occur during construction, water would be pumped from the DMC into Mendota Pool.

2.2.2.2 Operations After Construction

Operation of the restored capacity after construction would conform to the existing operating rules identified in the 2019 USFWS and NMFS Biological Opinions (USFWS 2019; NMFS 2019) and 2020 ROC on LTO ROD or

any future regulatory requirements and the terms and conditions specified in the relevant Biological Opinions. Reclamation and its operating entity (i.e. SLDMWA) would continue to maintain the facilities in compliance with the existing USFWS Biological Opinion titled *Formal Endangered Species Consultation on the Operations and Maintenance Program Occurring on Bureau of Reclamation Lands Within the South-Central California Area Office* that was issued on February 17, 2005 (referred furthermore as the 2005 USFWS Biological Opinion) (USFWS 2005) or any future regulatory requirements and the terms and conditions specified in the relevant Biological Opinions. The canal would be modified to meet its original design standards to convey original design flows. Therefore, no changes to the current maintenance and operations are anticipated.

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Chapter 3 Affected Environment/Environmental Settings

This chapter presents an overview of the physical environment and existing conditions that could be affected by the Proposed Action, as required by 40 C.F.R. Section 1501.5(c)(2) and CEQA Guidelines Section 15063(d)(2) for the EA/IS. Appendix E presents the federal, state, and local laws, regulations, policies, and plans that are relevant and applicable to the affected environment. Appendix F presents supporting information detailing the affected environment/environmental settings related to visual quality; hazards and hazardous materials; recreation; geology, seismicity, and soils; and public utilities in the study area. The study area for this EA/IS includes the DMC and related infrastructure where construction work would occur within the counties of Alameda, San Joaquin, Stanislaus, Merced, and Fresno. For resource areas, such as water supply and water quality, that have potential operational impacts associated with them, the study area is expanded to include San Benito and Santa Clara counties to encompass all of the SLDMWA member agencies.

3.1 Delta-Mendota Canal

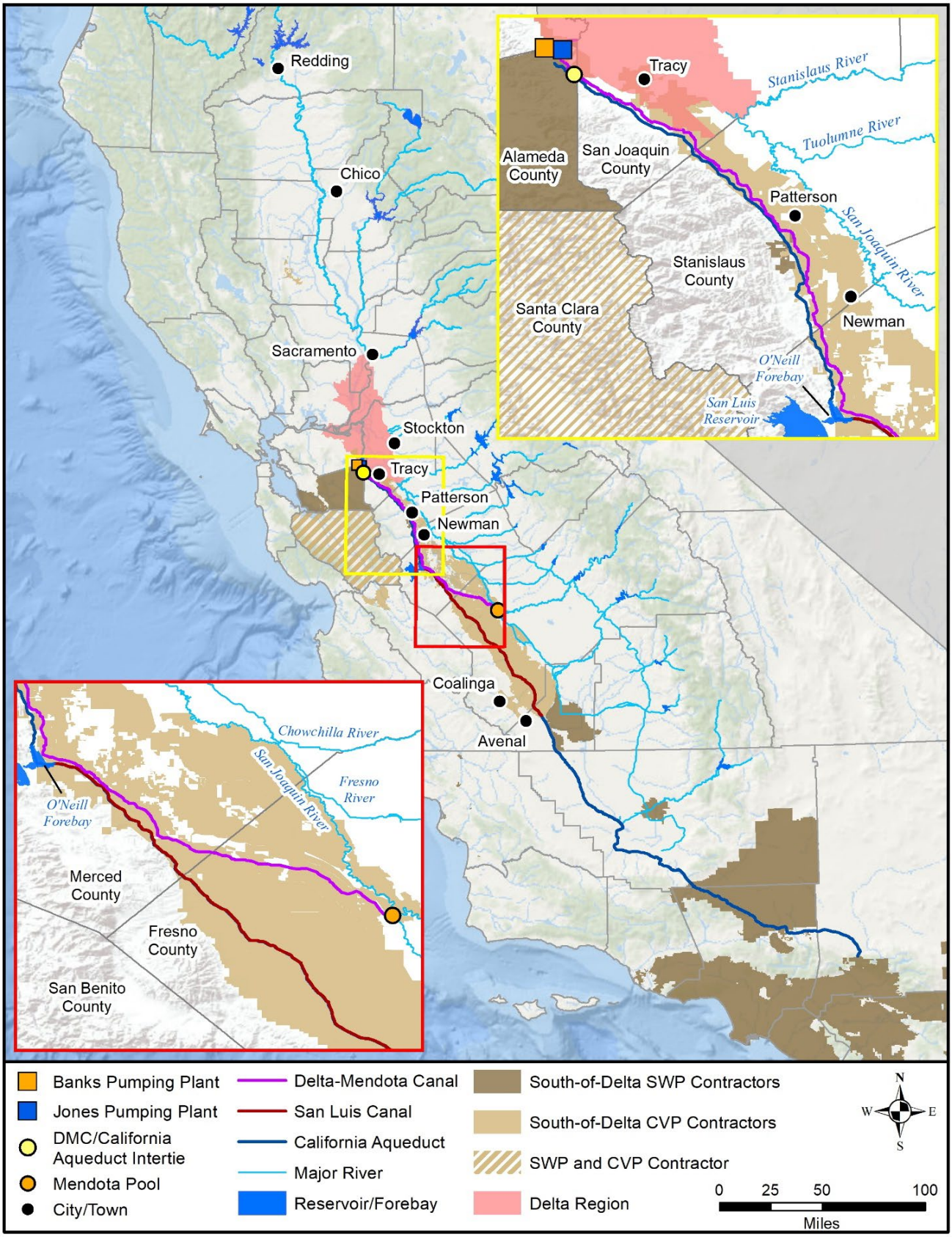
The DMC is an integral part of Reclamation's CVP and is essential for providing water supply for the land along the west side of the San Joaquin Valley in addition to San Benito and Santa Clara counties. For most of its length, the DMC runs parallel to Interstate 5 (I-5) and the California Aqueduct before branching off in the southeastern direction in south Merced County to terminate at the Mendota Pool in Fresno County (Figure 3-1). The area surrounding the DMC is characterized as flat, rural, agricultural land, although the canal passes through some areas containing industrial, commercial, or residential buildings. Current noise sources existing in the study area include agricultural noise, general stationary noise, and general mobile noise; no major sources of vibration are known to exist in the study area. Although portions of the DMC pass through incorporated cities or towns, the majority of the DMC runs through unincorporated areas[3] of the relevant counties.

Mendota Pool Park is the only recreational facility located within the canal ROW or in the immediate vicinity of the canal (within 0.25 miles of canal ROW). Mendota Pool Park offers 20.3 acres of trails (Mapcarta n.d.) with picnic areas and fishing opportunities. The canal is directly adjacent to the Tracy Municipal Airport, a public use airport located in San Joaquin County that fields the operation of an average of 161 aircrafts per day. In Stanislaus County, the canal passes within 200 feet of the out-of-service Crows Landing Airport, a private use airport that is planned to be functioning again in the next 20 years. Additionally, there are at least 20 landfills with available capacity located within a 40-mile radius of the DMC.

3.1.1 San Joaquin Valley

The San Joaquin Valley is the area of the Central Valley that lies south of the Delta and is drained by the San Joaquin River. The study area is located in the Great Valley geomorphic province, which is approximately 50 miles wide and 400 miles long and bordered on the east by the Sierra Nevada geomorphic province and on the west by the Coast Range geomorphic province. The area is characterized by containing highly expansive soils, meaning that the soils in the region are susceptible to changing shape and volume in response to moisture content. Highly expansive soils are conducive to the occurrence of land subsidence, which has significantly impacted the Project area and the greater San Joaquin Valley (United States Department of Agriculture Natural Resources Conservation Service 2022).

[3] An unincorporated area refers to the part of a county that is outside any municipality.



Key: CVP = Central Valley Project; DMC = Delta-Mendota Canal; SW = State Water Project

Figure 3-1. Study Area

The study area's location in the San Joaquin Valley makes workers and residents of the area susceptible to Valley Fever, an infection caused by the soil-dwelling fungus *Coccidoides* that when inhaled can cause symptoms such as chest pain, cough, fever, headache, and more (California Department of Public Health 2019). More than 50 active hazardous waste facilities are present within one-half mile of the canal (United States Environmental Protection Agency [USEPA] 2022a). Other potential hazards include the study area's proximity to areas of moderate to high wildfire risk, and the potential for structures in the Project area to contain asbestos and/or lead materials.

2.2 Water Supply

The federal and state governments constructed the CVP and SWP in pursuit of the State Water Plan to maximize use of the state's water supplies and provide flood control. Because C.W. 'Bill' Jones Pumping Plant (Jones Pumping Plant) is operated as an integral component of the CVP, changes in pumping at Jones Pumping Plant due to restoration of DMC capacity would affect operations of a majority of CVP and SWP facilities. Therefore, although the construction impacts are confined to the DMC ROW, the water supply study area captures all of the CVP and SWP contractors that may be impacted by changes to the operation of the DMC.

2.2.1 CVP Contractors

The CVP has several different types of contracts, including Repayment Contracts, Exchange Contracts, Refuge Contracts, Settlement Contracts, Friant Division Contracts, and Water Service Contracts for delivery of CVP water. Each year, Reclamation determines the amount of water that can be allocated to each CVP contractor based on contractors' water rights and conditions for that year. In most cases, these allocations are expressed as a percentage of CVP contractors' contract total (for contracts that allow use of both agricultural and municipal and industrial [M&I] water) or historical use (for M&I only contracts).

North of the Delta, there are 42 Water Service or Repayment contractors across three CVP divisions that deliver water for agricultural contractors, M&I, or both agricultural and M&I purposes. In the Delta and south-of-Delta areas, there are 31 Water Service or Repayment contractors across three CVP divisions and one unit that deliver water for agricultural, M&I, or both agricultural and M&I purposes. South-of-Delta CVP contractors are located south of the Delta and consist of the Delta Division, Cross Valley Canal Contractors, San Felipe Division, and San Luis Unit. Other CVP contractors located south of the Delta who may be impacted by the Proposed Action include the South-of-Delta Settlement Contractors, San Joaquin River Exchange Contractors Water Authority (Exchange Contractors), and Friant Division Contractors[4]. The SLDMWA, which extends from the City of Tracy in San Joaquin County in the north to Kettleman City in Kings County in the south, contains 25 member agencies that contract with Reclamation for CVP water. More information regarding these contractors and SLDMWA can be found in Appendix G.

2.2.2 SWP Contractors

The SWP delivers water to 29 public water agencies in Northern, Central, and Southern California that hold long-term contracts for surface water deliveries. The agencies deliver water for both urban and agricultural use, representing more than 25-million municipal contractors and 750,000 acres of irrigated farmland. Five of the agencies use the SWP water primarily for agricultural uses and the remaining 24 use the SWP water primarily for municipal use. Water supplies for agencies include imported SWP water, groundwater, local surface water, and (for some agencies) other imported supplies. The agencies collectively have received deliveries ranging from approximately 1.4 million acre-feet (MAF) in dry water years to approximately four MAF in wet years.

2.2.3 Power Production and Energy Usage Along the Delta-Mendota Canal

Water from CVP reservoirs flows into the Sacramento River, which carries water to the Delta, where water is lifted via six electric motors into the DMC by the Jones Pumping Plant located about 12 miles northwest of Tracy in Byron, California. Between the years 2011 through 2020, Jones Pumping Plant pumped an average of

[4] CVP Friant Division contractors receive deliveries from Friant Dam through the San Joaquin River, Madera Canal and the Friant Kern Canal. As such, they are separate from the CVP South of Delta Contractors that receive CVP deliveries from the Sacramento River and its tributaries or the Delta.

approximately 1.8 MAF of water from the Delta to the DMC each year (Reclamation 2022a). Once in the DMC, water conveyance is driven by gravitational force from north to south.

The O'Neill Pumping-Generating Plant is located about 12 miles west of Los Banos and lifts water from the DMC into O'Neill Forebay. The plant can also generate power when water is released from the forebay into the DMC. The San Luis/W.R. Gianelli Pumping-Generating Plant is located in the same region and lifts water from O'Neill Forebay to the San Luis Reservoir, generating energy when the water is released from the reservoir into the DMC or the San Luis Canal.

The Intertie Pumping Plant was constructed in May 2012 to move water more effectively from the Delta into the San Luis Reservoir by providing operational flexibility in the federal–state water distribution system when there are system restrictions that may prevent one party from moving water. The Intertie Pumping Plant can pump up to 700 cfs from the DMC to the California Aqueduct via an underground pipeline and can transfer up to 900 cfs from the California Aqueduct to the DMC via gravity flow. The Intertie Pumping Plant is located at DMC MP7.2 and California Aqueduct Mile 9 (Reclamation 2022b).

2.3 Air Quality and Greenhouse Gas Emissions

Although construction impacts are confined to the DMC ROW, the study area for air quality is broader. The study area follows the route of the DMC, originating in Contra Costa County and passing through Alameda, San Joaquin, Stanislaus, and Merced counties before terminating in Fresno County. As mentioned above, no construction activities are planned to be undertaken within Contra Costa County under the Proposed Action; thus, Contra Costa County is excluded from the air quality and greenhouse gas (GHG) emissions study area. Alameda County is within the San Francisco Bay Area Air Basin (SFBAAB) where air pollution is regulated by the Bay Area Air Quality Management District (BAAQMD), while San Joaquin, Stanislaus, Merced, and Fresno counties are within the San Joaquin Valley Air Basin (SJVAB), regulated by the San Joaquin Valley Air Pollution Control District (SJVAPCD). Because the study area is located in a valley, it is highly susceptible to air pollutant accumulation.

The federal Clean Air Act requires the classification of all or portions of air basins based on the ambient pollutant concentrations relative to the National Ambient Air Quality Standards (NAAQS). Areas for which the NAAQS have been achieved are designated as attainment. For areas where NAAQS have not been achieved, states must prepare a State Implementation Plan detailing strategies to reduce air pollutant concentrations in the area and achieve NAAQS. California, through the California Clean Air Act has adopted additional California Ambient Air Quality Standards (CAAQS), applicable only to California, for which attainment must be classified in addition to the NAAQS. In the SFBAAB and SJVAB, ozone (O_3)[5] and fine particulate matter ($PM_{2.5}$)[6] are pollutants of concern because ambient concentrations of these pollutants exceed the NAAQS and CAAQS. Additionally, ambient inhalable particulate matter (PM_{10}) concentrations in SFBAAB and SJVAB exceed CAAQS, while PM_{10} recently attained the NAAQS and is designated maintenance (California Air Resources Board [CARB] 2022; USEPA 2022b). Table I1-1 in Appendix I1 presents the attainment status of the SFBAAB and SJVAB for all criteria pollutants.

GHGs—carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride, hydrofluorocarbons, and perfluorocarbons—are emitted from human activities and natural systems into the atmosphere and trap heat that would otherwise be released into space. Thermal radiation absorbed by GHGs is reradiated in all directions, including back toward the Earth's surface. This results in an increase of the Earth's surface temperatures above what they would be without the presence of GHGs, which are persistent and remain in the atmosphere for long periods. GHGs differ from criteria pollutants in that GHG emissions do not cause direct adverse human health effects. Rather, the direct environmental effect of GHG emissions is the increase in global temperatures, which in turn has numerous indirect effects on the environment and humans. Most CO_2 emissions from human activities, known as anthropogenic emissions, are attributed to the burning of fossil fuels for electricity, heat, and

[5] Marginal nonattainment under NAAQS in SFBAAB; Extreme nonattainment under NAAQS in SJVAB (USEPA 2022).
[6] Moderate nonattainment under NAAQS in SFBAAB; Serious nonattainment under NAAQS in SJVAB (USEPA 2022).

transportation and land use changes, such as deforestation. GHG emissions are managed through thresholds set by the state and federal government described in Appendix E.

2.4 Cultural Resources in the Study Area

The cultural resources area of analysis is centered on the area of potential effects (APE) for the Proposed Action, or the area within which cultural resources may be directly or indirectly impacted by Project activities. The Project's APE is approximately 114 miles long. The APE's extent perpendicular to the DMC varies but lies primarily within Reclamation's ROW. Some areas adjacent to the ROW are included in the APE to accommodate for proposed work on bridges along the canal and their approaches. The Project APE amounts to 5,899 acres, although only specific areas will be subject to ground-disturbing activities. All access and staging would occur via existing O&M access roads along the DMC and would be contained within the ROW.

The archaeological record within the Central Valley encompasses the full range of prehistoric hunter-gatherer adaptations. Broad cultural periods identified for the Central Valley include the Paleo-Indian (13,500–10,500 years before present [BP]), Lower Archaic (8,500–7,500 BP), Middle Archaic (7,500–2,500 BP), Upper Archaic (2,500–850 BP), and Emergent (850–150 BP) periods. More localized sequences relevant to the DMC Study Area, which were defined largely through distinctive artifact types and mortuary practices, include the Positas (ca. 5,250–4,550 BP), Pacheco (4,550–1,650 BP), Gonzaga (1,650–950 BP), and Panoche (450–100 BP) complexes. The DMC APE falls within the traditional territory of the Northern Valley Yokuts—one of three ethnographically and linguistically defined groups that occupied the San Joaquin Valley at the time of European contact. The Northern Valley Yokuts were followed by Spanish, Mexican, and American explorers, missionaries, soldiers, and settlers who transformed the landscape.

The aridity of the western San Joaquin Valley began to pose problems for American Period (1850s to present) agriculture during the late-19th century as land was developed further away from water sources. Canal Projects were undertaken to move water from the rivers flowing into the San Joaquin Valley from the Sierra Nevada. The DMC, a key feature of the CVP, was completed in 1952. Friant Dam stored San Joaquin River flow and diverted it into the Madera and Friant-Kern canal systems. The DMC transports water from the Jones Pumping Plant (formerly Tracy Pumping Station) along the western side of the San Joaquin Valley for irrigation and for storage at the San Luis Reservoir. The prehistoric, ethnographic, and historic period cultural history of the region is explored in Appendix N and provides a context for the cultural resources discussed below.

2.4.1 Tribal Cultural Resources

No Native American resources were identified in the Project APE by the Native American Heritage Commission through searches of the Sacred Lands Inventory conducted on behalf of the SLDMWA in April of 2022. However, a list of interested Native American stakeholders was provided for SLDMWA to contact for further information. No tribal cultural resources, as defined under Public Resources Code (PRC) Section 21074, have been reported within the APE.

2.4.2 Paleontological Resources Within the Study Area

As defined in the Paleontological Resources Preservation Act of 2009, the term 'paleontological resource' refers to any fossilized remains, traces, or imprints of organisms, preserved in or on the earth's crust, that are of paleontological interest and that provide information about the history of life on earth. A record search of the University of California Museum of Paleontology databases found that there have been many invertebrate fossils found in Alameda, San Joaquin, Stanislaus, Merced, and Fresno counties at varying distances from the DMC (UCMP 2022). Because there have been fossils discovered in the vicinity of the canal and the canal is located in an area characterized by formations of alluvium deposited during the Pleistocene-Holocene era, the Project area is considered to be in a moderately high paleontologically sensitive area based on sensitivity evaluation techniques described by the Society of Vertebrate Paleontology (Society of Vertebrate Paleontology 2010).

2.5 Biological Resources in the Study Area

A biological survey report (BSR) was prepared to identify special-status species and other sensitive biological resources that may occur in or near the Project area (Appendix M, Attachment 1). The BSR presents findings from desktop research and field surveys conducted between March 31 and April 22, 2022, that documents the potential for the occurrence of special-status plant and wildlife species within the Project area and provides landscape-level reconnaissance mapping of vegetation and habitats. The following existing conditions are summarized from the detailed information presented in the BSR.

2.5.1 Natural Communities

Natural communities (i.e., habitat types) occurring within the Project area include agriculture (285 acres), annual grassland (742 acres), alkaline emergent wetland (seven acres), freshwater emergent wetland (20 acres), freshwater forested wetland (two acres), intermittent stream channels (eight acres), irrigation canals (six acres), maintained agricultural ditches and drainage features (110 acres), ponds (one acre), riparian woodland (one acre), ruderal/developed (2,663 acres), as well as riverine and emergent wetland within the channel of the DMC itself (identified as 'DMC – Riverine' [1,544 acres] and 'DMC – Freshwater Emergent Wetland' [55 acres], respectively). Sensitive habitats include riparian corridors, wetlands, habitats for legally protected species, areas of high biological diversity, areas supporting rare or special-status wildlife habitat, and unusual or regionally restricted habitat types. Based on these criteria, seven natural communities within the Project area are classified as sensitive: alkaline emergent wetland, freshwater emergent wetland, freshwater forested wetland, intermittent channel, maintained agriculture ditches and drainage features, pond, and riparian woodland.

The locations and areal extents of natural communities occurring within the Project area and a discussion of each habitat type are depicted in Appendix M, Attachment 1 (Habitat Map Book Appendix).

2.5.2 Special-Status Species

Special-status species are defined as those plants and animals that are legally protected under the Endangered Species Act (ESA), the California Endangered Species Act (CESA), or by other regulations; and species that are considered sufficiently rare by the scientific community to qualify for such listing. Based on existing habitat conditions, species-specific habitat requirements, known occurrence records, or direct observations recorded during biological surveys, a total of 54 special-status species—24 plants and 30 wildlife species —were identified as having the potential to occur in the Project area, as summarized in Table M-2 of Appendix M.

2.5.2.1 Special-Status Plants

The following 24 plant species have the potential to occur in the Project area: Alkali milk-vetch (*Astragalus tener* var. *tener*), heartscale (*Atriplex cordulata* var. *cordulata*), Lost Hills crownscale (*Atriplex coronate* var. *vallicola*), brittlescale (*Atriplex depressa*), lesser saltscale (*Atriplex minuscula*), vernal pool smallscale (*Atriplex persistens*), subtle orache (*Atriplex subtilis*), big tarplant (*Blepharizonia plumosa*), Lemmon's jewel flower (*Caulanthus lemmonii*), Hispid salty bird's-beak (*Chloropyron molle* ssp. *hispidum*), recurved larkspur (*Delphinium recurvatum*), spiny-sepaled button-celery (*Eryngium spinosepalum*), diamond-petaled California poppy (*Eschscholzia rhombipetala*), San Joaquin spearscale (*Extriplex joaquiniana*), woolly rose-mallow (*Hibiscus lasiocarpus* var. *occidentalis*), Munz's tidy-tips (*Layia munzii*), Panoche pepper-grass (*Lepidium jaredii* ssp. *album*), shining navarretia (*Navarretia nigelliformis* ssp. *radians*), prostrate vernal pool navarretia (*Navarretia prostrata*), California alkali grass (*Puccinellia simplex*), Sanford's arrowhead (*Sagittaria sanfordii*), long-styled sand-spurrey (*Spergularia macrotheca* var. *longistyla*), Wright's trichocoronis (*Trichocoronis wrightii* var. *wrightii*), and caper-fruited tropidocarpum (*Tropidocarpum capparideum*). These special-status plant species have the potential to occupy portions of the Project area where suitable habitats, such as annual grassland, alkaline and freshwater wetlands, and ponds, are present. Such habitats occur primarily along the landward edge of the DMC ROW. Further information regarding the current extent of suitable habitat for each special-status plant species within the Project area is provided in Table M-2 of Appendix M.

2.5.2.2 Special-Status Animals

The following 30 animal species have the potential to occur in the Project area: pallid bat (*Antrozous pallidus*), Townsend's big-eared bat (*Corynorhinus townsendii*), western mastiff bat (*Eumops perotis californicus*), western red bat (*Lasiurus blossevilii*), American badger (*Taxidea taxus*), San Joaquin kit fox (*Vulpes macrotis mutica*), tricolored

blackbird (*Agelaius tricolor*), grasshopper sparrow (*Ammodramus savannarum*), golden eagle (*Aquila chrysaetos*), short-eared owl (*Asio flammeus*), burrowing owl (*Athene cunicularia*), Swainson's hawk (*Buteo swainsoni*), northern harrier (*Circus hudsonius*), white-tailed kite (*Elanus leucurus*), loggerhead shrike (*Lanius ludovicianus*), song sparrow ('Modesto' population) (*Melospiza melodia*), yellow-headed blackbird (*Xanthocephalus xanthocephalus*), California tiger salamander – central California distinct population segment (*Ambystoma californiense*), California red-legged frog (*Rana draytonii*), western spadefoot toad (*Spea hammondii*), western pond turtle (*Emys marmorata*), longhorn fairy shrimp (*Branchinecta longiantenna*), vernal pool fairy shrimp *(Branchinecta lynchi*), vernal pool tadpole shrimp (*Lepidurus packardi*), northern California legless lizard (*Anniella pulchra*), California glossy snake (*Arizona elegans occidentalis*), San Joaquin whipsnake (*Masticophis flagellum ruddocki*), coast horned lizard (*Phrynosoma blainvillii*), giant garter snake (*Thamnophis gigas*), and Crotch bumble bee (*Bombus crotchii*). These special-status species have the potential to occur throughout the Project area where suitable habitat is present. Further information regarding the current extent and quality of existing habitat for each special-status animal species within the Project area, and the likelihood of each species to occur in these areas, is provided in Table M-2 of Appendix M.

2.6 Regulatory Setting

Appendix E lists the federal, state, regional, and local laws, regulations, policies, and plans that are relevant and applicable to the affected environment, study area, and the evaluation of potential impacts. The Proposed Action would be consistent with the applicable local and regional plans identified in Appendix E.

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Chapter 4 Impact Evaluation

This chapter presents the analysis of potential impacts associated with the implementation of the Proposed Action. Appendix G of the CEQA Guidelines was used to determine the appropriate resources for evaluation in this environmental impact analysis. Each subsection begins with an explanation of the assessment method(s) used to identify and address potential impacts and then presents the basis and criteria for determining whether the potential impacts are significant (under CEQA) and whether mitigation of the impact is warranted. Impacts are determined relative to the baseline of the No Action Alternative (for NEPA) and the existing conditions (for CEQA[7]). For each resource area, significance criteria were developed consistent with the CEQA Guidelines and used to assess the significance level of the impacts under CEQA. A NEPA environmental document must consider the effects[8] that would be caused by, or result from, a project. These factors were considered when developing the significance criteria under which each resource was evaluated to develop impact conclusions. Thus, determinations of significance in the EA/IS are for CEQA purposes only.

The impact discussion is concluded with a CEQA significance determination that indicates if there is no impact to a resource area, or if the impact to a resource area is beneficial, less than significant, or significant. For those impacts that would be significant, the Lead Agencies identified feasible mitigation measures to avoid or substantially reduce the magnitude of the impact to less than significant. Impacts for each resource are summarized in this chapter, with detailed analysis provided in the appendices. Full descriptions of mitigation measures (MMs) are provided in Section 4.14. An effects analysis table containing a summary of the significance criteria, assessment methodology, significance determination, MMs, and the location of the evaluation support is provided in Section 4.15.

4.1 Surface Water Supply

4.1.1 Assessment Methods

This section estimates the potential water supply effects using the California Simulation Model II (CalSim II). Effects of the Project are determined by comparing CalSim II model scenarios that assume full design capacity to a corresponding no action/no project model scenario, as detailed in Appendix D. Appendix G describes the changes to water supply associated with implementation of the Proposed Action in comparison to existing conditions and future no action conditions. Appendix G also includes the detailed modeling results and interpretation of those results. As noted in Chapter 2, under CEQA, existing conditions serve as the baseline to determine potential impacts of the Proposed Action. The existing condition CalSim II simulation was completed using historic hydrology from 1927 through 2003 and the current DMC capacity for existing conditions. This CEQA approach differs from NEPA, where the No Action Alternative reflects expected future conditions within the Project area if no action is taken. The future no action CalSim II simulation was completed using future-projected 2035 hydrology with climate change and the projected 2035 reduced DMC capacity.

The CalSim II model's monthly simulation of the actual daily (or even hourly) operation of the CVP and SWP results in several limitations in the use of its results. The model's results should be considered in a comparative manner to assess the magnitude of the Proposed Action's effect to the model's simulation of existing conditions rather than comparison to real-time observations. Given the CalSim II model's simulation of the CVP and SWP using a monthly time step and the assumptions it relies on to simulate operations, its output includes minor fluctuations of up to five percent. Therefore, if the quantitative changes identified between the Proposed Action and the No Action Alternative are five percent or less, conditions under the Proposed Action would be considered similar to conditions under the No Action Alternative.

4.1.2 Significance Criteria

Impacts on water supply would be considered significant if the Proposed Action would substantially reduce the annual water supply to the CVP, SWP, refuges, or other contractors. As previously discussed, the CalSim II

[7] California Code of Regulations, Title 14, Division 6, Chapter 3, Article 5, Section 15063(d)(3).
[8] "Effects" are defined by NEPA in C.F.R. Section 1508.1(g).

model output includes minor fluctuations because of model assumptions and approaches. Therefore, if quantitative changes between the Proposed Action and the No Action Alternative are five percent or less, conditions under the Proposed Action would be considered 'similar' to conditions under the No Action Alternative and are not identified as an adverse or beneficial water supply effect. If water supply delivery changes are a reduction of five percent or greater, water supply impacts would be considered significant.

4.1.3 Environmental Consequences/Impacts of the No Action Alternative

Under the No Action Alternative, no actions would be taken to restore, or otherwise offset, conveyance capacity lost in the DMC. Consequently, no drawdown or partial outage of the DMC would be needed to repair the canal. **There would be no construction-generated impacts to CVP or SWP surface water supply under the No Action Alternative.**

Under the No Action Alternative and consistent with the CVP M&I Water Shortage Policy, Reclamation would distribute Delta supplies to both south-of-Delta CVP contractors and north-of-Delta CVP contractors. However, because of the reduced capacity of the DMC, Reclamation would continue to deliver any south-of-Delta CVP supplies that are not able to be delivered via the DMC to north-of-Delta CVP contractors. The reduced capacity of the DMC under the No Action Alternative would also continue to limit the ability of the CVP to export their share of Delta excess, as defined under the 2018 Coordinated Operations Agreement Addendum. The reduced capacity of the DMC could limit the ability of Reclamation to meet CVP Exchange Contractor or settlement contractor delivery requirements, which could result in a further reduction in deliveries to other south-of-Delta CVP contractors or require the release of water from Friant Dam to meet CVP Exchange Contractor or settlement contractor delivery requirements, which could result in a reduction in deliveries to Friant Division contractors. Under the No Action Alternative, future subsidence would further reduce the capacity of the DMC. Under future no action conditions, average annual total south-of-Delta CVP agricultural deliveries are expected to decrease up to 17 percent, or 280 thousand acre-feet (TAF), under certain water-year types (dry and below normal) compared to existing conditions and total average annual south-of-Delta CVP M&I deliveries are expected to decrease up to 10 percent, or 26 TAF, as shown in Tables G-4 and G-5 in Appendix G. Therefore, CVP water supply deliveries under future no action conditions would be further reduced compared to existing conditions. **Reduced capacity in the DMC has the potential to cause significant impacts on CVP water supply deliveries under the No Action Alternative.**

Under the No Action Alternative, SWP contractors could continue to export the CVP's share of Delta excess beyond the SWP share that is defined under the 2018 Coordinated Operations Agreement Addendum. **As such, there would be a** continued **beneficial effect on SWP surface water supply deliveries as a result of the decreased capacity of the DMC under the No Action Alternative allowing for ongoing greater export of SWP water supplies.**

Under the No Action Alternative, the reduced capacity of the DMC would continue to limit the short-term conveyance of non-Project water and/or transferred water to south-of-Delta CVP water contractors or other contractors reliant on the DMC for water conveyance. **Reduced capacity in the DMC has the potential to cause significant impacts on water supply deliveries to south-of-Delta CVP water contractors or other contractors reliant on the DMC for water conveyance under the No Action Alternative.**

4.1.4 Environmental Consequences/Impacts of the Proposed Action

4.1.4.1 Construction of the Proposed Action

Construction of the Proposed Action is expected to last approximately seven and a half years. Some drawdowns of the canal water surface are needed to support construction activities; however, no partial outages are required, thus providing flexibility in completing construction activities without adversely impacting water supply deliveries. The modifications in the upper DMC requiring drawdowns limiting flows to levels not to exceed two-thirds of current capacity (i.e., 66 percent of current capacity) would be scheduled to occur between November-February. Average flow levels in the upper DMC during these drawdown periods are approximately 68 percent of current capacity. Higher flow levels exceeding 68 percent have been observed in wet and dry year types. During construction, in years with hydrologic conditions that would support the conveyance levels above the 66

percent limit, those additional supplies would be conveyed using available capacity in the DMC-California Aqueduct Intertie Pumping Plant and the California Aqueduct, in coordination with California Department of Water Resources (DWR). It is anticipated that with use of the Intertie Pumping Plant, impacts to CVP water supply deliveries in the upper DMC during construction of the Proposed Action would be minimal.

The proposed modification of check structures along the lower DMC would require flows to be held at two thirds of current capacity (66 percent of current capacity) between November through February of the construction duration. In the past five years, flows in the lower DMC have been lower than 60 percent of current capacity during the low-flow work months (October through May). Consequently, proposed modifications to check structures would be completed without impacting deliveries to contractors receiving supplies from the lower DMC and Mendota Pool. Repairs and stabilization activities along the earthen-lined segment of the lower DMC would require water levels to be drawn down by five feet, holding conveyance levels to approximately two thirds of the canal's current capacity (66 percent of current capacity) in that segment. This work is scheduled to occur between November-February when flow levels in the earthen-lined segment of the lower DMC are on average approximately 25 percent of current capacity and have been lower than 60 percent of current capacity in all year types. During these construction actions, scheduled to occur between November through February, limits on water levels in the earthen-lined segment of the lower DMC of up to six feet could result in a water surface elevation in the pool higher than the DMC. If these conditions occur during construction, water will be pumped from the DMC into Mendota Pool to avoid impacts to water supply to all water users receiving deliveries from Mendota Pool, including CVP Exchange Contractors and settlement contractors. The scheduling of construction actions requiring limits on DMC conveyance capacity to periods with lower demands and lower flows in the canal will support uninterrupted deliveries to water users (including CVP Exchange Contractors and settlement contractors) from the DMC. Consequently, construction of the Proposed Action is not expected to require the release of water from Friant Dam to meet CVP Exchange Contractor or settlement contractor delivery requirements, which could result in a reduction in deliveries to Friant Division contractors. In addition, Reclamation and SLDMWA would coordinate water delivery schedules during construction times to adjust water delivery as needed. **Therefore, construction of the Proposed Action would have a less than significant impact on CVP deliveries**.

During construction, the Intertie Pumping Plant would continue to be used to maintain CVP deliveries consistent with existing operations. **There would be no impact to SWP surface water supply deliveries from construction of the Proposed Action.**

4.1.4.2 Operation of the Proposed Action

Deliveries to CVP Contractors

Restored conveyance capacity under the Proposed Action would allow Reclamation to distribute contract deliveries more evenly to all CVP contractors consistent with the CVP M&I Water Shortage Policy. This would result in an average annual decrease in deliveries to north-of-Delta CVP contractors when compared to existing conditions and the No Action Alternative. Under operation of the Proposed Action, the average change in total annual north-of-Delta CVP deliveries is expected to be minimal, decreasing less than one percent under all water year types compared to existing and future no action conditions. Operation of the Proposed Action would decrease average annual north-of-Delta CVP deliveries up to five TAF under certain water-year types (dry and critical) compared to existing conditions and decrease up to four TAF under certain water-year types (critical) when compared to future no action conditions, as shown in Tables G-6 and G-7 in Appendix G. Overall, average annual north-of-Delta CVP deliveries would be reduced by less than one percent, and, as was noted in Section 4.1.2, projected changes of less than five percent are not identified as an adverse or beneficial water supply effect. **Therefore, operation of the Proposed Action would have a less than significant impact on north-of-Delta CVP contractors compared to existing and future no action conditions**.

Under operation of the Proposed Action, average annual total south-of-Delta CVP agricultural deliveries are expected to be restored up to 74 TAF, a five percent change, under certain water-year types (dry) compared to existing conditions and are expected to be restored up to 138 TAF, an eight percent change, under certain water-year types (below normal) compared to future no action conditions, as shown in Tables G-8 and G-9 in

Appendix G. In addition, consistent with the restoration of average annual total south-of-Delta CVP agricultural deliveries, Reclamation would most likely be able to meet CVP Exchange Contractor deliveries without impacting other south-of-Delta CVP contractors or requiring the release of water from Friant Dam. **Therefore, operation of the Proposed Action would have a beneficial effect on south-of-Delta CVP agricultural contractors compared to existing and future no action conditions**.

Under operation of the Proposed Action, average annual south-of-Delta CVP M&I deliveries are expected to be restored up to five TAF, a two percent change, under certain water-year types (above normal) compared to existing conditions and are expected to fluctuate up to three TAF, a one percent change, under certain water-year types (dry) compared to future no action conditions, as shown in Tables G-10 and G-11 in Appendix G. Overall, average annual south-of-Delta CVP M&I deliveries would change by less than one percent, and as was noted in Section 4.1.2; projected changes of less than five percent are not identified as an adverse or beneficial water supply effect. **Therefore, operation of the Proposed Action would have a less than significant impact on south-of-Delta CVP M&I contractors compared to existing and future no action conditions**.

Under operation of the Proposed Action, there would be no change to south-of-Delta CVP Level 2 refuge deliveries. Reclamation would continue to meet its obligation to acquire and deliver this water under the Central Valley Project Improvement Act. **Therefore, operation of the Proposed Action would have no impact on south-of-Delta CVP Level 2 refuge deliveries compared to existing and future no action conditions**.

Deliveries to SWP Contractors

Restored conveyance capacity under the Proposed Action would allow the CVP to more fully export its share of Delta excess, as defined under the 2018 Coordinated Operations Agreement Addendum, and therefore would reduce the SWP export of unused CVP share when compared to existing conditions and the No Action Alternative. Under operation of the Proposed Action, average annual south-of-Delta SWP Table A deliveries are expected to decrease up to 23 TAF, a one percent change, under certain water-year types (below normal) compared to existing conditions and are expected to decrease up to 42 TAF, a five percent change, under certain water-year types (critical) compared to future no action conditions, as shown in Tables G-12 and G-13 in Appendix G. As previously mentioned, the Proposed Action would restore CVP export capacity and correct the export imbalance under the No Action Alternative, consistent with the 2018 Coordinated Operations Agreement Addendum. Therefore, the slight decreases in average annual south-of-Delta SWP Table A deliveries are not identified as an adverse water supply effect.

In addition, with south-of-Delta CVP deliveries restored under the Proposed Action, there would be a decrease in potential surplus water supply (Article 21) and carryover water supply (Article 56) deliveries to SWP contractors. The availability of this surplus and carryover water in any particular year is uncertain, and contractors do not base long-term water supply decisions on the availability, or lack thereof, of this water. Both changes in surplus and carryover water supply are presented in the context of total SWP deliveries, including Table A deliveries, because surplus and carryover water is delivered in addition to Table A deliveries. Changes to average annual south-of-Delta SWP Article 21 and Article 56 deliveries compared to existing and future no action conditions are shown in Tables G-14 and G-15 in Appendix G. Under operation of the Proposed Action, average annual south-of-Delta SWP deliveries with surplus and carryover water supply are expected to decrease up to 37 TAF, a one percent change, under certain water-year types (above normal) compared to existing conditions and are expected to decrease up to 42 TAF, a four percent change, under certain water-year types (critical) compared to future no action conditions. All operations affecting Delta exports would be required to meet Delta water quality objectives (e.g., D-1641) and meet the requirements of the then-current USFWS and NMFS Biological Opinions and other current and future regulatory requirements for the long-term coordinated operations of the CVP and SWP. CalSim II modeling and other analyses show there will be no significant adverse effects on the SWP during construction and operation of the Proposed Action. **Therefore, operation of the Proposed Action would have a less than significant impact on south-of-Delta SWP deliveries compared to existing conditions and future no action conditions.**

Deliveries of Other Water

Implementing the Proposed Action could increase the availability of excess capacity in the DMC that would support the delivery of additional non-CVP water in the DMC when compared to the No Action Alternative. **Therefore, operating the Proposed Action would have a beneficial impact on south-of-Delta CVP water contractors or other contractors overall water supplies reliant on the DMC compared to existing and future no action conditions.**

4.2 Water Quality

4.2.1 Assessment Methods

Water quality monitoring data and CalSim II modeling were used to aid in evaluating potential water quality impacts within the Delta, San Luis Reservoir and the DMC. Impacts outside the Delta, San Luis Reservoir and DMC were not considered since CalSim II modeling showed little to no changes in reservoir and stream flow levels. Effects to the DMC are primarily expected to occur during construction. Construction-related water quality impacts were evaluated qualitatively based on anticipated construction practices, materials, locations, and duration of construction and related activities. Effects to the Delta water quality from potential changes to CVP and SWP exports are discussed below. Because water from the Delta is pumped into the DMC, water quality within the Delta is a good indicator of water quality within the DMC. As noted previously, the Proposed Action would restore conveyance capacity in the DMC back to its original design capacity. Operation of the Proposed Action would conform to the existing operating requirements identified in the 2019 USFWS and NMFS Biological Opinions (USFWS 2019; NMFS 2019) and 2020 ROC on LTO ROD (Reclamation 2020). Appendix H contains detailed water quality modeling results.

4.2.2 Significance Criteria

Impacts on water quality would be considered significant if the Proposed Action would (1) violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality; (2) substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner that would: (a) result in substantial erosion or siltation on- or off-site or (b) create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; or (3) conflict with or obstruct implementation of a water quality control plan.

4.2.3 Environmental Consequences/Impacts of the No Action Alternative

Under the No Action Alternative, no actions would be taken to restore, or otherwise offset, conveyance capacity lost in the DMC. No physical modifications, or operational or institutional changes, would occur under this alternative that would alter existing drainage patters, or create or contribute runoff water or degrade existing water quality conditions. Water quality conditions within the area of analysis would remain similar to existing and future no action conditions. **This alternative would have no impact on water quality.**

4.2.4 Environmental Consequences/Impacts of the Proposed Action

4.2.4.1 Construction of the Proposed Action

During construction, the exposure of bare soils, soil and material stockpiles, and the presence of fuels, lubricants, and solid and liquid wastes could cause short-term water quality impacts to the DMC and adjacent water bodies if not managed properly. Soil disturbance could also result in localized surface erosion, minor changes in drainage patterns, and changes in erosion rates. Therefore, construction-related activities have the potential to degrade surface water and groundwater quality and create additional sources of polluted runoff. Construction-related activities have the potential to degrade surface water and groundwater quality under the Proposed Action, which could affect the ability to meet objectives in a water quality control plan. **These impacts would be significant.** Implementation of MM WQ-1 would require the preparation of a Stormwater Pollution Prevention Plan (SWPPP). Additionally, the Central Valley Regional Water Quality Control Board (CVRWQCB) would require best management practices (BMPs), as well as monitoring and other construction controls, to protect water quality. **With the implementation of MM WQ-1, this impact would be less than significant.**

4.2.4.2 Operation of the Proposed Action

On average, operation of the Proposed Action would generate negligible changes in Delta water quality and outflows compared to the No Action Alternative. Tables H-3 through H-6 in Appendix H summarize modeled changes in the location of the low salinity zone[9] as measured by X2 as an indicator of the Proposed Action's potential effect on Delta salinity levels. Average annual changes to X2 would be less than one kilometer compared to existing and future no action conditions. Considering X2 moves several kilometers every few hours twice per day (Water Education Foundation 2014), this change would not be significant. South-of-Delta exports are expected to increase, with the DMC operating at design capacity under the Proposed Action, resulting in decreases in Delta outflows. Tables H-7 through H-10 in Appendix H summarize the change in south-of-Delta exports under the Proposed Action compared to existing and future no action conditions. Tables H-11 through H-14 in Appendix H summarize the change in Delta outflows under the Proposed Action compared to existing and future no action conditions. While there would be changes to Delta exports and outflows, the modeling results indicate that those changes under the Proposed Action would not be substantial and would result in a less than a one percent change on average compared to existing and future no action conditions. The DMC is not an impaired water body and Reclamation monitors and evaluates the quality of water in the DMC. The DMC's operations after construction are expected to continue as they were executed following the original construction of the canal and water quality impacts are not expected. San Luis Reservoir is capable of receiving water from the DMC and operation of the Proposed Action would result in minor fluctuations of storage levels within San Luis Reservoir. As shown in Table H-15 through Table H-18, operation of the Proposed Action would result in a less than one percent change on average compared to existing and future no action conditions and is not expected to have a measurable impact on water quality conditions in San Luis Reservoir. In addition, the Proposed Action would be operated consistent with all environmental requirements pertaining to Delta operations, including the 2019 USFWS and NMFS Biological Opinions for CVP and SWP operations and any future Biological Opinions or requirements. Therefore, operation of the Proposed Action would not substantially degrade water quality and would not conflict with or obstruct implementation of a water quality control plan. **The Proposed Action would have a less than significant impact on water quality.**

4.3 Air Quality

4.3.1 Assessment Methods

This section describes the assessment methods used to analyze potential air quality effects of the alternatives, including the No Action Alternative. Emissions from construction-related equipment engine exhaust were estimated using emission factors derived from emissions and activity data from the CARB EMFAC2017 on-road component of the CARB's web-based emissions model and the OFFROAD2021 off-road component of the CARB's web-based emissions model (CARB 2022a, 2022b). Appendix I1 provides a comprehensive description of the existing environment and details the methods, assumption, and results of the air quality modeling conducted. Appendix I2 provides detailed information on the emission calculations for off-road construction equipment exhaust; on-road haul/vendor truck and construction worker commuting exhaust; and fugitive dust emissions from unpaved road material handling, grading, and bulldozing. Appendix I3 provides a health risk screening tool assessment, which was conducted to assess construction-related TAC emissions. The assessment utilized SJVAPCD's Prioritization tool, with inputs modified to reflect the short-term and temporary exposure of construction activities.

4.3.2 Significance Criteria

Impacts on air quality would be considered significant if the Proposed Action (1) would result in emissions of air pollutants exceeding the General Conformity *de minimis* emission levels or the quantitative criteria promulgated by the applicable local air pollution control agency; (2) would result in a cumulatively considerable net increase of any criteria pollutant for which the Project region is nonattainment under an applicable federal or state ambient air quality standard; (3) would expose sensitive receptors to substantial pollutant concentrations; or (4) would

[9] The low salinity zone often is referenced by X2, which is the distance upstream (in kilometers) from the Golden Gate Bridge, where tidally averaged salinity is equal to 2 parts per thousand. X2 primarily is determined by Delta outflow (Kimmerer 2004).

result in other emissions, such as those leading to objectionable odors, adversely affecting a substantial number of people. The quantitative significance criteria developed by the local air districts and the General Conformity *de minimis* thresholds were developed to determine compliance with the first two significance criteria. This Project is subject to the General Conformity regulations because it involves a federal agency (Reclamation) and is in a nonattainment or maintenance area. The second criterion for cumulative impacts is addressed in Chapter 5, "Cumulative Effects," and is not discussed further in this chapter. The third and fourth criterion were evaluated based on the Proposed Action's potential to emit toxic air contaminants (TAC) in the form of construction equipment engine exhaust, including diesel particulate matter (DPM)[10] and the potential to generate near-field odors that certain individuals may find objectionable.

Quantitative significance criteria have been developed by the BAAQMD and SJVAPCD. These criteria were developed such that a project consistent with the criteria would not be expected to exceed the CAAQS or NAAQS and would not conflict with or obstruct implementation of the respective applicable regional air quality plans. Impacts on air quality would be significant if implementing the Proposed Action would cause the thresholds developed by BAAQMD and SJVAPCD to be exceeded; if these thresholds are exceeded, conflicts with applicable air quality plans and contributions to air quality standard violations for applicable pollutants can be assumed.

4.3.3 Environmental Consequences/Impacts of the No Action Alternative

Under the No Action Alternative, no actions would be taken to restore, or otherwise offset (e.g., increased pumping at Banks Pumping Plant or increased use of the Intertie Pumping Plant) conveyance capacity lost in the DMC; as such, there would be no short-term dust or odors from construction activities. Operational changes would occur to compensate for the effects of future land subsidence on the capacity of the DMC, but these changes would be minor and would not result in an appreciable change to regional air pollutant emissions, localized concentrations of TAC, or odors or dust associated with operation of the DMC. **The No Action Alternative would have less than significant impacts on air quality**.

4.3.4 Environmental Consequences/Impacts of the Proposed Action

4.3.4.1 Construction of the Proposed Action

Construction-related emissions in the BAAQMD and SJVAPCD were estimated for off-road construction equipment, on-road haul trucks and delivery vehicles, and construction workers commuting under the Proposed Action. As shown in Table I1-5 in Appendix I1, construction activities under the Proposed Action would generate air pollutant emissions that would be less than the USEPA General Conformity *de minimis* levels and would be less than the BAAQMD and SJVAPCD quantitative thresholds (Appendix I2 contains detailed calculations). **Therefore, impacts to air quality relative to air pollutant emissions from the Proposed Action would be less than significant**.

Construction activities along the canal have the potential to emit TAC in the form of construction equipment engine exhaust, including DPM. Construction impacts under the Proposed Action would be temporary and highly mobile, occurring for short periods along various points of the 116-mile DMC. In addition, pollutant concentrations have been shown to drop up to 70 percent at a distance of 500 feet from a vehicle exhaust source and up to 80 percent by 1,000 feet (CARB 2005). The health risk screening assessment of construction-related TAC emissions, presented in Appendix I3, confirmed that construction TAC emissions would not be expected to result in significant health risks to sensitive receptors nearest to project activities. **Therefore, the exposure of sensitive receptors to DPM or other potential TAC would be minimal, and impacts to air quality relative to the exposure of sensitive receptors to substantial pollutant concentrations would be less than significant.**

[10] DPM is listed by California Office of Environmental Health Hazard Assessment (OEHHA) as a carcinogen and contributes to noncancer chronic health effects. OEHHA has not established a hazard index attributable to DPM for acute (short term) health effects.

Construction of the canal would result in the emission of diesel engine exhaust, which may generate near-field odors that certain individuals may find objectionable. Earthmoving activities and operation of construction vehicles on paved and unpaved roadways would also result in the generation of fugitive dust; however, construction areas would be watered during earthmoving activities, thereby reducing emissions of fugitive dust up to 61 percent (California Air Pollution Control Officers Association 2022). In addition, owing to the rural, sparsely populated nature of the Project area, relatively few individuals would have the potential to experience construction odors or dust. **Exposure to construction-related odors or dust for individuals in the vicinity of construction would be minimal, and impacts to air quality relative to other emissions adversely affecting a substantial number of people would be less than significant.**

4.3.4.2 Operation of the Proposed Action

Operating the DMC at design capacity under the Proposed Action would not require the addition of new pollutant emitting sources, such as pumps or generators. Once construction activities are completed, the DMC would be operated and maintained using the same facilities and procedures as are currently utilized. Operation and maintenance of the DMC under the Proposed Action would not be expected to result in an appreciable change to regional air pollutant emissions, local TAC concentrations, or odors/dust. **For this reason, the long-term impact on air quality as a result of the operation of the Proposed Action would be less than significant.**

4.4 Greenhouse Gas Emissions

4.4.1 Assessment Methods

GHG emissions were estimated using the same methods discussed in Section 4.3.1, with any notable differences detailed in Appendix J. Appendix J provides a detailed description of the existing environment and details on the methods, assumption, and results of the GHG emissions modeling conducted. Appendix I2 provides detailed information about the GHG emission calculations for off-road construction equipment exhaust, and on-road haul/vendor truck and construction worker commuting exhaust.

4.4.2 Significance Criteria

Impacts relative to GHG would be considered significant if the Proposed Action would (1) generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment; or (2) conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the GHG emissions.

4.4.2.1 Quantitative Emissions Threshold

The Proposed Action would involve construction activities partially within each of the SJVAB and SFBAAB. Neither the SJVAPCD or BAAQMD—the responsible air quality agencies of the SJVAB and SFBAAB, respectively—have promulgated quantitative GHG significance criteria applicable to the Project, which might be expected to have a significant impact on the environment (BAAQMD 2017; SJVAPCD 2015). The South Coast Air Quality Management District (SCAQMD) has adopted a 10,000-metric-ton per year carbon dioxide equivalent ($MTCO_2e$) threshold for combined operational emissions and amortized construction emissions below which a project would not be expected to conflict with state GHG reduction goals or result in a significant impact on the environment (SCAQMD 2008).[11] SCAQMD is responsible for air quality in the South Coast Air Basin, a region of similar air quality to the SJVAB. Therefore, the SCAQMD threshold was considered the most applicable quantitative threshold for evaluation of the Proposed Action and was used as a quantitative threshold for evaluation of GHG significance criteria.

4.4.3 Environmental Consequences/Impacts of the No Action Alternative

Under the No Action Alternative, there would be no construction or changes to existing operations within the study area. Future changes in operation would likely occur to compensate for the effects of future land subsidence on the capacity of the DMC, but these changes would be minor and would not be anticipated to

[11] Construction-related GHG emissions would be amortized over a presumed project lifetime of 30 years, consistent with SCAQMD guidance.

result in substantial changes to operational GHG emissions. **This alternative would have a less than significant impact with respect to GHG emissions and would not be expected to conflict with an applicable plan, policy, or regulation adopted to reduce GHG emissions**.

4.4.4 Environmental Consequences/Impacts of the Proposed Action

4.4.4.1 Construction of the Proposed Action

Under the Proposed Action, construction activities related to raising deficient structures along the canal would generate GHG emissions throughout the construction period.

Table 4-1 summarizes the construction-related GHG emissions for the Proposed Action. Because there would be no change in GHG emissions associated with operation under the Proposed Action, amortized construction emissions are compared against the 10,000 $MTCO_2e$ threshold. Detailed GHG emission summaries and calculations are presented in Appendix I2. As shown, Project-related GHG emissions would not exceed the applicable quantitative threshold. Additionally, a plan consistency analysis was performed for the Proposed Action and is included in Appendix J. The Proposed Action was found to not conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the GHG emissions. **Therefore, the Proposed Action would have a less than significant impact on GHG emissions and applicable plan, policy, or regulatory conflicts**.

Table 4-1. Total Construction Greenhouse Gas Emissions from the Proposed Action

	Construction GHG Emissions	Significance Criteria	Exceeds Criteria?
Proposed Action	11,991 total MTCO2e[1,2]	n/a	n/a
Amortized Over 30 Years	397 $MTCO_2e$ per year[1]	10,000 $MTCO_2e$ per year	no

Notes:

[1] CO_2e emissions are estimated from emissions of CO_2, CH_4, and N_2O using Intergovernmental Panel on Climate Change AR4 GWP of 1, 25, and 298, respectively.

[2] The presented value represents the total GHGs emitted over the construction period including exhaust from equipment used during all elements of Project construction, exhaust from hauling and delivery vehicle trips, and exhaust from worker commute vehicles.

Key: GHG = greenhouse gases; $MTCO_2e$ = metric tons of carbon dioxide equivalent; n/a = not applicable

4.4.4.2 Operation of the Proposed Action

Construction of new facilities that would result in permanent, operational GHG emissions are not proposed under the Proposed Action. **Therefore, long-term operation of the Proposed Action would be the same as the existing or future no action conditions and would have no impact on GHG emissions**.

4.5 Visual Quality

4.5.1 Assessment Methods

Assessment of visual resources was accomplished through the use of the United States Department of Agriculture (USDA) Scenery Management System (SMS), outlined in *Landscape Aesthetics: A Handbook for Scenery Management, Agriculture Handbook Number 701* (USDA Forest Service 1995). The USDA SMS categorizes visual resources into three classes of scenic attractiveness: Class A, Distinctive (areas whose features combine to provide unusual, unique, or outstanding scenic quality); Class B, Typical (areas whose features combine to provide ordinary or common scenic quality); and Class C, Indistinctive (areas whose features combine to provide low scenic quality because of missing attributes of variety, unity, vividness, uniqueness, balance, etc.).

In addition to scenic attractiveness, the USDA SMS uses landscape visibility to develop a meaningful measurement of the relative importance and sensitivity or what is seen and perceived within the landscape. The USDA SMS uses concern levels to measure the degree of public importance placed on landscapes viewed from travelways (linear concentrations of public-viewing, including highways, trails, commercial flight paths, and waterways) and use areas (spots that receive concentrated public-viewing use) (USDA Forest Service 1995). Concern levels are divided into three categories that rank interest in scenery: Level 1 (high), Level 2 (moderate), and Level 3 (low). The level of concern assigned to a visual resource is further influenced by whether the

travelway and use area are defined as primary (national and/or regionally important locations largely associated with recreation and tourism use) or secondary (locally important locations associated with all types of use, including recreation and tourism).

4.5.2 California State Scenic Highways Program

There are four State Scenic Highways (SSHs), as designated by the 1963 California State Scenic Highway Program, that connect to one another (collectively referred to as a single SSH) and run parallel to the DMC for approximately 58.8 miles. The SSH (includes sections of Interstate 580 [I-580] and Interstate 5 [I-5]) located in Alameda, San Joaquin, Stanislaus, and Merced counties (California Department of Transportation [Caltrans] 2018). A desktop survey was conducted using Microsoft Bing maps to determine the distance of the SSH to the DMC and whether the DMC is an integral part of the conserved viewshed associated with the SSH. The survey found that, of the 31 sites surveyed along the SSH, the DMC is on average 0.74 mile away from the SSH and is not visible from any of these sites. Although not captured in the sites surveyed, there are two locations along the SSH at which the DMC is clearly visible; these locations are the sites at which the DMC crosses under the SSH. However, these two locations of visibility combined span approximately 0.24-mile total, which is approximately 0.01 percent of the total SSH length. More details regarding this survey are available in Appendix F.

4.5.3 Significance Criteria

Impacts on visual resources would be considered significant if the Proposed Action would: (1) have a substantial permanent or temporary adverse effect on a scenic vista (areas with Scenic Attractiveness Class A or Class B classifications); (2) substantially damage scenic resources, including, but not limited to trees, rock outcroppings, and historic buildings, within a state scenic highway corridor; (3) substantially degrade the existing visual character or quality of public views of the site and its surroundings; or (4) create a new source of substantial light or glare, which would adversely affect day or nighttime views of the area.

4.5.4 Environmental Consequences/Impacts of the No Action Alternative

Under the No Action Alternative, there would be no construction or changes to existing operations within the study area. Future changes in operation would likely occur to compensate for the effects of future land subsidence on the capacity of the DMC, but the effect of these changes on visual resources would be minor and largely imperceivable from the main vantage points and highways (I-580 and I-5). Therefore, there would be no short- or long-term impacts to visual resources under this alternative. **This alternative would have less than significant impacts to visual resources.**

4.5.5 Environmental Consequences/Environmental Impacts of the Proposed Action

4.5.5.1 Construction of the Proposed Action

Under the Proposed Action, construction activities related to raising deficient structures of the canal would affect the area around the canal and facilities associated with it. There are no scenic vistas (Class A or B resources) present within the Project area; the DMC and surrounding agricultural land are considered Class C. The DMC is largely not visible from the nearby SSH, but at the few locations at which it is visible, the panoramic nature of the background views of agricultural fields and the speed of motorists passing the site make the DMC an area of low scenic concern, reducing the overall impact generated by construction activities. No nighttime construction would occur under this alternative; therefore, the use of temporary lighting during construction would not be required. **Therefore, the impact of the Proposed Action on the visual character of the study area would be less than significant.**

4.5.5.2 Operation of the Proposed Action

Implementation of the Proposed Action would result in some lengths of the canal having slightly raised lining and embankments (between one and three feet higher), allowing the canal to convey more water than it currently is capable of, thus improving its utility as a Class C Resource. The restoration of the DMC back to its design capacity is unlikely to result in visual changes to the canal that would be drastic enough to be noticed from the designated SSHs or other common vantage points. **Thus, the long-term impact on visual resources as a result of the operation of the Proposed Action would be less than significant.**

4.6 Noise

4.6.1 Assessment Methods

Activities with the potential for generating short-term, temporary increases in noise levels include construction activities and construction-related traffic. Long-term noise impacts could occur from operation of new facilities. The noise level at nearby sensitive receptors during the construction of the Proposed Action was calculated by (1) attenuating the construction sound level for distance to the receptor and (2) logarithmically adding the attenuated construction noise source level to the ambient noise level.

4.6.2 Significance Criteria

Impacts on noise would be considered significant if the Proposed Action would result in (1) generation of noise levels in excess of standards established in the local general plan or noise ordinance or applicable standards of other agencies;[12] (2) generation of excessive ground-borne vibration or ground-borne noise levels (significance threshold of 0.3 inch per second [in./sec] of peak particle velocity [PPV]);[13] or (3) generation of a substantial permanent increase in ambient noise levels above levels existing without the Proposed Action. For the purpose of this analysis, the sound-level limitations set by Fresno and Alameda counties (Appendix E) state that no sound source should exceed the background sound level of 50 A-weighted decibels (dBA) during daytime and 45 dBA during nighttime, has been applied. However, all five county ordinances exempt construction activities during varying daytime hours. For this noise analysis, the most conservative daytime hours limitations set by the counties were applied. As such, construction noise between 7:00 a.m. and 7:00 p.m. on weekdays and 9:00 a.m. and 5:00 p.m. on weekends would be exempt from specific sound-level limitations. If nighttime construction were to exceed the 45 dBA threshold (a 15 dBA increase from the 30 dBA existing nighttime ambient noise level), impacts would be considered significant.

Construction-related traffic noise sources would include construction worker vehicles, material delivery trucks, and material off-hauling trucks. Because of the logarithmic nature of noise, a doubling of traffic would result in a 3 dBA increase in noise levels, which would be barely perceptible to the human ear (FHWA 2011). Traffic would need to be increased at least three times for increased noise to be readily perceived (5 dBA) and at least nine times to double the noise levels (10 dBA) and result in a significant impact.

4.6.3 Environmental Consequences/Impacts of the No Action Alternative

Ambient noise and vibration levels under the No Action Alternative would be the same as existing conditions. Neither construction-related activities nor increased operational activities would occur. **This alternative would have no impact on noise.**

4.6.4 Environmental Consequences/Impacts of the Proposed Action

4.6.4.1 Construction of the Proposed Action

Under the Proposed Action, all construction activities would occur in Alameda, San Joaquin, Stanislaus, Merced, and Fresno counties. Each of these counties specifically exempt construction activities from specific sound-level limitations during daytime hours. Construction noise under the Proposed Action would occur within the county-designated construction noise exempt hours between 7:00 a.m. and 7:00 p.m. on weekdays and 9:00 a.m. and 5:00 p.m. on weekends. The maximum increase in traffic volume under the Proposed Action would occur on SR-33, where the traffic volume would increase from 2,700 cars per day under the No Action Alternative (2026) to 4,012 cars per day under the Proposed Action. The traffic volume increase ratio on SR-33 would be 1.49, which is well below the increase ratio threshold of nine (Table 1 in Appendix K). The PPV for the Proposed Action's construction activities would not exceed the significance criteria of 0.3 in./sec (Table 4 in Appendix K).

[12] The applicable local standards are detailed in Appendix E.

[13] To assess the potential for structural damage associate with vibration, the vibratory ground motion near the affected structure is measured in terms of PPV in the vertical and horizontal directions, typically in units of inches per second (in/sec). The PPV is defined as the maximum instantaneous peak of vibration signal. Caltrans estimates the frequent generation of vibration at levels exceeding 0.3 in/sec can damage older residential structures and cause annoyance to humans (Caltrans 2020).

The short-term impact on ambient noise and vibration levels as a result of the construction of the Proposed Action would be less than significant.

4.6.4.2 Operation of the Proposed Action

Operating the DMC at design capacity under the Proposed Action would not require the addition of new noise and vibration generating sources, such as pumps or generators. Once construction activities are completed, the DMC would be operated using the same facilities as are currently utilized, and ambient noise and vibration levels would return to existing conditions. **For this reason, the long-term impact on ambient noise and vibration levels as a result of the operation of the Proposed Action would be less than significant.**

4.7 Traffic and Transportation

4.7.1 Assessment Methods

For the Proposed Action, anticipated short-term construction-related and long-term operations-related trip generation were identified. These additional trips were assigned to regional roadways in the vicinity of the Project area (DMC across Fresno, Merced, Stanislaus, San Joaquin, and Alameda Counties in the San Joaquin Valley) to determine traffic operations and level of service (LOS) under the Proposed Action. Because this is not a demand-inducing land use development or roadway capacity improvement Project, and construction-related trips are expected to be within the construction period only, the vehicle miles traveled (VMT) at the regional level is not expected to change in the long run. Therefore, LOS analysis is used to assess the impacts of the construction-related trips, instead of VMT analysis for this Project.

Year 2026 was selected as the analysis year because all the construction activities are expected to occur simultaneously, representing the worst-case scenario in which construction trips would occur on roadways within the Project area. Appendix L provides detailed information about traffic flow assessment methods, trip generation, and roadway operations under the Proposed Action. In this analysis, all study roadway segments are either freeways or state highways, so the LOS standard from Caltrans provided in Appendix L was used to identify traffic impacts. LOS thresholds shown in Appendix L were used to identify corresponding daily-level LOS. For a.m. and p.m. peak hours, the Highway Capacity Software, Version 7.9.6, was used to assess peak hour LOS.

Traffic safety effects were analyzed by reviewing potentially hazardous areas or roads/intersections not designed to handle the proposed construction traffic. Construction and operations effects were also analyzed to identify conditions that could result in impact to public transit or emergency access.

4.7.2 Significance Criteria

Impacts related to traffic and transportation would be considered significant if they result in one or more of the following conditions or situations: (1) conflict with a program, plan, ordinance or policy addressing the circulation system, including transit, roadway, bicycle and pedestrian facilities; (2) increase traffic substantially in relation to the existing traffic load and capacity of the street system; (3) substantially increase hazards due to a geometric design feature or incompatible uses; or (4) result in inadequate emergency access. The significance criteria apply to all transportation systems that could be affected by the Project.

4.7.3 Environmental Consequences/Impacts of the No Action Alternative

Under the No Action Alternative, there would be no construction or changes to existing operations within the study area. Hence, there would be no short- or long-term impacts to traffic operations under this alternative. **This alternative would have no impacts on traffic and transportation.**

4.7.4 Environmental Consequences/Impacts of the Proposed Action

4.7.4.1 Construction of the Proposed Action

Under the Proposed Action, construction activities related to raising deficient structures of the canal would affect the area around the canal and facilities associated with it. To accommodate the increased DMC water level due to restoring it to its design capacity, 45 vehicular bridges across the Project corridor would have to be

reconstructed. However, most of these are small bridges on low-volume rural roadways, and only three bridges would be reconstructed concurrently. Therefore, existing traffic crossing the DMC can be diverted to nearby roadways.

Construction-related traffic under the Proposed Action would not conflict with the goals and objectives of any applicable programs, plans, ordinances, or policies in relevant jurisdictions that establish roadway performance standards and would not result in a substantial increase in traffic in relation to the existing traffic load and roadway capacity.

Trip generation and roadway operations during construction of the Proposed Action and bridge modifications are presented in Appendix L. For daily operations, the added construction-related trips would not change the LOS at any of the study roadway segments, except for I-5 at SR 130 in Stanislaus County. Even though LOS degrades at this location, it does not exceed Caltrans' threshold of significance (LOS D). For peak hour operations, the added construction-related trips would not change the LOS at any of the study roadway segments, except at the following locations: SR 33 north of DMC northbound and southbound in Fresno County. Even though LOS degrades at these locations, it does not exceed Caltrans' threshold of significance.

Construction equipment and construction worker vehicle trips would increase traffic hazards at key roadway segments and intersections close to the DMC crossings, including SR 33 in Fresno County, SR 165, SR 152, and SR 33 in Merced County, and SR 132 in San Joaquin County. Construction traffic has the potential to limit or slow this emergency access. Therefore, construction of the Proposed Action would increase the potential for traffic hazards at roadway segments and intersections and potentially conflict with emergency vehicles. **This impact would be significant.** Developing a site-specific health and safety plan, installing caution signs, implementing dust-control measures, and implementing construction traffic management actions, such as temporary traffic control plans included in MM TR-1, described in Section 4.14, would reduce the severity these traffic safety impacts. **With the implementation of MM TR-1, this impact would be less than significant.**

4.7.4.2 Operation of the Proposed Action

Implementation of the Proposed Action would result in some lengths of the canal having slightly raised lining and embankments (between one and three feet higher), allowing the canal to convey more water than it currently is capable of. Roadway operations would remain similar to those under No Action Alternative conditions. No long-term additional trips would be associated with the operations of the Proposed Action. **Thus, the long-term impact on traffic flow as a result of the operation of the Proposed Action would be less than significant.**

4.8 Hazardous Materials

4.8.1 Assessment Methods

Analysis of potential hazards and hazardous materials impacts of the Proposed Action is generally qualitative, focusing on three types of impacts associated with hazards and hazardous materials: (1) the potential to encounter hazardous materials, including contaminated soil and/or groundwater at existing active hazardous materials sites near proposed construction; (2) accidental release of hazardous materials (e.g., fuels, oils) during transportation to and from sites related to construction and operations; and (3) physical hazards within the Project area. Evaluation of the potential short- and long-term impacts of the Proposed Action on the potential to affect or be affected by hazards was based on the results of technical maps, reports, and other documents to describe the hazardous conditions within the study area, and on professional judgment. Appendix F presents a detailed description of existing conditions regarding hazards and hazardous materials.

4.8.2 Significance Criteria

The criteria were developed in accordance with CEQA Guidelines to determine the significance of potential impacts in relation to hazards and hazardous materials. Impacts would be considered significant if the Proposed Action would: (1) create significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials; (2) impair or physically interfere with an adopted emergency response plan or emergency evacuation plan; (3) expose people or structures to a significant risk of loss, injury, or death involving

wildland fires; (4) create a significant hazard to the public or the environment through reasonable foreseeable upset and accident conditions involving the release of hazardous materials into the environment; or (5) be located in the vicinity of a private airstrip or within two miles of a public use airport, which could result in a safety hazard for people residing or working within the Project area. Because no schools are located within 0.25 mile of the study area, the CEQA Guidelines pertaining to release of hazardous materials in the vicinity of a school is not applicable and not discussed further.

4.8.3 Environmental Consequences/Impacts of the No Action Alternative

Under the No Action Alternative, no actions would occur in the study area, including the regions in the vicinity of the Tracy Municipal Airport, and therefore no hazardous substances would be used, transported, or disposed of. No road closures or other impacts that could impair adopted emergency response/evacuation plans would occur. Ground-disturbing activities that could increase the likelihood of accidental release of hazardous materials into the environment would not be required under this alternative. Spark-generating mechanical equipment would not be required. **Therefore, there would be no impact of this alternative on hazards and hazardous materials in the short term.**

4.8.4 Environmental Consequences/Impacts of the Proposed Action

4.8.4.1 Construction of the Proposed Action

Under the Proposed Action, construction and demolition activities would involve removing deficient vehicle bridges, pipe crossings, and other structures that may contain asbestos or lead products, creating the potential for a hazard to be posed through the transport and disposal of these materials. Additionally, vehicles and mechanical equipment required for construction could have the potential to cause leaks or spills within or around the Project area. **These impacts would be significant.** MMs WQ-1, HAZ-1, and HAZ-2 would require the preparation of an SWPPP, a Spill Prevention and Response Plan, and a health and safety awareness training. **With the implementation of MMs WQ-1, HAZ-1, and HAZ-2, the impacts related to the transport, use, or disposal of hazardous materials would be less than significant.**

Some construction activities, such as vehicle bridge replacements, would require road closures. **Road closures would have a significant impact on emergency evacuation or response plans in the study area**. However, MM TR-1 would require the creation of a traffic control plan to ensure that emergency access routes in and through construction areas would be kept clear. **With implementation of TR-1, the impact on emergency response or evacuation plans would be less than significant.**

Construction of the Proposed Action would introduce construction equipment and vehicles that could increase wildfire risk. **This impact could be significant.** Implementation of MM HAZ-3 would require fire prevention controls to ensure fire hazard risks are reduced. **With the implementation of HAZ-3, the impact on wildland fire risk would be less than significant**.

Ground-disturbing work required by the Proposed Action has the potential to accidentally expose workers or residents within the Project area to infection by Valley fever, or accidentally release hazardous materials stored in nearby hazardous waste sites to the public and environment. **This impact would be significant**. MMs HAZ-2 and HAZ-4 would require health and safety awareness training and development of a contaminated soil/groundwater remediation plan. **With the implementation of MMs HAZ-2 and HAZ-4, the impact on accidental release of hazardous substances would be less than significant**.

The Project area's proximity to the Tracy Municipal Airport poses physical risks, associated with airplane takeoffs and landings, to the people working in the area. **These impacts would be significant**. Airport safety coordination, as required by MM HAZ-5, would reduce this impact. **With the implementation of MM HAZ-5, the impact associated with airport hazards would be less than significant**.

4.8.4.2 Operation of the Proposed Action

Operation of the restored conveyance capacity in the DMC would not require the introduction of new hazards or hazardous materials into the Project area or require actions that have the potential to exacerbate hazards and hazardous materials that already exist within the Project area in a way that could expose the public or

environment to them. In addition, maintenance activities under the Proposed Action would continue to be implemented as currently done and would not require the introduction of new hazards or hazardous materials. **Implementation of the Proposed Action would have no long-term impacts on hazards or hazardous materials within the Project area.**

4.9 Biological Resources

4.9.1 Assessment Methods

The impact analysis for biological resources was conducted by evaluating the potential for construction and/or operation of the Proposed Action to result in adverse effects on special-status species or sensitive habitats that would meet or exceed any of the significance criteria described below.

4.9.2 Significance Criteria

The significance criteria described were developed in accordance with the CEQA Guidelines to determine the significance of potential impacts related to biological resources. Impacts would be significant if implementing the Proposed Action would: (1) have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by California Department of Fish and Wildlife (CDFW), USFWS, or NMFS; (2) have a substantial adverse effect on any riparian habitat or other sensitive natural community or critical habitat identified in local or regional plans, policies, or regulations or by the CDFW, USFWS, or NMFS; (3) have a substantial adverse effect on state or federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means; (4) interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors or impede the use of native wildlife nursery sites; or (5) conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance.

4.9.3 Environmental Consequences/Impacts of the No Action Alternative

Under the No Action Alternative, no actions would be taken to restore, or otherwise offset, conveyance capacity lost in the DMC, and impacts on biological resources would remain similar to those experienced under existing conditions. OM&R activities would be similar to or would slightly increase over existing conditions as a result of increased effort required to address issues that may arise owing to aging infrastructure. Reclamation would continue to maintain the facilities in compliance with the 2005 USFWS Biological Opinion (USFWS 2005). OM&R of the DMC would occur within the existing canal footprint and canal ROW and would not result in significant impacts on biological resources.

Under the No Action Alternative, deficient bridges would be partially submerged when the canal is operated at the design flow. These deficient bridges provide potential roosting habitat for the three special-status bat species with the potential to occur within the Project area—pallid bat, Townsend's big-eared bat, and western mastiff bat. Reduction in roosting habitat would be localized and temporary, and any resultant adverse effects on these species would likely be short-term and minor. Therefore, such **impacts would be less than significant.**

4.9.4 Environmental Consequences/Impacts of the Proposed Action

4.9.4.1 Construction of the Proposed Action

The Proposed Action would have direct and indirect impacts on 54 special-status species, as described in Appendix M. These impacts include the potential for direct injury, mortality, stress, or behavioral effects from construction noise and activity. Impacts also include indirect impacts such as increased risk of predation, increased competition, and reproductive failure from disturbance or loss of habitat. Estimated temporary and permanent impacts on existing habitat types within the Project area are presented in Table M-7 in Appendix M. Per CEQA, t**hese impacts would be significant.** MMs BIO-1 through BIO-15 include the following requirements to avoid or minimize impacts to the extent practicable: pre-construction surveys for special-status plants and animals to determine the presence of these species, implementation of a biological resources monitoring and management plan, environmental awareness training for construction personnel, implementation of general (e.g., litter control, marking construction areas, and appropriate erosion control materials), and

species-specific measures (e.g., avoidance buffers, modifying timing of construction activities, biological monitoring, and preservation of habitats). **With implementation of MMs BIO-1 through BIO-15, impacts on special-status species would be less than significant**.

The Proposed Action would have impacts on sensitive natural communities, as described in Appendix M. **These impacts would be significant.** However, with the implementation of MM BIO-16, sensitive natural communities will be protected in place to the greatest extent practicable to avoid or minimize impacts on sensitive natural communities to the extent feasible. **With the implementation of MM BIO-16**, **impacts on sensitive natural communities would be less than significant**.

The Proposed Action could impact approximately 0.6 acre of designated critical habitat for the California red-legged frog, as further described in Appendix M. **This impact would be significant.** However, with the implementation of MMs BIO-10 and BIO-16 work with the potential to impact critical habitat would not be initiated until appropriate consultation with USFWS was completed. **With the implementation of MMs BIO-10 and BIO-16, impacts on critical habitat for the California red-legged frog would be less than significant.**

Although the northern extent of the Project area overlaps a small portion of the geographic area designated as critical habitat for Delta smelt, the Project area does not support any of the biological or physical habitat attributes that are essential to the Delta smelt's conservation (i.e., primary constituent elements). Furthermore, the portion of Delta smelt critical habitat that overlaps the Project area does not maintain factors constituting habitat for the species in surrounding areas. Additionally, because the portions of the Project area where in-water and near-water construction activities would occur are well downstream of all surrounding Delta smelt critical habitat, construction activities would not have the potential to degrade water quality in areas that do support primary constituent elements of critical habitat for Delta smelt through the introduction of sedimentation or pollutants. **Therefore, there would be no impact on critical habitat for Delta smelt**.

Numerous wetlands and other waters potentially under the jurisdiction of U.S. Army Corps of Engineers (USACE) or Regional Water Quality Control Board (RWQCB) occur along the length of the Project area, as described in Appendix M. **Potential construction impacts to these wetlands would be significant.** A formal wetland delineation to determine the extent of jurisdictional waters within the Project area will be conducted and any applicable permits/authorizations from USACE and RWQCB will be obtained prior to any construction activities within state or federally protected wetlands. All terms and conditions of any applicable state and federal permits/authorizations will be implemented under the Proposed Action, as described in MM BIO-17. Additionally, where impacts on jurisdictional wetlands and other waters cannot be avoided, restoration and compensatory mitigation will be required to offset temporary and permanent impacts, as described in MM BIO-17. **With the implementation of MM BIO-17, impacts on state or federally protected wetlands would be less than significant.**

Although construction of the Proposed Action would last for approximately seven and a half years, work crews would be highly mobile, and the construction period at any one location along the 116-mile DMC canal would be relatively brief. As such, implementation of the Proposed Action would have short-term, temporary impacts on habitats that may be used by wildlife as migratory corridors—this could impact the movement of native or resident migratory species. **These impacts would be significant.** However, with the implementation of MMs BIO-16 and BIO-17, protections for these habitats would be required. **With the implementation of MMs BIO-16 and BIO-17, impacts would be less than significant**.

Each county within which the Project area is located has adopted a general plan that guides decisions on future growth, development, and the conservation of resources based on goals related to the preservation and protection of biological resources, as described in Appendix M. The potential impacts on biological resources identified with the implementation of the Proposed Action could conflict with these goals. **These impacts would be significant.** However, with implementation of MM BIO-1 through BIO-17 to avoid or minimize impacts on biological resources, the Proposed Action would not conflict with the goals of these regional plans. **With the implementation of MM BIO-1 through BIO-17, these impacts would be less than significant**.

4.9.4.2 Operation of the Proposed Action

Under the Proposed Action, south-of-Delta exports are expected to increase, which may impact biological resources through resultant changes to hydrodynamic conditions impacting water quality conditions (e.g., salinity, temperature, total dissolved solids levels) in the central and southern Delta. However, south-of-Delta exports rates under Proposed Action are within the range considered in the 2019 USFWS and NMFS Biological Opinions (USFWS 2019; NMFS 2019), and thus, any potential resultant impacts on federally listed species are already addressed by the terms and conditions specified in these documents. Furthermore, operation and maintenance of the Proposed Action would be conducted in accordance with all relevant existing or future regulatory requirements and the terms and conditions specified in all applicable current or future Biological Opinions. Additionally, operation of the Proposed Action could change the water elevation at Oroville Reservoir, Folsom Lake, Shasta Lake, and San Luis Reservoir, which could impact biological resources at these locations. However, expected changes in water elevation at these reservoirs would be less than five percent, as summarized in Table M-3 through Table M-6 in Appendix M, which is within the range attributable to the assumptions associated with the model outputs. **As such, the Proposed Action would have less than significant operational impacts on biological resources.**

4.10 Recreation

4.10.1 Assessment Methods

Desktop research was conducted to identify recreational facilities located in the vicinity of the Project area. A map of relevant recreational facilities is presented in Appendix F. This analysis assesses impacts to recreation by evaluating closures or access restriction to sites at or near the DMC. The only local, state, or federal recreational or public facility within 0.25 mile of the canal ROW is Mendota Pool Park. In addition to the Mendota Pool Park, there are several reservoirs offering recreational activities that may be impacted by changes to operations under the Proposed Action: Oroville Reservoir, Folsom Lake, Shasta Lake, and San Luis Reservoir.

4.10.2 Significance Criteria

Impacts on recreation would be considered potentially significant if the Proposed Action would: (1) substantially reduce access to or close recreation areas; (2) increase the use of the existing recreation facility or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated due to overcrowding; or (3) reduce water levels in recreational water bodies to an extent that recreational uses would be substantially affected.

4.10.3 Environmental Consequences/Impacts of the No Action Alternative

Under the No Action Alternative, no actions would be taken to restore, or otherwise offset, conveyance capacity lost in the DMC. Therefore, this alternative would not result in change to recreation facilities or activities that occur. **This alternative would have no impact on recreational facilities within the Project area**.

4.10.4 Environmental Consequences/Impacts of the Proposed Action

4.10.4.1 Construction of the Proposed Action

Under the Proposed Action, construction actions near the lower end of the DMC could temporarily impact access to and recreational utility of the Mendota Pool Park. However, this impact would be short-term and would not significantly impact recreation, as visitors would still be able to utilize recreational opportunities at the nearby Mendota Wildlife Area (five miles south of Mendota Pool Park). **The impact on recreation as a result of the construction of the Proposed Action would be less than significant.**

4.10.4.2 Operation of the Proposed Action

The operation of the Proposed Action could change the water elevation at the following recreation sites: Oroville Reservoir, Folsom Lake, Shasta Lake, and San Luis Reservoir. A comparison of the baseline water elevation and the predicted water elevations under the Proposed action using CalSim modeling showed monthly fluctuations of zero to two feet for all water year types. Oroville Reservoir and Folsom Lake could decrease zero to one foot, Shasta Lake could decrease one to two feet, and San Luis Reservoir could

increase two feet in winter months and decrease two feet in summer months. The changes in water elevation are not likely to impact water-based recreation at these locations, which includes boating, fishing, and swimming. The proposed operation of the Proposed Action is consistent with and has already been evaluated in the ROC on LTO Environmental Impact Statement (Reclamation 2019). **Therefore, the long-term impact on recreation facilities as a result of the operation of the Proposed Action would be less than significant.**

4.11 Cultural Resources

4.11.1 Assessment Methods

A cultural resources assessment was accomplished by completing an archival and records search of the California Historical Resources Information System (CHRIS) for the Project APE and a surrounding 0.25-mile radius, background research, an intensive pedestrian archaeological survey of the APE, an architectural survey of the APE built environment, and National Register of Historic Places (NRHP) and California Register of Historical Resources (CRHR) evaluations for cultural resources that were previously identified and relocated, or newly recorded within the APE. The records search was conducted at the Central California Information Center (CCIC), Northwest Information Center (NWIC), and the Southern San Joaquin Valley Information Center (SSJVIC) of the CHRIS. No previously recorded archaeological sites were documented within the APE. Two Native American archaeological sites and a single historic period (glass) isolate were identified within the 0.25-mile records search area around the APE. Historic period built environment resources identified during the record review include the DMC and several features associated with the canal. The DMC is a component of the CVP and has been determined eligible for the NRHP by consensus. Since 2005, it has been treated as eligible for listing in the NRHP under Criteria A and C. The CHRIS search results identified three linear historic properties that cross under or over the DMC that have been previously determined eligible for listing in the NRHP, as well as nine additional linear built environment resources that cross under or over the DMC that have been previously determined not eligible for listing in the NRHP.

The APE for archaeology and built environment encompasses the horizontal and vertical limits of proposed Project activities. The APE for this Project was developed by Reclamation and JRP Historical Consulting, LLC (JRP) and includes the DMC ROW from MP 2.5 to MP 116.6. and encompasses the entire length of the canal. The APE is approximately 114.1 miles long. The APE encompasses the area where the Project may directly or indirectly affect historic properties, if any are present.

Pacific Legacy has prepared a Draft Archaeological Survey and Evaluation Report that presents the results of the archaeological inventory survey and evaluations for resources recorded within the APE (Appendix N). Geoarchaeological sampling is planned but has not been completed. Two newly identified archaeological sites were recorded and evaluated during the archaeological inventory, both of which date to the historic period. DMC-CRP-001 is a ditch complex that was partially obliterated by the construction of the DMC and I-5. It is composed of an earthen ditch that has portions carved into rock, an earthen linear berm, the ruins of a flood gate, and a patch of green grass. CRP-002 is a historic period debris scatter comprising 15 glass bottle fragments dating to the 1950s. DMC-CRP-001 and DMC-CRP-002 were evaluated for eligibility for the NRHP and the CRHR and were recommended ineligible for inclusion in either list.

JRP prepared a Draft Historic Resources Inventory and Effects Analysis Report that addresses the built environment. The JRP report identified three linear historic properties that cross over or under DMC and were previously determined eligible for listing in the NRHP: the San Joaquin Pipelines/Hetch Hetchy Aqueduct, the Santa Fe Grade, and the Outside Canal. Resources recorded in the JRP report are the DMC, San Luis Drain, a drainage canal that is part of the Firebaugh Canal Water District in Fresno County, and two rural residential properties on Lammers Road (APNs 251-050-120 and 240-140-260) in San Joaquin County. The DMC was previously determined eligible for the NRHP and CRHR, and Reclamation received concurrence from the California State Historic Preservation Office (SHPO) for that determination. The JRP report provides a full inventory of the DMC, which had not been previously recorded in its entirety. JRP (2022: Appendix F in Appendix N) concluded the San Luis Drain is eligible for listing in the NRHP and CRHR, significant under NRHP Criterion A and CRHR Criterion 1. JRP concluded that the three other built resources evaluated for this

Project are not eligible for the NRHP or CRHR. Furthermore, JRP concluded that the Project will cause an adverse effect to the DMC because the Project proposes demolition of portions of the canal, as well as other alterations to the canal. JRP (JRP 2022; Appendix F in Appendix N) concluded that the Project does not cause an adverse effect to the other built environment historic properties within the APE.

4.11.2 Significance Criteria

'Cultural resources' is a broad term that includes prehistoric, historic, architectural, and traditional cultural properties. For the purposes of this undertaking, impacts would be significant if they would (1) result in adverse effects to historic properties listed or eligible for listing in the NRHP; (2) result in substantial adverse changes to historical resources, unique archaeological resources, or tribal cultural resources listed or eligible for listing in the CRHR; or (3) disturb human remains, including those interred outside of formal cemeteries. These criteria, associated significance determinations, MMs, and references to the location of supporting evaluations for these determinations are detailed in Appendix N.

4.11.3 Environmental Consequences/Impacts of the No Action Alternative

Under the No Action Alternative, there would be no construction or changes to existing operations within the study area. Future changes in operation would likely occur to compensate for the effects of impending land subsidence on the capacity of the DMC. The conveyance capacity would be reduced from design capacity during operation to meet Reclamation Design Standards No. 3 (Reclamation 2014). Deficient bridges would be partially submerged when the canal is operated at the design flow, resulting in safety risks. Hence, there would be no adverse impacts to cultural resources under this alternative. No historic properties would be adversely affected. **This alternative would result in no significant impacts to archaeological and built environment resources.**

4.11.4 Environmental Consequences/Impacts of the Proposed Action

4.11.4.1 Construction of the Proposed Action

Five historic properties have been identified within the construction footprint for the Proposed Action. Under the Proposed Action, construction activities related to raising deficient structures of the canal would impact historic properties. Identified historic properties include the DMC, the San Luis Drain, the San Joaquin Pipelines/Hetch Hetchy Aqueduct, the Santa Fe Grade, and the Outside Canal. The Proposed Action would adversely affect the DMC but would not adversely affect the other historic properties in the APE. The Proposed Action would impact the following character-defining features of DMC: the canal prism, lining, embankments, maintenance roads, turnouts, and wasteway gates. The Proposed Action does not propose any actions that have potential to impact the San Luis Drain, the San Joaquin Pipelines-Hetch Hetchy Aqueduct, the Santa Fe Grade, or the Outside Canal.

Under the Proposed Action, there would be direct and indirect impacts to known historic properties, historical resources, and other cultural resources when compared to existing conditions. **Implementation of the MM CR-1 would reduce the severity of these impacts to a level that is less than significant. This alternative would result in less than significant impacts to known historic properties.**

4.11.4.2 Operation of the Proposed Action

Implementation of the Proposed Action would result in some lengths of the canal having slightly raised lining and embankments (between one and three feet higher), allowing the canal to convey more water than it currently is capable of, thus improving its utility. Operation and maintenance of the DMC infrastructure could alter the character-defining features of this historic property. Under the Proposed Action, there would be direct and indirect impacts to known historic properties, historical resources, and other cultural resources when compared to existing conditions. **Implementation of the MM CR-1 would reduce the severity of these impacts to a level that is less than significant.** The Proposed Action would result in **less than significant impacts to known historic properties**.

4.12 Geology, Seismicity, and Soils

4.12.1 Assessment Methods

The evaluation of impacts on geology, seismicity, and soils relies on a qualitative review of a geotechnical investigation conducted by Reclamation in 2021, technical maps, reports, and other documents that describe the geologic, seismic, and soil conditions in the Project area. The analysis assumes that execution of the Proposed Action would adhere to relevant local, state, and federal regulations.

4.12.2 Significance Criteria

Impacts would be considered significant if the Proposed Action would: (1) result in substantial soil erosion or the loss of topsoil; (2) result in strong seismic ground shaking or seismic-related ground failure (including liquefaction); (3) be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the Proposed Action, and potentially result in on- or off-site landslides, lateral spreading, subsidence, liquefaction, or collapse; (4) be located on expansive soil, creating substantial direct or indirect risks to life or property; or (5) directly or indirectly destroy a unique paleontological resource or site, or unique geologic feature.

4.12.3 Environmental Consequences/Impacts of the No Action Alternative

Under the No Action Alternative, no changes to the canal infrastructure would occur and the canal would continue to operate under existing conditions. No ground-disturbing activities would occur under this alternative, thus there would be no potential for erosion/loss of topsoil or paleontological resources to be destroyed. Additionally, the No Action Alternative would not increase the risk of seismic-related ground failure, risk of unstable geology or soils that could result in seismic hazards, or risks associated with the DMC's location on expansive soil. However, under this alternative, the DMC would continue to undergo a reduction in capacity as a result of ongoing and future subsidence. This reduced capacity of the DMC could lead to changes in agricultural production, including land fallowing or conversion of agricultural resources to other uses, which could result in increased erosion or loss of topsoil. **The No Action Alternative has the potential to cause less than significant impacts on geology and soils.**

4.12.4 Environmental Consequences/Impacts of the Proposed Action

4.12.4.1 Construction of the Proposed Action

Activities associated with construction of the Proposed Action, such as grading and paving, earthwork, demolition of old structures, construction of new foundations, stripping, topsoil moving, excavation, and more, have the potential to cause soil erosion and/or loss of topsoil. **These impacts would be significant**. Implementation of MMs WQ-1 and GEO-1 would require the preparation of a SWPPP and emergency erosion control measures for unexpected failures of planned measures, respectively. **With the implementation of MMs WQ-1 and GEO-1, impacts on soil erosion and loss of topsoil would be less than significant.**

Because ground-disturbing construction activities would occur within the DMC ROW that was previously disturbed during the original construction of the DMC, the potential to encounter previously undetected but potentially significant paleontological resources is very low. Although the Project area is located in a relatively seismically active area, the construction activities proposed by the Proposed Action are not expected to significantly increase the risk or frequency of seismic ground shaking, landslides, lateral spreading, land subsidence, or any other seismic hazards in the vicinity of the Project area. **Therefore, impacts on seismic hazards and paleontological resources would be less than significant.**

4.12.4.2 Operation of the Proposed Action

Implementation of the Proposed Action would result in the DMC being restored to its design capacity; therefore, the only changes in operation compared to current conditions are associated with the amount of water that the DMC would be able to safely convey throughout the Project area. **Because these changes in operation do not involve ground-disturbing activities or changes to the geology, soils, or risks of seismic hazards in the Project area, impacts associated with the Proposed Action would be less than significant.**

4.13 Utilities and Power

4.13.1 Assessment Methods

Impacts to public services, utilities, and power resources could occur during construction of the Proposed Action. The significance of these impacts is assessed qualitatively. Potential long-term impacts to energy use and power in the area of analysis could result from changes in water supply sources and the operation of water supply facilities. These changes are analyzed based on the energy impact guidance in Appendix F of the CEQA Guidelines (Association of Environmental Professionals 2016).

4.13.2 Significance Criteria

Impacts on utilities, public services, and power would be considered significant if operation or construction of the Proposed Action would: (1) generate solid waste in excess of state or local standards, or otherwise impair the attainment of solid waste reduction goals; (2) result in adverse effects related to the depletion of local or regional energy supplies; (3) require or result in the construction of new stormwater drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects; or (4) require expanded entitlements or resources of water supplies to serve the Proposed Action.

4.13.3 Environmental Consequences/Impacts of the No Action Alternative

No actions would be taken to restore, or otherwise offset, conveyance capacity lost in the DMC. Because no construction would occur, no water trucks or other water supplies would be required, no equipment requiring energetic resources would be used, no solid waste would be generated, and no stormwater drainage facilities would be constructed or expanded. In the long term, the anticipated reduction in canal capacity could reduce pumping or require differential use of pumping or pumping-generating plants south-of-Delta. In addition, the reduction in canal capacity could also possibly alter the amount of available water delivered to the Project area. However, differential use of these facilities would have less than significant impacts on the general availability of energy resources in the Project area. No long-term impacts on solid waste generation, water supplies, or stormwater drainage facilities would occur as a result of this alternative. **The No Action Alternative would have less than significant impacts on public utilities and power usage in the Project area.**

4.13.4 Environmental Consequences/Impacts of the Proposed Action

4.14.4.1 Construction of the Proposed Action

The Proposed Action is expected to produce approximately 37,800 cubic yards (CY) of waste per year of construction through activities such as excavation and removal of deficient structures, which would be well within the permitted disposal limitations and would not exceed available landfill space in the Project vicinity (Appendix F contains a complete list of relevant landfills). Additionally, construction equipment would be fueled by diesel or gasoline fuel, resulting in no significant usage of local or regional energy or power supplies. Although stormwater drainage infrastructure would be altered under the Proposed Action, the construction related to this work would not cause significant environmental impacts. Approximately three AF of water would be required each year to perform construction activities; however, this amount is negligible in the context of the amount of water that is currently available for use in the Project area. **Construction of the Proposed Action would generate less than significant impacts on public utilities and power usage in the Project area.**

4.14.4.2 Operation of the Proposed Action

Long-term operation of the Proposed Action would not have any impact on solid waste generation in the Project area. Alterations to stormwater drainage infrastructure, such as culverts and drain inlets, would result in less than significant beneficial impacts, as it would reduce the amount of ponding that occurs in four areas along the DMC. Additionally, differential use of pumping-generating plants as a result of the DMC's capacity being restored to design capacity would have less than significant impacts on power availability in the Project area, and water supply in the Project area may increase slightly as a result of the capacity restoration but would be within

existing contracted supplies. **The long-term operation of the Proposed Action would generate less than significant impacts on public utilities and power usage in the Project area.**

4.14 Mitigation Measures

4.14.1 Water Quality

4.14.1.1 WQ-1: Prepare Site-Specific Stormwater Pollution Prevention Plan (SWPPP)

The objectives of the SWPPP would be to: (1) identify pollutant sources that may affect the quality of stormwater associated with construction activity; and (2) identify, construct, and implement stormwater pollution prevention measures to reduce pollutants in stormwater discharges during and after construction. The SWPPP would also include details of how the sediment and erosion control practices, referred to as BMPs would be implemented. The implementation of the SWPPP would comply with state and federal water quality regulations.

4.14.2 Traffic and Transportation

4.14.2.1 TR-1: Develop a Temporary Traffic Control Plan

The following construction management actions will be documented in a temporary traffic control plan developed by the contractor as a requirement that will be included in its construction contract. The temporary traffic control plan will be submitted for Caltrans' review and approval during the Encroachment Permit process.

Construction contractors will install signage at roadways and intersections identified as dangerous in accordance with the California Manual on Uniform Traffic Control Devices guidelines warning motorists of slow-moving construction traffic and lane closures. Signage shall also be posted at these locations one month in advance to allow motorists time to plan for delays or alternate routes.

Construction contractors shall implement dust abatement and perform proper construction traffic management actions, including signage warning motorists of construction activity and traffic controls like flaggers or temporary traffic lights where construction equipment will be entering roadways, to reduce conflicts during periods of high traffic volume in and around each construction site and to avoid conflicts with emergency responders entering and existing the area during an emergency.

In addition to the temporary traffic control plan, before the initiation of any construction actions, construction contractors shall develop and adhere to a health and safety plan outlining all applicable Occupational Safety and Health Administration requirements, and important traffic safety plans, including identification of emergency access routes in and through construction areas that would still need to be kept clear at all times during construction. The health and safety plan shall include coordination with emergency service personnel to ensure adequate mitigation for all impacts.

4.14.3 Hazardous Materials

4.14.3.1 HAZ-1: Activity Containment and Spills Management

During construction and operations, all associated activities, equipment, and machinery shall be restricted to the canal ROW. To ensure containment, construction contractors should place boundaries and noticeable signs of entry and exit, restricting access to within the ROW. All construction equipment and vehicles used shall be maintained properly according to manufacturer specifications and should be inspected to identify and fix any excessive fluid leakages prior to arriving to the construction site. Additionally, the construction contractor shall also prepare a Spill Prevention and Response Plan for preventing spills and responding to chemical or hazardous substance spills. This plan will include spill prevention management, including employee training, hazardous substance inventory, and spill response equipment. The plan will also include a spill response plan, including evacuation procedures, spill containment and cleanup, and reporting a release.

4.14.3.2 HAZ-2: Risk Reduction – Airborne Hazardous Materials

To reduce risks of hazards involving release of airborne hazardous materials, the construction contractor shall implement the United States Occupational Safety and Health Administration's (OSHA's) regulations for asbestos

and lead (29 C.F.R. 1910.1001, 1926.1101, and 1926.62) prior to demolition of any structures that could contain asbestos or lead paint. Demolition of structures suspected to contain lead paint (structures built prior to 1978) should be wetted prior to demolition to reduce the likelihood of inhaling lead dust particles. Construction workers should be outfitted in the proper personal protective equipment, including an appropriate respirator, before completing demolition work.

Under AB 203, the construction contractor shall implement health and safety awareness training before excavation of any topsoil to reduce infection of by Valley fever. Safety and MMs that should be included in the training include wetting down soil before digging to reduce aggravation of dust and dirt, wearing a N95 mask or respirator, and halting work in the presence of a dust storm or windy conditions and staying indoors or in an enclosed area away from dust.

4.14.3.3 HAZ-3: Fire Prevention Controls

Construction contracts should be required to provide (1) fire prevention controls such as spark arrestors and (2) fire safety training to avoid risk of wildfire. Since work is year-round, all temporary heaters should be used in accordance with manufacturer instructions and monitored by employees in compliance with fire safety training. In addition, the construction contractor shall prepare a Fire Prevention Plan to prevent a fire from occurring, compliant with OSHA regulations. The plan shall include:

- List of all major fire hazards, proper handling and storage procedures for hazardous materials, potential ignition sources and their control, and the type of fire protection equipment necessary to control each major hazard
- Procedures to control accumulations of flammable and combustible waste materials
- Procedures for regular maintenance of safeguards installed on heat-producing equipment to prevent the accidental ignition of combustible materials
- Name or job title of employees responsible for maintaining equipment to prevent or control sources of ignition or fires; and
- Name or job title of employees responsible for the control of fuel source hazards

4.14.3.4 HAZ-4: Contaminated Soil/Groundwater Remediation Plan

The construction contractor in coordination with the Lead Agencies shall work with the California Department of Parks and Recreation (CDPR) and the Central Valley RWQCB to review existing monitoring data of the hazardous materials/waste sites within the study area to evaluate the potential for interacting with hazardous soil contamination during construction. If the construction contractor and the Lead Agencies (as the responsible party for this potential disturbance) determine that interaction with contaminated soil cannot be avoided and these construction actions could generate a release of this soil to nearby water bodies or elsewhere off-site, the construction contractor shall prepare a Contaminated Soil/ Groundwater Remediation Plan. This remediation plan shall detail the nature of the contaminants on-site, measures required to avoid interaction with these contaminants including (if necessary) a pre-construction cleanup of the site, and a response action plan in the event of an inadvertent release of contaminated soils from the construction site. This plan shall be submitted to the CDPR and the Central Valley RWQCB for review and approval prior to the initiation of any construction.

4.14.3.5 HAZ-5: Airport Safety

Construction contracts shall include requirements for the contractor to prepare a construction safety plan prior to any construction activities in collaboration with the City of Tracy Department of Parks and Recreation (owners of the Tracy Municipal Airport) to coordinate construction activities, including a schedule, coordination of personnel with aviation radios, and notice requirements. The contractor shall also coordinate with emergency service personnel to ensure adequate mitigation for all impacts.

4.14.4 Biological Resources

4.14.4.1 BIO-1: Measures to Minimize Impacts on Special-Status Plants

A botanical survey shall be conducted prior to construction activities to determine the presence or absence of special-status plant species within the Project area. The surveys shall be conducted in general accordance with the *Protocols for Surveying and Evaluating Impacts to Special-Status Native Plant Populations and Natural Communities* (CDFW 2021) and shall be timed to appropriately coincide with the blooming period of special-status plant species with the potential to occur in the Project disturbance areas.

If more than five years lapse after the botanical survey is conducted prior to ground disturbance, two botanical surveys (early and late season) shall be conducted in all suitable habitat located within the Project disturbance areas to determine the presence or absence of special-status plants.

If special-status plant species are found during the botanical surveys, the locations of the special-status plants and a 50-foot buffer will be marked as avoidance areas both in the field using flagging, staking, fencing, or similar devices and on construction plans.

If non-listed, special-status plants are identified during botanical surveys and complete avoidance is not practicable, and the Project would directly or indirectly affect more than 25 percent of a local occurrence by either number of plants or square footage of occupied habitat, then a qualified biologist will determine whether implementation of a conservation plan is recommended. If federal- or state-listed plants are identified during botanical surveys and complete avoidance is not practicable, coordination with CDFW and/or USFWS will be conducted as appropriate to develop the conservation plan. No take of state-listed or federally listed species will occur without an Incidental Take Permit (ITP) from either CDFW or USFWS.

The special-status plant conservation plan may consist of, but would not necessarily be limited to, purchase of mitigation credits at a regional conservation bank; plant salvage and relocation; collection and subsequent planting of seed or incorporating seed from native nursery into seed mix used for revegetation efforts; stockpiling, storing, and replacing topsoil containing the local seed bank; or other measures determined practicable based on the species and site conditions. If on-site conservation measures are implemented, the objective is to restore the impacted special-status plant species community to pre-existing conditions by providing for the restoration of a self-sustaining population of special-status plants in the general area where the impact occurred at a minimum of a 1:1 ratio (e.g., number of plants, square footage occupied). For on-site conservation measures, the conservation plan will identify success criteria and provide for annual or other regular monitoring to evaluate whether the conservation effort has met the success criteria. The conservation plan will also include measures for remedial actions (e.g., additional plantings, supplemental irrigation, increased monitoring) if monitoring efforts indicate that success criteria are not being met.

For some species and site conditions, the biologist may determine that a conservation plan is not recommended. Some of these circumstances may include but are not limited to the following: (1) there are other nearby populations that will not be disturbed; (2) plant relocation, seeding, or revegetation would not have a reasonable probability of success; (3) implementation of measures could result in detrimental effects on existing special-status plant populations; or (4) incompatibility with required operations and maintenance activities. If the biologist determines, in coordination with CDFW and/or USFWS, that a conservation plan is not warranted, then no additional measures are required.

4.14.4.2 BIO-2: General Measures to Minimize Impacts on Special-Status Animal Species

A Biological Resources Management and Monitoring Plan (BRMMP) shall be developed and implemented for the Project. The BRMMP shall provide for the following:

1) Overall implementation and monitoring of the MMs for biological resources and the terms and conditions of any agency permits/authorizations throughout the duration of Project construction and restoration/revegetation of riparian habitat.

2) Designation of an overall Project biologist and the roles and responsibilities of the Project biologist and other monitoring biologists and the roles of Reclamation, SLDMWA, and construction personnel in coordinating and implementing the BRMMP.

3) Adaptive management in scheduling worker environmental awareness training (WEAT) and conducting pre-construction surveys for special-status species. In some cases, additional biological surveys beyond those identified in the MMs may be warranted to proactively avoid biological constraints or conflicts with protective measures. For example, early monitoring for nesting birds or occupied mammal burrows may be needed to preserve opportunities for vegetation removal, removal of nesting starts before egg laying, and burrow monitoring and closure prior to the initiation of breeding or nesting activities.

4) Procedure and authorizations required to modify the MMs, if needed, to resolve conflicts with constructability requirements or other measures required by agency permits/authorizations or to provide for equivalent avoidance/minimization of adverse effects on sensitive biological resources under changing conditions over the life of Project construction. For example, nesting birds or other special-status species may initiate nesting or denning activities in proximity to construction areas while active construction activities are ongoing, including those within the 'no-disturbance buffers.' In these cases, it may be that the animals are acclimated to the level of construction disturbance, and continuance of construction activities would not be expected to adversely affect the animals or their nesting/breeding activities (assuming that increased levels of disturbance or closer proximity of construction activities is not planned). The BRMMP will include provisions for how these and similar circumstances will be addressed and how determinations regarding additional biological monitoring or agency coordination will be addressed.

5) Procedure to record and document implementation of the MMs and other measures including any pre-construction survey reports, WEAT sign-in forms, routine biological monitoring forms, photographs, and other materials related to implementation of the BRMMP.

6) Procedure to comply with the terms and conditions and notification and reporting requirements of any agency permits/authorizations required for the Project, and the procedure for coordination/consultation with resource or permitting agencies, as necessary.

7) Procedure to inform, document, and monitor restoration and revegetation activities associated with restoring temporary impacts on terrestrial and aquatic habitats and vegetation communities. This includes any post-construction monitoring/reporting and remedial measures that may be required.

Prior to the initiation of ground disturbance, a qualified biologist(s) will conduct a WEAT for all construction personnel. Training sessions will be repeated for all new personnel before they access the Project site. Sign-in sheets identifying attendees and the contractor/company they represent will be prepared for each training session, and records of attendance will be maintained by the Project. At minimum, the WEAT will include a description of the protected species and biological resources that may occur in the Project area and their physical description, habitats, and natural history, as well as the measures that are being implemented to avoid or minimize Project-related impacts, penalties for noncompliance, and the boundaries of the work area. As appropriate, training will be conducted in languages other than English to ensure that employees and contractors understand their roles and responsibilities. A written summary of the training will be provided to all attendees, and an electronic copy will be provided so that the Project can make and distribute future copies. The WEAT will be conducted annually, at minimum, for all construction personnel.

A litter control program will be instituted at each Project site. All workers will place their food scraps, paper wrappers, food containers, cans, bottles, and other trash in covered or closed trash containers. The trash containers should be removed from the Project area at the end of each working day.

No firearms (except as possessed by federal, state, or local law enforcement officers) or pets will be permitted on construction sites.

To prevent inadvertent entrapment of wildlife during construction, all excavated steep-walled holes or trenches greater than two-feet deep should be covered or filled at the end of each working day or provided with one or

more escape ramps no greater than 200 feet apart. Before such trenches or holes are filled, they shall be thoroughly inspected for trapped animals. If protected species are found in any of the holes or trenches, work shall cease until an escape ramp is provided and the animal leaves on its own volition, or until the animal has been relocated by a USFWS-approved biologist, and/or in coordination with USFWS, as appropriate.

All construction activity will be confined within the Project site, which may include temporary access roads, haul roads, and staging areas specifically designated and marked for these purposes.

Restoration and revegetation work associated with temporary impacts shall be done using California native plant material from on-site or local sources (i.e., local ecotype). Plant materials from non-local sources shall be allowed only with written authorization from USFWS. To the maximum extent practical (i.e., presence of natural lands), topsoil shall be removed, cached, and returned to the site according to successful restoration protocols. Loss of soil from runoff or erosion shall be prevented with straw bales, straw wattles, or similar means provided they do not entangle, block escape, or dispersal routes of listed animal species.

The Project construction area shall be delineated with high visibility temporary fencing, flagging, or other barrier to prevent encroachment of construction personnel and equipment onto any sensitive areas during Project work activities. Such fencing shall be inspected and maintained daily until completion of the Project. The fencing will be removed only when all construction equipment is removed from the site. No Project activities will occur outside the delineated Project construction area.

Only USFWS-approved personnel holding valid permits issued pursuant to Section 10(a)(l)(A) of the Act will be allowed to trap or capture listed species. Any relocation plan will be approved by USFWS prior to release of any listed species.

Tightly woven fiber netting or similar material (no monofilament material) will be used for erosion control or other purposes at the Project site to ensure that animals do not become trapped.

Prior to Project implementation, Reclamation will consult with USFWS to ensure its actions do not jeopardize the continued existence of any federally listed species or destroy/adversely modify critical habitat pursuant to Section 7(a)(2) of the ESA. If consultation with USFWS results in the issuance of a biological opinion, the Proposed Action will be conducted in compliance with all reasonable and prudent measures and terms and conditions set forth in the biological opinion.

To inform discussions between SLDMWA and CDFW regarding the potential for the Proposed Action to impact species currently protected under the CESA, and out of an abundance of caution, a qualified biologist familiar with the behavior and life history of the Crotch bumble bee will conduct surveys to determine the presence/absence of the species within the project area within 1 year prior to the initiation of construction. These surveys will be conducted during the Crotch bumble bee flying season (i.e., March 1 to September 1) when the species is most likely to be detected above ground. Survey results, including negative findings, will be submitted to CDFW prior to the initiation of project-related ground-disturbing activities. At a minimum, the survey report will provide the following:

a. A description and map of the survey area, focusing on areas that could provide suitable habitat for the Crotch bumble bee.

b. Field survey conditions that include the name(s) of qualified biologist(s) and their qualifications, date and time of the survey, survey duration, general weather conditions, and survey goals.

c. A map(s) showing the location of Crotch bumble bee nests/colonies identified during the surveys.

d. A description of the physical (e.g., soil, moisture, slope) and biological (e.g., plant composition) conditions where each Crotch bumble bee nest/colony was found. A sufficient description of biological conditions, primarily impacted habitat, including native plant composition (e.g., density, cover, and abundance) within the impacted habitat (e.g., species list separated by vegetation class, density, cover, and abundance of each plant species).

Prior to Project implementation, SLDMWA will consult with CDFW if any species protected under CESA are confirmed present within the project area and it is determined that take of one or more of these species cannot

be avoided during Project implementation. Should it be determined that the Proposed Action would result in take of one or more species protected under CESA, SLDMWA would obtain take authorization through the acquisition of an ITP from CDFW, pursuant to Fish and Game Code Section 2081 subdivision (b).

4.14.4.3 BIO-3: Measures to Minimize Impacts on Bats

To the extent practicable, the removal of large trees with cavities or the modification of canal infrastructure with the potential to provide bat roosts will occur before maternity colonies form (i.e., prior to March 1) or after young are volant (able to fly) (i.e., after August 15).

If construction (including the removal of large trees and/or the modification of canal infrastructure) occurs during the non-volant season (March 1 to August 15), a qualified biologist will conduct a pre-construction survey of the Project area for maternity colonies. The pre-construction survey will be performed no more than 14 days prior to the implementation of construction activities (including staging and equipment access). If a lapse in construction activities for 14 days or more occurs between those dates, another pre-construction survey will be performed. If any maternity colonies are detected, appropriate conservation measures (as determined by a qualified biologist) will be implemented. These measures may include, but are not limited to, establishing a construction-free buffer zone around the maternity colony site, biological monitoring of the maternity colony, and delaying construction activities within the vicinity of the maternity site.

4.14.4.4 BIO-4: Measures to Minimize Impacts on the American Badger

Any American badger detected within the Project area during Project-related activities will be allowed to move out of the work area of its own volition.

Concurrent with other required surveys, during winter and spring months before new Project activities, and concurrent with other pre-construction surveys (e.g., San Joaquin kit fox [SJKF] and burrowing owl), a qualified biologist will perform a survey to identify the presence of active or inactive American badger dens. If this species is not found, no further mitigation will be required. If badger dens are identified within the construction footprint during the surveys or afterward, they will be inspected and closed using the following methodology:

- When unoccupied dens are encountered outside of work areas but within 100 feet of proposed activities, vacated dens will be inspected to ensure they are empty and temporarily covered using plywood sheets or similar materials.
- If badger occupancy is determined at a given site within the work area, work activities at that site should be halted. Depending on the den type, reasonable and prudent measures to avoid harming badgers will be implemented and will include seasonal limitations on Project construction near the site (e.g., restricting the construction period to avoid spring–summer pupping season) or establishing a construction exclusion zone around the identified site or resurveying the den at a later time to determine the species' presence or absence.
- Badgers will be passively relocated using burrow exclusion (e.g., installing one-way doors on burrows) or similar CDFW-approved exclusion methods. In unique situations, it may be necessary to actively relocate badgers (using live traps) to protect individuals from potentially harmful situations. Such relocation would be performed with advance CDFW coordination and concurrence.

4.14.4.5 BIO-5: Measures to Minimize Impacts on San Joaquin Kit Fox

Determine the presence of SJKF dens:

a) Pre-construction monitoring will be performed no less than 14 days and no more than 30 days prior to construction to identify kit fox habitat features within the Project Area.

b) Areas within which pre-construction monitoring have been completed more than 30 days prior to construction will be re-inventoried not more than 30 days prior to construction.

c) Pre-construction monitoring for dens will be conducted by qualified biologists familiar with SJKF biology, natural history, and potential dens.

d) Pipes and culverts will be searched for SJKF immediately prior to being moved or sealed to ensure that an animal has not been trapped. If SJKF is observed, a USFWS-approved biologist will gently encourage it to leave the area (i.e., without using loud noise, physical force, or physical movement of the pipe or culvert such that the animal could be injured or startled while it is leaving the area).

Identify and document locations of potential or occupied dens (natal or non-natal) and their status (occupied or unoccupied). Definitions:

a) Known den: any existing natural den or manmade structure that is used or has been used at any time in the past by SJKF. Evidence of use may include historical records, past or current radiotelemetry or spotlighting data, kit fox sign such as tracks, scat, and/or prey remains, or other reasonable proof that a given den is being or has been used by a kit fox. USFWS discourages use of the terms "active" and "inactive" when referring to any kit fox den because a great percentage of occupied dens show no evidence of use, and because kit foxes change dens often, with the result that the status of a given den may change frequently and abruptly.

b) Potential den: any subterranean hole within the species' range that has entrances of appropriate dimensions (five to eight inches in diameter) for which available evidence is insufficient to conclude that it is being used or has been used by a kit fox. Potential dens shall include the following: (1) any suitable subterranean hole five to eight inches in diameter within the species' range; or (2) any den or burrow of another species (e.g., coyote, badger, red fox, or ground squirrel) that otherwise has appropriate characteristics for kit fox use.

c) Natal/pupping den: any den used by kit foxes to whelp and/or rear their pups. Natal/pupping dens may be larger with more numerous entrances than dens occupied exclusively by adults. These dens typically have more kit fox tracks, scat, and prey remains in the vicinity of the den, and may have a broader apron of matted dirt and/or vegetation at one or more entrances. A natal den, defined as a den in which kit fox pups are actually whelped but not necessarily reared, is a more restrictive version of the pupping den. In practice, however, it is difficult to distinguish between the two, therefore, for purposes of this definition either term applies.

d) Atypical den: any manmade structure which has been or is being occupied by SJKF. Atypical dens may include pipes, culverts, and diggings beneath concrete slabs and buildings.

Identify and execute appropriate action(s) regarding notification, buffers, excavation and fill, or seal off:

a) Occupied natal den: if an occupied natal den is visible or encountered within the Project limits or on publicly accessible land sufficiently close to the Project construction area such that it would be disturbed (based on qualified biologist opinion and monitoring), USFWS and CDFW will be contacted immediately and before any Project action occurs to determine permissible actions to permit resumption of work.

b) Unless determined necessary for safety or constructability by Reclamation, SLDMWA, or the Project contractor, the Project site will not be lighted between sunset and sunrise.

c) Pipes or culverts with a diameter greater than four inches will be capped or taped closed when it is ascertained that no SJKF are present. Any SJKF found in a pipe or culvert will be allowed to escape unimpeded.

If a natural den or burrow is determined to meet size criteria (i.e., greater than four inches in diameter) and cannot be avoided per the no-disturbance buffers recommended in the USFWS *Standardized Recommendations for Protection of the SJKF Prior to or During Ground Disturbance* (USFWS 2011) or shall be destroyed, the following guidelines will be followed:

a) Prior to den destruction, areas scheduled for construction within the vicinity of potential SJKF dens shall be monitored by a qualified biologist to determine their status. Monitoring will begin with pedestrian surveys to identify locations of potential SJKF dens and observe for suitable surrounding habitat. Because it is logistically impractical to monitor all dens using remote cameras and tracking medium (or to

hand excavate to confirm vacancy), baited camera traps may be used to assess presence or absence of SJKF activity. Prior to ground-disturbing activities in Project segments that require excavation, baited camera traps will be deployed in approximate 0.25-mile increments for four consecutive nights. Baited camera traps may be placed farther than 0.25 mile apart, depending on the suitability of surrounding habitat and land uses that are observed during pedestrian surveys and in areas with lower densities of potential SJKF dens. If no SJKFs are detected by the camera traps during this time period, it can be assumed that SJKFs are not currently using the area, and ground-disturbing activities may commence in that area. If a SJKF is detected by a camera trap, then further investigation will be required, as described below.

b) If a SJKF is detected by a baited camera trap or otherwise observed in an area, further pre-construction monitoring will be conducted to determine which den(s) are being used. Baited camera traps will be deployed in the area, and tracking medium will be placed at the entrances of suspected dens to monitor the area for four consecutive nights. If no SJKF activity is observed during this period, the den will be deemed unoccupied and destroyed immediately under the supervision of a USFWS-approved biologist to preclude subsequent use. If SJKF activity is observed at the den during this period, then the den will be monitored for at least five consecutive days from the time of observation to allow any resident animal to move to another den during its normal activities. Use of the den can be discouraged during this period by partially plugging the entrance(s) with soil in such a manner that any resident animal can escape easily. Destruction of the den may begin when, in the judgment of a USFWS-approved biologist, the animal has vacated. The biologist will be trained and familiar with SJKF biology. If the animal is still present after five or more consecutive days of plugging and monitoring, the den may be excavated when, in the judgment of a USFWS-approved biologist, it is temporarily vacant (e.g., during the animal's normal foraging activities). All den destruction shall be conducted under the supervision of a USFWS-approved biologist.

c) All dens requiring excavation will be excavated under the supervision of a USFWS-approved biologist. In no event will an excavation that meets the definition of a confined space (i.e., a space large enough and so configured that a person can bodily enter but has limited or restricted means for entry or exit) be initiated. In this circumstance, discouragement (as described above) would be used.

d) The den will be fully excavated and then filled with dirt and compacted so that SJKF cannot reenter or use the den during the construction period. If, at any point during excavation, an SJKF is discovered inside the den, the excavation activity will cease immediately, and monitoring of the den will be resumed. Destruction of the den may be resumed when, in the judgment of a USFWS-approved biologist, the animal has escaped from the partially destroyed den.

Before and during construction:

- Project-related vehicles should observe a daytime speed limit of 20 mph throughout the site in all Project areas, except on county roads and state and federal highways; this is particularly important at night when SJKFs are most active. Nighttime construction should be minimized to the extent possible. However, if it does occur, then the speed limit should be reduced to 10 mph. Off-road traffic outside of designated Project areas should be prohibited.

- Kit foxes are attracted to den-like structures, such as pipes, and may enter stored pipes and become trapped or injured. All construction pipes, culverts, or similar structures with a diameter of four inches or greater that are stored at a construction site for one or more overnight periods should be thoroughly inspected for SJKFs before the pipe is subsequently buried, capped, or otherwise used or moved in any way. If a SJKF is discovered inside a pipe, that section of pipe should not be moved until USFWS has been consulted. If necessary, and under the direct supervision of the biologist, the pipe may be moved only once to remove it from the path of construction activity, until the fox has escaped.

- A representative shall be appointed by the Project proponent who will be the contact source for any employee or contractor who might inadvertently kill or injure a SJKF or who finds a dead, injured or

entrapped SJKF. The representative will be identified during the employee education program and their name and telephone number shall be provided to USFWS.

- In the case of trapped animals, escape ramps or structures should be installed immediately to allow the animal(s) to escape, or USFWS should be contacted for guidance. If at any time a trapped or injured kit fox is discovered, USFWS and CDFW shall be contacted as noted below.
- Any contractor, employee, or military or agency personnel who are responsible for inadvertently killing or injuring a SJKF shall immediately report the incident to their representative. This representative shall contact USFWS immediately in the case of a dead, injured, or entrapped SJKF.
- The Sacramento Fish and Wildlife Office and CDFW shall be notified in writing within three working days of the accidental death or injury to a SJKF during Project-related activities. Notification shall include the date, time, and location of the incident or of the finding of a dead or injured animal and any other pertinent information.
- New sightings of SJKF shall be reported to the CNDDB. A copy of the reporting form and a topographic map clearly marked with the location of where the SJKF was observed should also be provided to USFWS.
- Because this species most actively forages during dusk and dawn, to the extent practicable, all construction activities will cease one-half hour before sunset and will not begin prior to one-half hour before sunrise. Except when necessary for driver or pedestrian safety, lighting of a Project site by artificial lighting during nighttime hours is prohibited.

4.14.4.6 BIO-6: Measures to Minimize Impacts on the Tricolored Blackbird and the Yellow-Headed Blackbird

Prior to construction, appropriately timed surveys for tricolored blackbirds and yellow-headed blackbirds will be conducted in areas supporting potentially suitable habitat within 0.25 mile of construction areas. Habitat within 0.25 mile of tricolored blackbird or yellow-headed blackbird colonies will be avoided during nesting season, which can begin as early as mid-March and extend through August. If colonies cannot be avoided, CDFW will be consulted to potentially reduce buffer distances with active monitoring during construction by a qualified biologist.

4.14.4.7 BIO-7: Measures to Minimize Impacts on the Burrowing Owl

A minimum of one pre-construction survey for burrowing owls within a minimum of 500 feet of the Project area (where accessible) will be conducted by a qualified biologist within 15 days prior to the initiation of construction activities in a given area, regardless of the timing of construction. Pre-construction surveys each year of construction during the nonbreeding season (September 1 to January 31) will take place in order to determine the presence of burrowing owls before breeding activities begin. If any occupied burrows are identified, appropriate conservation measures (as determined by a qualified biologist) will be implemented. No disturbance will occur within 150 feet of occupied burrows during the nonbreeding season (September 1 to January 31) or within 250 feet during the breeding season (February 1 to August 31). These measures may also include establishing a construction-free buffer zone around the active nest site in coordination with the CDFW, biological monitoring of the active nest site, and delaying construction activities in the vicinity of the active nest site until the young have fledged.

If burrowing owls are detected within the Project area during the nonbreeding season and maintaining a 150-foot, no-disturbance buffer is not practicable, a qualified biologist will submit an exclusion and passive relocation plan to CDFW. The exclusion and passive relocation plan will generally follow the guidelines outlined in Appendix E of the *Staff Report on Burrowing Owl Mitigation* (CDFW 2012). The exclusion and passive relocation plan will consist of installing one-way doors in potential burrows, daily monitoring, and collapsing burrows once it is determined that the burrows are unoccupied. Exclusion may only take place during the nonbreeding season (September 1 to January 31) and may be an ongoing effort during this time period. This will allow the owls to exit burrows if they are present, but not return. The exclusion and passive relocation plan will also detail plans to

replace collapsed burrows with artificial burrows at a minimum 1:1 ratio or describe why artificial burrows are not needed (e.g., numerous available natural burrows are available in nearby areas that will not be disturbed). Monitoring of collapsed burrows will be conducted as needed so that burrowing owls do not recolonize the area prior to construction disturbance.

If occupied burrows are detected during the breeding season and maintaining a 250-foot no-disturbance buffer is not practicable, CDFW will be consulted to determine alternative measures to minimize the potential for disturbance to occupied burrows and nesting activities. Measures may include but are not limited to continuous biological monitoring by a qualified biologist until it has been determined that the young have fledged and are no longer reliant on the nest or parental care for survival or construction is complete. No direct disturbance of burrows with eggs or young can be conducted without written authorization from the CDFW and USFWS.

4.14.4.8 BIO-8: Measures to Minimize Impacts on the Golden Eagle, Swainson's Hawk, Northern Harrier, or White-Tailed Kite

For construction activities that occur between February 1 and August 31, a qualified biologist will conduct pre-construction surveys for golden eagles, Swainson's hawks, northern harriers, and white-tailed kites. The pre-construction surveys will include the Project footprint and a minimum of a 0.50-mile radius where access is permitted around the construction area in suitable nesting habitat (i.e., large trees for Swainson's hawk and white-tailed kite, cliff faces for golden eagle, and grasslands for northern harrier). The pre-construction surveys will be conducted no more than 10 days before ground disturbance in a given area and will be phased based on the construction schedule.

If nesting golden eagles, Swainson's hawks, northern harriers, or white-tailed kites are detected, an appropriate no-disturbance buffer (minimum of 500 feet for northern harrier, 0.50 mile for golden eagle, Swainson's hawk, and white-tailed kite) will be established and monitored daily by a qualified biologist. Buffers will be maintained until a qualified biologist has determined that the young have fledged and are no longer reliant on the nest or parental care for survival. A 0.50-mile no-disturbance buffer will also be maintained from any overwintering eagles if they are detected in the Project area or surrounding areas; the buffer will be maintained for the duration that the bird(s) are present. If any bald eagles or golden eagles are detected, Reclamation will coordinate with USFWS, as necessary, to comply with the Bald and Golden Eagle Protection Act.

If maintaining the minimum no-disturbance buffer around an active golden eagle, Swainson's hawk, northern harrier, or white-tailed kite nest (or any overwintering eagles) is not practicable, CDFW will be consulted to determine whether reduced minimum no-disturbance buffers are appropriate based on site-specific circumstances (e.g., visual barriers between nest and construction area, existing level of disturbance) or to identify alternative measures to minimize the potential for Project-related disturbance to the nest site that could result in nest abandonment or other forms of take. Measures may include, but are not limited to, continuous biological monitoring by a qualified biologist until it has been determined that the young have fledged and are no longer reliant on the nest or parental care for survival or construction is complete. If the nesting pair shows signs of distress (i.e., adults leaving the nest when eggs or young chicks are present) as a result of Project-related activities, the monitoring biologist will have authority to stop work until it is determined that the adults have returned and are no longer showing signs of distress.

If trees suitable for nesting by Swainson's hawk are scheduled to be removed during the non-nesting season, a qualified biologist will conduct a pre-construction survey during the nesting season prior to tree removal to determine whether Swainson's hawks are using the trees for nesting. If the trees proposed for removal are being used by nesting Swainson's hawk, consultation with CDFW will take place per BIO-8. prior to tree removal.

If CESA compliance is required, and consultation with CDFW results in a determination that take of an active Swainson's hawk nest cannot be avoided, then take authorization pursuant to CESA will be obtained from CDFW prior to initiation of any activities that are likely to result in such take.

If an active golden eagle or white-tailed kite nest may not be avoidable, then all activities that are likely to result in take will be delayed until a qualified biologist has determined that the young have fledged and are no longer reliant on the nest or parental care for survival.

4.14.4.9 BIO-9: Measures to Minimize Impacts on Nesting Migratory Birds

To the extent practicable, vegetation removal will be scheduled to avoid the breeding season for nesting raptors and other special-status birds (generally February 1 through August 31, depending on the species). Removal of vegetation outside of the nesting season is intended to minimize the potential for delays in vegetation removal because of active nests.

Regardless of when vegetation removal is scheduled, a qualified biologist will conduct a minimum of one pre-construction survey for nesting migratory birds and raptors within the Project area and a buffer (250 feet for migratory birds, 500 feet for raptors) around the Project area (where accessible) for all construction-related activities that will occur during the nesting season. The pre-construction survey will be conducted no more than 15 days prior to the initiation of construction in a given area and will be phased based on the construction schedule. Because of the ongoing, phased approach to construction, multiple pre-construction surveys per year may be required. If an active nest is found, a construction-free buffer zone (250 feet for migratory birds, 500 feet for raptors) will be established around the active nest site. If establishment of the construction-free buffer zone is not practicable, appropriate conservation measures (as determined by a qualified biologist) will be implemented. These measures may include, but are not limited to, consultation with CDFW to establish a different construction-free buffer zone around the active nest site, daily biological monitoring of the active nest site, and delaying construction activities in the vicinity of the active nest site until the young have fledged.

If removal of bridges or other bridge work is scheduled to occur during the swallow nesting season, exclusionary devices (e.g., netting) will be installed around the bridges prior to the initiation of the avian breeding season (before February 15) during the same year as the bridges are scheduled for removal and after a qualified biologist has determined no active nests (i.e., nests with eggs or young) are present. The exclusionary devices will remain in place until August 15 or until the bridge removal or other bridge work is completed. The exclusionary devices will be anchored such that swallows cannot attach their nests to the structure through gaps. Exclusionary devices will be regularly inspected as necessary to confirm that they are adequately preventing initiation of nest building. If swallows have breached the exclusionary devices and began building nests on the structure, nesting material (i.e., partially built nests) can be removed only if a qualified biologist has determined that eggs or young are not present. No removal of nests with eggs or young can be conducted without written authorization from CDFW and USFWS, or until a qualified biologist has determined that the nest is no longer active (e.g., the nest has failed, the young have fledged and are no longer dependent on the nest).

4.14.4.10 BIO-10: Measures to Minimize Impacts on the California Tiger Salamander (CTS) and the California Red-legged Frog (CRLF)

Before and during construction:

- Protocol presence/absence surveys shall be conducted by a USFWS-approved biologist in suitable habitat prior to construction with a negative finding. As the Project is multi-year, protocol presence/absence surveys can be conducted in portions of the Project area that have work scheduled the following year. Alternatively, presence can be assumed in suitable habitat and the measures below can be implemented.
- To the maximum extent practicable, the Project design and construction implementation will avoid impacts to suitable breeding habitat. Areas of avoidance shall be indicated on Project plan sets and shall be clearly delineated in the field. Signage indicating "Environmentally Sensitive Area: Keep Out" shall be posted.
- Protocol aquatic surveys shall be conducted by a USFWS-approved biologist in suitable breeding habitat within areas that will be disturbed by construction in the following year, and within 1.3 miles of those areas to detect occupied breeding resources (one survey in March, April, and May each). Any occupied breeding resources will be prioritized for avoidance.
- Resources documented to support breeding populations of CTS/CRLF shall be avoided during construction with a buffer sufficient to ensure the continued functioning of that breeding resource. If

adherence to this buffer is not feasible, USFWS shall be contacted to determine whether moving individuals prior to construction is authorized.

- A USFWS-approved biologist shall survey the work sites where suitable habitat has been identified no more than 30 days before the onset of construction. Adult individuals detected during the surveys shall be relocated out of the area of disturbance by a USFWS-approved biologist.
- Work in occupied habitat shall only occur during the dry season.
- Areas beneath construction equipment and vehicles shall be inspected daily, prior to operation, for presence of CTS/CRLF under tracks/tires and within machinery by a USFWS-approved biologist until the biologist determines a designated contractor is sufficiently trained to monitor. A USFWS-approved biologist will ensure that this individual receives training consistent with USFWS requirements. A USFWS-approved biologist will be on-call to come to the site if CTS/CRLF are found.
- CTS/CRLF one-way, exclusion fencing shall be installed between construction areas and occupied habitat. This fencing shall extend 1.3 miles from the boundary of the occupied habitat along the alignment of the Project area.
- Overnight staging of vehicles or equipment shall be prohibited within 100 feet of occupied or assumed-occupied breeding resources.
- Work in occupied breeding habitat shall only occur during the dry season.

After construction:

- Temporary disturbance of occupied habitat shall be mitigated by restoring the area to pre-Project contours and revegetation.

4.14.4.11 BIO-11: Measures to Minimize Impacts on the Western Spadefoot Toad

If a western spadefoot toad is encountered during construction activities, it will be allowed to move out of harm's way of its own volition, or a qualified biologist will relocate it to the nearest suitable habitat that is at least 100 feet outside of the construction impact area.

Prior to moving equipment or materials each day, construction personnel will inspect for western spadefoot toads underneath and around equipment and other Project materials (e.g., stored pipes greater than two inches in diameter) that are located within 200 feet of aquatic habitat. If western spadefoot toads are found, they will be allowed to move out of the construction area under their own volition, or a qualified biologist will relocate individuals to the nearest suitable habitat that is at least 100 feet outside of the construction impact area.

4.14.4.12 BIO-12: Measures to Minimize Impacts on the Northern California Legless Lizard, California Glossy Snake, San Joaquin Coachwhip, and Coast Horned Lizard

Prior to moving equipment or materials each day, construction personnel will inspect underneath and around equipment for northern California legless lizard, California glossy snake, San Joaquin coachwhip, and coast horned lizard. If these species are encountered during construction activities, they will be allowed to move out of harm's way of their own volition, or a qualified biologist will relocate the organism(s) to the nearest suitable habitat that is at least 100 feet outside of the construction impact area.

4.14.4.13 BIO-13: Measures to Minimize Impacts on the Giant Garter Snake

Before and during construction:

- Protocol presence/absence surveys shall be conducted by a USFWS approved biologist in suitable habitat prior to construction. As the project is multi-year, protocol presence/absence surveys can be conducted in portions of the Project Area that have work scheduled the following year. Alternatively, presence can be assumed in suitable habitat and the measures below implemented.

- Avoid construction activities within 200 feet from the banks of occupied giant garter snake aquatic habitat. Confine movement of heavy equipment to existing roadways to minimize habitat disturbance.
- Construction activity within suitable habitat should be conducted between May 1 and October 1. This is the active period for giant garter snakes and direct mortality is lessened, because snakes are expected to actively move and avoid danger. Impacts to winter hibernacula should be avoided during the period of October 2 and April 30.
- The Project area shall be surveyed for giant garter snakes 24 hours prior to construction activities. Survey of the Project area should be repeated if a lapse in construction activity of two weeks or more has occurred. If a snake is encountered during construction, activities shall cease until appropriate corrective measures have been completed or it has been determined that the snake will not be harmed.
- Any dewatered habitat should remain dry for at least 15 consecutive days after April 15 and prior to excavating or filling of the dewatered habitat.

4.14.4.14 BIO-14: Measures to Minimize Impacts on the Western Pond Turtle

Before construction activities begin, a qualified biologist will conduct western pond turtle surveys within creeks and in other ponded areas affected by the Project. Adjacent upland areas will be examined for evidence of nests and individual turtles. The Project biologist will be responsible for the survey and for the relocation of pond turtles, if found. Construction will not proceed until reasonable effort has been made to capture and relocate as many western pond turtles as possible to minimize take. However, some individuals may remain undetected or enter sites after surveys and could be subject to injury or mortality. If a nest is observed, a biologist with the appropriate permits and prior approval from CDFW will move eggs to a suitable location or facility for incubation and release hatchlings into the creek system the following autumn.

4.14.4.15 BIO-15: Measures to Minimize Impacts on the Longhorn Fairy Shrimp, Vernal Pool Fairy Shrimp, and Vernal Pool Tadpole Shrimp

Before and during construction:

- Protocol presence/absence surveys shall be conducted by a USFWS-approved biologist in suitable habitat prior to construction with a negative finding. As the Project is multi-year, protocol presence/absence surveys can be conducted in portions of the Project area that have work scheduled the following year. Alternatively, presence can be assumed in suitable habitat.
- Work in occupied listed vernal pool branchiopod habitat shall only occur during the dry season.
- The authorized limits of branchiopod habitat (i.e., 250 feet from the pool edge) will be clearly staked in the field to prevent construction personnel from causing impacts to areas outside of work limits.
- Where temporary impacts will occur to occupied or assumed-occupied listed vernal pool branchiopod habitat, the top one to three inches of soil shall be salvaged to preserve the cyst bank. Saved topsoil shall be covered to avoid erosion. Topsoil shall be replaced as soon as possible upon completion of work in the impacted habitat.
- Overnight staging of vehicles or equipment shall be prohibited within 100 feet of occupied or assumed-occupied fairy shrimp.

After construction:

- Temporary impacts to listed branchiopod habitat shall mitigated for by restoring the affected area to pre-Project contours, compaction levels, and revegetation.

4.14.4.16 BIO-16: Measures to Minimize Impacts on Sensitive Natural Communities

Temporary and permanent impacts on sensitive natural communities known to occur within the Project area will be minimized to the greatest extent practicable. Trees and other vegetation will not be removed if it can

otherwise be reasonably avoided. In determining areas where vegetation shall be removed to provide adequate access for construction or staging, consideration will be given to selecting areas that require the least amount of removal of mature trees and canopy cover in coordination with a qualified biologist.

Prior to the initiation of construction activities, exclusionary fencing will be installed along the boundaries of all environmentally sensitive areas to be avoided, which will include sensitive natural communities and aquatic resources adjacent to the areas of Project-related impacts, so that impacts on environmentally sensitive areas outside of the construction area are minimized. Locations of environmentally sensitive areas and exclusionary fencing will be identified on construction plans. The exclusionary fencing will be inspected and maintained on a regular basis throughout Project construction in the areas where the fencing is needed to avoid unintended disturbance.

A Post-Construction Revegetation and Monitoring Plan will be developed and implemented to provide for the restoration of temporarily impacted riparian habitats to pre-existing conditions. The plan will include provisions for the planting of native woody vegetation and native seed mix or otherwise provide for the reestablishment of self-sustaining native riparian vegetation similar to the existing native riparian vegetation community. Planting of native riparian vegetation will include, but is not limited to, replacement of any trees removed by the Project at a 3:1 ratio (replaced to removed) with appropriate native tree species. For the purposes of this requirement, a tree is defined as a native woody plant (i.e., tree or mature shrub) with at least one stem measuring two inches or greater diameter at breast height. The plan will also identify success criteria and provide for annual or other regular monitoring to evaluate whether the revegetation effort has met the success criteria. The plan will include measures for remedial actions (e.g., additional plantings, supplemental irrigation, increased monitoring) if monitoring efforts indicate that success criteria are not being met.

4.14.4.17 BIO-17: Measures to Minimize Impacts on Wetlands

Prior to any temporary or permanent impacts on aquatic resources, any required permits/authorizations from RWQCB and USACE will be obtained. All terms and conditions of the required permits/authorizations will be implemented.

Where jurisdictional wetlands and other waters cannot be avoided, to offset temporary and permanent impacts that would occur as a result of the Project, restoration and compensatory mitigation to ensure no net loss will be provided as described below.

A wetland mitigation and monitoring plan will be developed in coordination with CDFW, USACE, or RWQCB to detail mitigation and monitoring obligations for temporary and permanent impacts to wetlands and other waters owing to construction activities and for other CDFW jurisdictional areas. The plan will quantify the total acreage affected; provide for mitigation, as described below, to wetland or riparian habitat; specify annual success criteria for mitigation sites; specify monitoring and reporting requirements; and prescribe site-specific plans to compensate for wetland losses resulting from the Project consistent with USACE's no net loss policy.

Prior to construction, the aquatic structure of wetland and riparian areas to be disturbed will be photo-documented and measurements of width, length, and depth will be recorded. Recontouring and revegetation of the disturbed portions of jurisdictional areas in areas temporarily affected by construction prior to demobilization by the construction contractor will be completed at the end of Project construction. Creek banks will be recontoured to a more stable condition, if necessary.

Revegetation will include a palette of species native to the watershed area according to a revegetation plan to be developed by Reclamation and submitted to USACE, CDFW, and RWQCB for approval. Following removal, woody trees habitat acreage would be replanted at a minimum 1:1 ratio, or as determined and agreed upon by the permitting agencies. Interim vegetation or other measures will be implemented, as necessary, to control erosion in disturbed areas prior to final revegetation.

Wetland and other waters impact in the construction and inundation area will be compensated at a ratio of 2:1 or at a ratio agreed upon by the wetland permitting agencies. Compensatory mitigation will be conducted by creating or restoring wetland and aquatic habitat at an agency-approved location on nearby lands or through purchasing mitigation credits at a USACE- or CDFW-approved mitigation bank (depending on the resource). If

mitigation is conducted on- or off-site, a five-year wetland mitigation and monitoring program for on- and off-site mitigation will be developed. Appropriate performance standards may include a 75-percent survival rate of restoration plantings; absence of invasive plant species; and a viable, self-sustaining creek or wetland system at the end of five years.

A weed control plan for the Project to limit the spread of noxious or invasive weeds will be developed. This plan would be consistent with current integrated pest management plans already in practice on lands surrounding the reservoir. Noxious or invasive weeds include those rated as 'high' in invasiveness by the California Invasive Plant Council. The plan will include a baseline survey to identify the location and extent of invasive weeds in the Project area prior to ground-disturbing activity, a plan to destroy existing invasive weeds in the construction area prior to initiation of ground-disturbing activity, weed-containment measures while the Project is in progress, and monitoring and control of weeds following completion of construction.

4.14.5 Cultural Resources

4.14.5.1 CR-1: Implement a Formal Agreement Document to National Historic Preservation Act (NHPA) Section 106 Compliance and Resolve any Adverse Effects/Significant Impacts to Cultural Resources

The resolution of adverse effects to historic properties occurs through the implementation of measures agreed on through consultation with the SHPO, Advisory Council on Historic Preservation (ACHP), and other Section 106 consulting parties. These measures are discussed in the draft *Programmatic Agreement Between the Bureau of Reclamation, Interior Region 10 California-Great Basin; and the California State Historic Preservation Officer Regarding Compliance with Section 106 of the National Historic Preservation Act Pertaining to the Implementation of the Delta-Mendota Canal Subsidence Correction Project, Alameda, Contra Costa, San Joaquin, Stanislaus, Merced, and Fresno counties*, which remains in review. In general, significant impacts to cultural resources under NEPA would be mitigated through the measures agreed to through the Section 106 process. Cultural resources that are formally determined not eligible for inclusion in the NRHP or the CRHR would require no further management prior to Project implementation. If cultural resources determined 'not eligible for listing in the NRHP but eligible for listing in the CRHR' are identified as part of the Project, such resources will be managed per CEQA requirements.

4.14.6 Geology, Seismicity, and Soils

4.14.6.1 GEO-1: Prepare for Unexpected Failures of Erosion Control Measures

To prepare for unexpected failures of erosion control measures, a supply of erosion control materials will be maintained on-site during the construction period to facilitate a quick response to unanticipated storm events or emergencies.

4.15 Impact Summary

Table 4-2 summarizes the environmental impacts of the No Action Alternative and the Proposed Action, MMs, contributions to cumulative conditions, and where to find evaluation support for each resource discussed.

Table 4-2. Impact Summary

Potential Impact	Alternative	Significance Determination (W/O Mitigation, W Mitigation)[1]	Mitigation	Evaluation Support	Contribution to Cumulative Condition	Mitigation	Cumulative Evaluation Support
4.1 Water Supply							
Alter CVP deliveries to CVP contractors as a result of construction	No Action	NI	--	Section 4.1.3	Not a considerable contribution.	--	Section 5.1.1
	Proposed Action	LTS	None	Section 4.1.4	Not a considerable contribution.	None	Section 5.1.1
Alter CVP deliveries to CVP contractors as a result of operation	No Action	S	--	Section 4.1.3	Not a considerable contribution.	--	Section 5.1.1
	Proposed Action	North-of-Delta CVP: LTS South-of-Delta CVP (Agricultural): B South-of Delta CVP (M&I): LTS South-of-Delta CVP Refuges: NI	None	Section 4.1.4	Not a considerable contribution.	None	Section 5.1.1
Alter SWP deliveries to SWP contractors as a result of construction	No Action	NI	--	Section 4.1.3	Not a considerable contribution.	--	Section 5.1.1
	Proposed Action	LTS	None	Section 4.1.4	Not a considerable contribution.	None	Section 5.1.1
Alter SWP deliveries to SWP contractors as a result of operation	No Action	B	--	Section 4.1.3	Not a considerable contribution.	--	Section 5.1.1
	Proposed Action	LTS	None	Section 4.1.4	Not a considerable contribution.	None	Section 5.1.1
Alter deliveries of other water as a result of construction	No Action	S	--	Section 4.1.3	Not a considerable contribution.	--	Section 5.1.1
	Proposed Action	B	None	Section 4.1.4	Not a considerable contribution.	None	Section 5.1.1
4.2 Water Quality							
Cause a violation of existing water quality standards or waste discharge requirements.	No Action	NI	--	Section 4.2.3	Not cumulatively considerable.	--	Section 5.1.2
	Proposed Action	S, LTS	WQ-1	Section 4.2.4	Not cumulatively considerable.	WQ-1	Section 5.1.2
Substantially alter the existing drainage pattern of the site or area, including through the	No Action	NI	--	Section 4.2.3	Not cumulatively considerable.	--	Section 5.1.2

Potential Impact	Alternative	Significance Determination (W/O Mitigation, W Mitigation)[1]	Mitigation	Evaluation Support	Contribution to Cumulative Condition	Mitigation	Cumulative Evaluation Support
alteration of the course of a stream or river, in a manner that would result in substantial erosion or siltation on- or off-site or provide substantial additional sources of polluted runoff.	Proposed Action	S, LTS	WQ-1	Section 4.2.4	Not cumulatively considerable.	WQ-1	Section 5.1.2
Conflict with or obstruct implementation of a water quality control plan.	No Action	NI	--	Section 4.2.3	Not cumulatively considerable.	--	Section 5.1.2
	Proposed Action	S, LTS	WQ-1	Section 4.2.4	Not cumulatively considerable.	WQ-1	Section 5.1.2
4.3 Air Quality							
Result in emissions of air pollutants exceeding the General Conformity *de minimis* emission levels or the quantitative criteria promulgated by the applicable local air pollution control agency	No Action	LTS	--	Section 4.3.3	Not a considerable contribution.	--	Section 5.1.3
	Proposed Action	LTS	None	Section 4.3.4	Not a considerable contribution.	None	Section 5.1.3
Expose sensitive receptors to substantial pollutant concentrations	No Action	LTS	--	Section 4.3.3	Not a considerable contribution.	--	Section 5.1.3
	Proposed Action	LTS	None	Section 4.3.4	Not a considerable contribution.	None	Section 5.1.3
Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people	No Action	LTS	--	Section 4.3.3	Not a considerable contribution.	--	Section 5.1.3
	Proposed Action	LTS	None	Section 4.3.4	Not a considerable contribution.	None	Section 5.1.3
4.4 Greenhouse Gas Emissions							
Generate GHG emissions that may have a significant impact on the environment	No Action	NI	--	Section 4.4.3	Not a considerable contribution.	--	Section 5.1.4
	Proposed Action	LTS	None	Section 4.4.4	Not a considerable contribution.	None	Section 5.1.4
Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the GHG emissions	No Action	NI	--	Section 4.4.3	Not a considerable contribution.	--	Section 5.1.4
	Proposed Action	LTS	None	Section 4.4.4	Not a considerable contribution.	None	Section 5.1.4
4.5 Visual Resources							
Substantially damage scenic resources within a state scenic highway corridor	No Action	LTS	--	Section 4.5.4	Not a considerable contribution.	--	Section 5.1.5
	Proposed Action	LTS	None	Section 4.5.5	Not a considerable contribution.	None	Section 5.1.5

Potential Impact	Alternative	Significance Determination (W/O Mitigation, W Mitigation)[1]	Mitigation	Evaluation Support	Contribution to Cumulative Condition	Mitigation	Cumulative Evaluation Support
Substantially degrade the existing visual character or quality of public views of the site and its surroundings or conflict with applicable regulations governing scenic quality	No Action	LTS	--	Section 4.5.4	Not a considerable contribution.	--	Section 5.1.5
	Proposed Action	LTS	None	Section 4.5.5	Not a considerable contribution.	None	Section 5.1.5
Create a new source of substantial light or glare, which would adversely affect day or nighttime views in the area	No Action	LTS	--	Section 4.5.4	Not a considerable contribution.	--	Section 5.1.5
	Proposed Action	LTS	None	Section 4.5.5	Not a considerable contribution after mitigation.	None	Section 5.1.5
4.6 Noise and Vibration							
Expose sensitive receptors to a generation of noise levels in excess of standards	No Action	NI	--	Section 4.6.3	Not a considerable contribution.	--	Section 5.1.6
	Proposed Action	LTS	None	Section 4.6.4	Not a considerable contribution.	None	Section 5.1.6
Expose sensitive receptors to or generate excess ground-borne vibration	No Action	NI	--	Section 4.6.3	Not a considerable contribution.	--	Section 5.1.6
	Proposed Action	LTS	None	Section 4.6.4	Not a considerable contribution.	None	Section 5.1.6
Create a substantial permanent increase in ambient noise levels	No Action	NI	--	Section 4.6.3	Not a considerable contribution.	--	Section 5.1.6
	Proposed Action	NI	None	Section 4.6.4	Not a considerable contribution.	None	Section 5.1.6
4.7 Traffic and Transportation							
Conflict with a program, plan, ordinance, or policy addressing the circulation system, including transit, roadway, bicycle, and pedestrian facilities	No Action	NI	--	Section 4.7.3	Not a considerable contribution.	--	Section 5.1.7
	Proposed Action	NI	None	Section 4.7.4	Not a considerable contribution.	None	Section 5.1.7
Cause a substantial increase in traffic in relation to the existing traffic load and capacity of the street system	No Action	NI	--	Section 4.7.3	Not a considerable contribution.	--	Section 5.1.7
	Proposed Action	LTS	None	Section 4.7.4	Not a considerable contribution.	None	Section 5.1.7
Substantially increase traffic hazards due to a geometric design feature or incompatible uses	No Action	NI	--	Section 4.7.3	Not a considerable contribution.	--	Section 5.1.7
	Proposed Action	S, LTS	TR-1	Section 4.7.4	Not a considerable contribution after mitigation.	TR-1	Section 5.1.7

Potential Impact	Alternative	Significance Determination (W/O Mitigation, W Mitigation)[1]	Mitigation	Evaluation Support	Contribution to Cumulative Condition	Mitigation	Cumulative Evaluation Support
Result in inadequate emergency access	No Action	NI	--	Section 4.7.3	Not a considerable contribution.	--	Section 5.1.7
	Proposed Action	S, LTS	TR-1	Section 4.7.4	Not a considerable contribution.	TR-1	Section 5.1.7
4.8 Hazards and Hazardous Materials							
Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials	No Action	NI	--	Section 4.8.3	Not a considerable contribution.	--	Section 5.1.8
	Proposed Action	S, LTS	HAZ-1, HAZ-2, WQ-1	Section 4.8.4	Not a considerable contribution after mitigation.	HAZ-1, HAZ-2, WQ-1	Section 5.1.8
Impair or physically interfere with an adopted emergency response plan or emergency evacuation plan	No Action	NI	--	Section 4.8.3	Not a considerable contribution.	--	Section 5.1.8
	Proposed Action	S, LTS	TR-1	Section 4.84	Not a considerable contribution after mitigation.	TR-1	Section 5.1.8
Expose people or structures to a significant risk of loss, injury, or death involving wildland fires	No Action	LTS	--	Section 4.8.3	Not a considerable contribution.	--	Section 5.1.8
	Proposed Action	S, LTS	HAZ-3	Section 4.8.4	Not a considerable contribution after mitigation.	HAZ-3	Section 5.1.8
Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment	No Action	NI	--	Section 4.8.3	Not a considerable contribution.	--	Section 5.1.8
	Proposed Action	S, LTS	HAZ-2, HAZ-4	Section 4.8.4	Not a considerable contribution after mitigation.	HAZ-2, HAZ-4	Section 5.1.8
Be located in the vicinity of a private airstrip or within two miles of a public airport or public use airport which could result in a safety hazard for people residing or working in the Project area	No Action	NI	--	Section 4.8.3	Not a considerable contribution.	--	Section 5.1.8
	Proposed Action	S, LTS	HAZ-5	Section 4.8.4	Not a considerable contribution after mitigation.	HAZ-5	Section 5.1.8
4.9 Biological Resources							
Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the CDFW, USFWS, or NMFS	No Action	LTS	--	Section 4.9.3	Not a considerable contribution.	--	Section 5.1.9
	Proposed Action	S, LTS	BIO-1 through BIO-15	Section 4.9.4	Not a considerable contribution after mitigation.	BIO-1 through BIO-15	Section 5.1.9

Potential Impact	Alternative	Significance Determination (W/O Mitigation, W Mitigation)[1]	Mitigation	Evaluation Support	Contribution to Cumulative Condition	Mitigation	Cumulative Evaluation Support
Have a substantial adverse effect on any riparian habitat or other sensitive natural community or critical habitat identified in local or regional plans, policies, or regulations or by the CDFW, USFWS, or NMFS	No Action	NI	--	Section 4.9.3	Not a considerable contribution.	--	Section 5.1.9
	Proposed Action	S, LTS	BIO-16	Section 4.9.4	Not a considerable contribution after mitigation.	BIO-16	Section 5.1.9
Have a substantial adverse effect on state or federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal) through direct removal, filling, hydrological interruption, or other means	No Action	NI	--	Section 4.9.3	Not a considerable contribution.	--	Section 5.1.9
	Proposed Action	S, LTS	BIO-17	Section 4.9.4	Not a considerable contribution after mitigation.	BIO-17	Section 5.1.9
Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites	No Action	NI	--	Section 4.9.3	Not a considerable contribution.	--	Section 5.1.9
	Proposed Action	S, LTS	BIO-16 and BIO-17	Section 4.9.4	Not a considerable contribution after mitigation.	BIO-16 and BIO-17	Section 5.1.9
Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance	No Action	NI	--	Section 4.9.3	Not a considerable contribution.	--	Section 5.1.9
	Proposed Action	S, LTS	BIO-1 through BIO-17	Section 4.9.4	Not a considerable contribution after mitigation.	BIO-1 through BIO-17	Section 5.1.9
4.10 Recreation							
Substantially reduce, physically alter, or close recreation facilities or impact public facilities such as fire protection, police protection, schools, parks, or other public facilities	No Action	NI	--	Section 4.10.3	Not a considerable contribution.	--	Section 5.1.10
	Proposed Action	LTS	None	Section 4.10.4	Not a considerable contribution.	None	Section 5.1.10
Increase the use of existing local and regional recreational facilities such that overcrowding or over capacity would occur at these facilities	No Action	NI	--	Section 4.10.3	Not a considerable contribution.	--	Section 5.1.10
	Proposed Action	LTS	None	Section 4.10.4	Not a considerable contribution.	None	Section 5.1.10
4.11 Cultural Resources							
Result in substantial adverse effects to historic properties listed or eligible for listing in the NRHP	No Action	NI	--	Section 4.11.3	Not a considerable contribution.	--	Section 5.1.11
	Proposed Action	S, LTS	CR-1	Section 4.12.3	Not a considerable contribution after mitigation.	CR-1	Section 5.1.11

Potential Impact	Alternative	Significance Determination (W/O Mitigation, W Mitigation)[1]	Mitigation	Evaluation Support	Contribution to Cumulative Condition	Mitigation	Cumulative Evaluation Support
Result in substantial adverse changes to historic resources, unique archaeological resources, or tribal cultural resources listed or eligible for listing in the CRHR	No Action	NI	--	Section 4.11.3	Not a considerable contribution.	--	Section 5.1.11
	Proposed Action	S, LTS	CR_1	Section 4.12.3	Not a considerable contribution after mitigation.	CR-1	Section 5.1.11
Disturb human remains, including those interred outside of formal cemeteries	No Action	NI	--	Section 4.11.3	Not a considerable contribution.	--	Section 5.1.11
	Proposed Action	S, LTS	CR-1	Section 4.12.3	Not a considerable contribution after mitigation.	CR-1	Section 5.1.11
4.12 Geology and Soils							
Result in substantial soil erosion or loss of topsoil	No Action	LTS	--	Section 4.12.3	Not a considerable contribution.	--	Section 5.1.12
	Proposed Action	S, LTS	GEO-1, WQ-1	Section 4.12.4	Not a considerable contribution after mitigation.	GEO-1, WQ-1	Section 5.1.12
Result in strong seismic ground shaking or seismic-related ground failure, including liquefaction	No Action	NI	--	Section 4.12.3	Not a considerable contribution.	--	Section 5.1.12
	Proposed Action	LTS	--	Section 4.12.4	Not a considerable contribution after mitigation.	--	Section 5.1.12
Be located on a geologic unit or soil that is unstable, or would become unstable as a result of the Project, and potentially result in on- or off-site landslides, lateral spreading, subsidence, liquefaction, or collapse	No Action	NI	--	Section 4.12.3	Not a considerable contribution.	--	Section 5.1.12
	Proposed Action	LTS	--	Section 4.12.4	Not a considerable contribution after mitigation.	--	Section 5.1.12
Be located on expansive soil, creating substantial direct or indirect risks to life or property	No Action	NI	--	Section 4.12.3	Not a considerable contribution.	--	Section 5.1.12
	Proposed Action	LTS	None	Section 4.12.4	Not a considerable contribution after mitigation.	None	Section 5.1.12
Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature	No Action	NI	--	Section 4.12.3	Not a considerable contribution.	--	Section 5.1.12
	Proposed Action	S, LTS	--	Section 4.12.4	Not a considerable contribution after mitigation.	--	Section 5.1.12

Potential Impact	Alternative	Significance Determination (W/O Mitigation, W Mitigation)[1]	Mitigation	Evaluation Support	Contribution to Cumulative Condition	Mitigation	Cumulative Evaluation Support
4.13 Public Utilities and Power							
Generate solid waste in excess of state or local standards, or otherwise impair the attainment of solid waste reduction goals	No Action	NI	--	Section 4.13.3	Not a considerable contribution.	--	Section 5.1.13
	Proposed Action	LTS	None	Section 4.13.4	Not a considerable contribution.	None	Section 5.1.13
Result in adverse effects related to the depletion of local or regional energy supplies	No Action	LTS	--	Section 4.13.3	Not a considerable contribution.	--	Section 5.1.13
	Proposed Action	LTS	None	Section 4.13.4	Not a considerable contribution.	None	Section 5.1.13
Require or result in the construction of new stormwater drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects	No Action	NI	--	Section 4.13.3	Not a considerable contribution.	--	Section 5.1.13
	Proposed Action	LTS	None	Section 4.13.4	Not a considerable contribution.	None	Section 5.1.13
Require expanded entitlements or resources of water supplies to serve the Project	No Action	NI	--	Section 4.13.3	Not a considerable contribution.	--	Section 5.1.13
	Proposed Action	LTS	None	Section 4.13.4	Not a considerable contribution.	None	Section 5.1.13

Notes:

[1] Column 3 presents significance determinations without implementation of proposed Mitigation Measure and significance determination with implementation of proposed Mitigation Measure. For example, "Cause a violation of existing water quality standards or waste discharge requirements" is presented as S, LS under the Proposed Action. Therefore, the Proposed Action would cause significant impacts that would be mitigated with the implementation of WQ-1 to less than significant levels.

Key: B – Beneficial; CDFW – California Department of Fish and Wildlife; CRHR – California Register of Historical Resources; CVP – Central Valley Project; LTS – Less than Significant; M&I – Municipal and Industrial; NI – No Impact; NMFS – National Marine Fisheries Service; NRHP – National Register of Historic Places; S – Significant; SWP – State Water Project; USFWS – United States Fish and Wildlife Service; W – with; W/O – without

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Chapter 5 Cumulative Effects

This chapter provides an analysis of cumulative effects of the Proposed Action taken together with other past, present, and reasonably foreseeable probable future projects (or actions) as required by NEPA implementing regulations (40 C.F.R. 1508.1(g)(3)). Resource-specific cumulative effects analyses are presented below. Descriptions of the cumulative project are provided in Appendix O.

5.1 Cumulative Effects Analysis

5.1.1 Surface Water Supply

Cumulative impacts on water supply resulting from concurrent projects would be associated with the short-term impacts of water supply delivery interruptions as a result of any required construction drawdown. The Proposed Action requires some drawdowns of the canal; however, CVP and SWP operations are closely coordinated by Reclamation and DWR and reductions in deliveries would be avoided to the maximum extent practical. This would include construction of the Proposed Action and the California Aqueduct – San Luis Canal Embankment and Liner Raise Project, which would be timed to ensure adequate capacity is maintained to prevent water supply delivery interruptions. In addition, because the Proposed Action would maintain adequate capacity during construction to avoid water supply interruptions, there would be no impact on the operation of the San Joaquin River Restoration Program. **Therefore, the construction of the Proposed Action in combination with concurrent projects would not result in significant cumulative impacts on surface water supply.**

Implementation of the California Aqueduct – San Luis Canal Embankment and Liner Raise Project, Delta Conveyance Project, B.F. Sisk Dam Raise and Reservoir Expansion Project, Los Vaqueros Reservoir Expansion Phase 2 Project, San Luis Low Point Improvement Project, Del Puerto Canyon Reservoir Project, Friant-Kern Canal Middle Reach Capacity Correction Project, and the Pacheco Reservoir Expansion Project would expand or improve water management and storage and, therefore, improve water supply reliability within the CVP and SWP service area. Operation of the Proposed Action would produce long-term beneficial impacts on water supply reliability within the CVP service area. **The long-term incremental contribution of the Proposed Action to significant cumulative water supply impacts would be beneficial for CVP contractors. The Proposed Action would also restore the capacity of the DMC, which provides benefits for operational flexibility for flow adjustment.**

5.1.2 Water Quality

Construction activities associated with the Mendota Pool Bypass and Reach 2B Improvements Project and the various infrastructure projects in San Joaquin and Stanislaus counties (described in Appendix O) would involve earthmoving and construction activities near the DMC. Construction of the Proposed Action would also involve earthmoving activities that could introduce pollutants into the water and compromise water quality. If construction of these cumulative projects was completed concurrently or over time alongside the Proposed Action, there could be significant cumulative short-term effects from construction contaminants causing water quality degradation in nearby water bodies. However, similar to the Proposed Action, the cumulative projects would be required to implement BMPs and MMs to reduce impacts. **The Proposed Action would implement BMPs and MM WQ-1 to reduce their impacts to water quality, and their incremental contribution to any significant cumulative water quality impacts would not be cumulatively considerable.**

Implementation of the Delta Conveyance Project could result in long-term changes to Delta region operations and habitat health with the implementation of conservation and restoration measures designed to improve the health of the Delta ecosystem while also improving water supply and water quality conditions. Future improved conditions in the Delta region could result in increased south-of-Delta exports but they would be within existing water right allowances. Changes in Delta water quality, south-of-Delta export of CVP and SWP water, and Delta outflow would be similar to existing and future no action conditions under the Proposed Action and impacts would be minimal. **Therefore, the operation of the Proposed Action in combination with this concurrent project would not result in significant cumulative impacts on water quality.**

5.1.3 Air Quality

Air pollution is largely a cumulative impact, as a region's nonattainment of the CAAQS or NAAQS is the product of past and present development within the region. Cumulative projects with the highest potential to contribute to cumulative regional air quality impacts would be those that would be under construction at the same time and in the same general area as the Proposed Action. Tables I1-6 and I1-7 in Appendix I1 summarize the cumulative maximum annual construction emissions (after implementation of applicable mitigations outlined in the respective environmental documents) anticipated to result from the identified cumulative projects within the SFBAAB and SJVAB. Cumulative projects in the SFBAAB and SJVAB would result in combined construction emissions which would exceed BAAQMD and SJVAPCD's emissions criteria for individual projects.

As described in Section 4.3.4, construction of the Proposed Action would not result in emissions that would exceed the BAAQMD and SJVAPCD's air emissions criteria for any criteria pollutant or the General Conformity *de minimis* levels. BAAQMD air quality guidance explains that the criteria were developed with specific consideration to the levels at which a project's individual emissions would be cumulatively considerable (BAAQMD 2017). SJVAPCD air quality guidance states that an individual project that is compliant with an approved air quality attainment or maintenance plan would have an incremental contribution to a cumulative effect that is not cumulatively considerable (SJVAPCD 2015). As discussed in Appendix I1, the quantitative air emissions criteria from SJVAPCD and the General Conformity *de minimis* levels from USEPA were developed such that a project consistent with the criteria would not be expected to exceed the CAAQS or NAAQS and would not conflict with or obstruct implementation of the respective applicable regional air quality plans. **Thus, the incremental contribution of the construction of the Proposed Action to cumulative air quality impacts in the region would not be cumulatively considerable.**

Operation of the DMC under the Proposed Action would not result in a change to regional emissions relative to the existing, or future no action, conditions. **Therefore, the operation of the Proposed Action would have no long-term cumulative impact on air quality.**

5.1.4 Greenhouse Gas Emissions

Impacts from GHG emissions are inherently cumulative, with global emissions of GHG contributing to global and regional climate impacts. Implementation of the cumulative projects presented in Appendix O would emit GHGs during construction and operations that would contribute to cumulative GHG emissions in the region. No single project can noticeably change the global climate temperature; therefore, when considered in relationship to all past, present, and future development, implementation of the Proposed Action could result in a significant cumulative impact. The significance criterion used to assess the Proposed Action's individual significance is sufficient to determine whether a project would conflict with an applicable plan, policy, or regulation adopted for reducing GHG emissions for which project-specific thresholds have been set. Therefore, if the Proposed Action would produce GHG emission impacts that are individually significant, then the Proposed Action's impact would be cumulatively considerable. GHG emissions under the Proposed Action would be below the identified criteria and would not produce significant GHG emission impacts. **Therefore, the incremental contribution of the Proposed Action would not be cumulatively considerable to global and regional climate impacts.**

5.1.5 Visual Resources

Most of the construction activities associated with the cumulative projects described in Appendix O would not be located in areas at which activities related to the Proposed Action would be visible concurrently. However, if construction of the B.F. Sisk Dam Raise Reservoir Expansion Project, Reach 2B and Mendota Pool Bypass Project, and/or the various infrastructure development projects in San Joaquin and Stanislaus counties overlap with the construction work on nearby segments of the DMC under the Proposed Action, construction activities would likely be visible at the same time as activities associated with the Proposed Action. This impact would be localized and short-term. The short timeframe combined with the low number of viewers in affected area would yield less than significant cumulative impacts on visual resources. **As such**, t**he Proposed Action's incremental contribution to any significant cumulative visual resource impacts would not be cumulatively considerable.**

5.1.6 Noise and Vibration

Most of the construction activities associated with the cumulative projects presented in Appendix O would occur several miles from the DMC, where construction actions under the Proposed Action would occur. Construction of the B.F. Sisk Reservoir Dam Raise and Expansion Project, Reach 2B and Mendota Pool Bypass Project, and/or the various infrastructure developments in San Joaquin and Stanislaus counties could overlap with the work on the DMC, as prescribed by the Proposed Action, and likely generate construction noise and vibration concurrently. However, all construction activities performed under the Proposed Action would take place within the county-exempted daytime hours. **Therefore, the Proposed Action's incremental contribution to any significant cumulative noise and vibration impacts would not be cumulatively considerable.**

Cumulative projects and population growth in the study area could result in cumulative long-term impacts to noise and vibration. Although construction is projected to occur in all the study area counties as a result of projected population growth, it is not expected to be along the DMC. **As such, the long-term effect of the Proposed Action, when combined with population growth, would have a cumulatively less than significant impact on noise and vibration.**

5.1.7 Traffic and Transportation

Most of the construction activities associated with the cumulative projects described in Appendix O would not occur near construction activities related to the Proposed Action. However, if construction of the B.F. Sisk Dam Raise and Reservoir Expansion Project, Reach 2B and Mendota Pool Bypass Project, California Aqueduct – San Luis Canal Embankment and Liner Raise, and/or the various housing infrastructure developments in San Joaquin and Stanislaus counties occur concurrently with the work on nearby segments of the DMC, there could be a cumulative short-term impact on traffic and transportation on shared primary access roads as a result of construction-related traffic. **The Proposed Action would implement MM TR-1 to reduce its impacts on traffic and transportation, and its incremental contribution to any significant cumulative traffic and transportation impacts would not be cumulatively considerable.**

5.1.8 Hazards and Hazardous Materials

There is potential for construction activities related to the B.F. Sisk Dam Raise and Reservoir Expansion Project, Reach 2B and Mendota Pool Bypass Project, and/or the various infrastructure developments in San Joaquin and Stanislaus counties to occur in the same vicinity and at the same time as construction of the Proposed Action. Construction activities under these cumulative projects would use equipment that could require the use of motor oil, gasoline, diesel fuel, solvents, and degreasers. However, a SWPPP for all projects would be required by the RWQCB for approval of a General Construction Permit under the National Pollutant Discharge Elimination System (NPDES) Program. The SWPPP would describe safety measures and BMPs to be implemented when transporting, storing, or using hazardous materials.

Additionally, the use of mechanical, spark-generating equipment would be required by cumulative projects, which could significantly increase the risk of wildland fire occurrence owing to the moderate to high wildfire risk within the area.

The same primary access roads for trucks and other equipment used under the Proposed Action may be used concurrently by the cumulative projects described in Section 5.1.7, which could conflict with emergency response and evacuation plans within State Responsibility Areas (SRAs). Although this could be a potentially significant cumulative effect, performing construction on the portion of the canal within the SRA near these cumulative projects at a different time than the construction of other projects' elements and implementing MM TR-1 would eliminate the significance of this effect.

Overall, construction of the Proposed Action in combination with cumulative projects mentioned above could result in cumulative impacts on hazards and hazardous materials. The implementation of MMs HAZ-1 through HAZ-5 and TR-1 would reduce the effects of the Proposed Action to a less than significant level. **Therefore, although the Proposed Action may combine with other projects to create a cumulatively considerable contribution to significant cumulative hazards and hazardous materials impacts pre-mitigation, this impact would not be cumulatively considerable post-mitigation.**

5.1.9 Biological Resources

Cumulative impacts on biological resources from concurrent projects would occur when the extents of potential effects from such projects overlap with areas impacted by the Proposed Action. As such, implementation of the Proposed Action, combined with construction of the B.F. Sisk Reservoir Expansion Project, Reach 2B and Mendota Pool Bypass Project, and various infrastructure developments in San Joaquin and Stanislaus counties could result in cumulative impacts on biological resources. However, concurrent impacts would be short-term in nature, and it is expected that each contemporaneous project would be required to comply with a suite of laws and regulations protecting and mitigating impacts on biological resources, similar to those listed in Appendix E. In addition, all construction actions performed under the Proposed Action would be conducted in accordance with MMs BIO-1 through BIO-17. **Therefore, although the Proposed Action may combine with other projects to create a cumulatively considerable contribution to significant cumulative biological resources impacts pre-mitigation, this impact would not be cumulatively considerable post-mitigation.**

The ongoing operations and maintenance of the DMC would adhere to the terms and conditions stipulated in the 2005 USFWS Biological Opinion (USFWS 2005) and the 2019 USFWS and NMFS Biological Opinions (USFWS 2019; NMFS 2019), the 2020 ROC on LTO ROD (Reclamation 2020), or any future regulatory requirements and the terms and conditions specified in relevant future Biological Opinions. **Therefore, the operation of the Proposed Action in combination with the concurrent projects would not result in significant cumulative impacts on biological resources.**

5.1.10 Recreation

There is potential for construction of the Mendota Pool Bypass and Reach 2B Improvements Project to overlap with work on the earthen-lined segment of the DMC, as required by the Proposed Action. However, Mendota Pool Park would only be closed for the duration of construction associated with the Proposed Action and not the Mendota Pool Bypass and Reach 2B Improvements Project. Implementation of the Proposed Action would result in only a short-term closure of Mendota Pool Park and no additional closures resulting from concurring projects. **Therefore, the construction of the Proposed Action in combination with concurrent projects would not result in significant cumulative impacts on recreation.**

5.1.11 Cultural Resources

The B.F. Sisk Dam Raise and Reservoir Expansion Project, Delta Conveyance Project, Los Vaqueros Reservoir Expansion Project, San Luis Low Point Project, Del Puerto Canyon Reservoir Project, and the Pacheco Reservoir Expansion Project have all been identified as cumulative actions that could result in significant impacts to cultural resources. Archival and records search information, geoarchaeological sensitivity studies, and pedestrian inventory surveys were used to assess potential impacts to cultural resources within the project area of analysis. The cumulative projects listed above could have a cumulatively significant effect on cultural resources, though impacts would be reduced through the implementation of MMs associated with each project. Impacts to cultural resources from construction activities and operations under the Proposed Action also would be reduced through implementation of Mitigation Measure CR-1. **For this reason, the impacts of the Proposed Action, when combined with the concurrent projects on cultural resources, would remain less than significant**.

5.1.12 Geology, Seismicity, and Soils

Construction activities associated the Reach 2B and Mendota Pool Bypass Project and the various infrastructure projects in San Joaquin and Stanislaus counties (described in Appendix O) would involve earthmoving and construction projects near the DMC, which could result in impacts such as erosion and/or loss of topsoil. Construction of the Proposed Action would result in significant impacts on geology, seismicity, and soils primarily localized to the DMC ROW due to the potential for erosion and loss of topsoil. These impacts would be mitigated to the less than significant level by implementing MMs WQ-1 and GEO-1. Similar to the Proposed Action, the cumulative projects would be required to implement BMPs and MMs to reduce impacts. **Therefore, although the Proposed Action may have a significant impact on geology, seismicity, and soils impacts pre-mitigation, this impact would not be cumulatively considerable post-mitigation.**

5.1.13 Public Utilities and Power

Over time, construction debris from other construction projects, such as the Reach 2B and Mendota Pool Bypass Project and the various infrastructure developments in San Joaquin and Stanislaus counties, and from future growth and development could cause some landfills in the area to reach capacity. However, there are numerous landfills with available capacity surrounding the DMC, and the Proposed Action's contributions to the landfills would be insubstantial relative to their unused capacity. Cumulative projects and the Proposed Action are expected to use standard construction equipment fueled by gasoline or diesel, the demand for which could be met by regional supplies. The various infrastructure developments in San Joaquin and Stanislaus counties (described in Appendix O) may impact energy consumption, stormwater management, wastewater management, solid waste disposal, or emergency services over the long term through the creation of new business developments. The Proposed Action would not require long-term expanded water entitlements and would have less than significant impacts on stormwater drainage structures and wastewater facilities. Overall, the Proposed Action would have less than significant impacts on public utilities and power. **Therefore, the construction of the Proposed Action in combination with concurrent projects would not result in significant cumulative impacts on public utilities and power.**

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Chapter 6 Other Compliance Requirements

In addition to resources analyzed in Chapter 4, Department of the Interior Regulations, Executive Orders, and Reclamation guidelines require a discussion of the following additional items when preparing environmental documentation.

6.1 Indian Trust Assets

Indian Trust Assets (ITAs) are defined as legal interests in property held in trust by the U.S. government for Indian tribes or individuals, or property protected under U.S. law for federally recognized Indian tribes or individuals. ITAs can include land, minerals, federally reserved hunting and fishing rights, federally reserved water rights, and in-stream flows associated with a Reservation or Rancheria. By definition, ITAs cannot be sold, leased, or otherwise encumbered without approval of the United States.

The nearest ITA is a public domain allotment approximately 43 miles to the south of the study area. Based on the nature of the Project, the ITA would not be impacted by the Project nor would the Project occur on Indian lands. Therefore, it is reasonable to assume that the Project would not have any impacts on ITAs.

6.2 Indian Sacred Sites

As defined by federal Executive Order 13007 *Indian Sacred Sites*, a sacred site refers to "any specific, discrete, narrowly delineated location on federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site." An archaeological survey of the APE was performed by qualified archaeologists, the results of which are detailed and evaluated in Appendix N. Additionally, the results of the Sacred Lands Inventory and CHRIS searches are presented in Section 4.11 and discussed in more detail in Appendix N. Reclamation is consulting with Tribes regarding the Project and will address any Sacred Sites should they be identified as part of that consultation.

6.3 Environmental Justice

Executive Order 12898 directs federal agencies to address disproportionately high and adverse human health and environmental effects on minority and low-income populations. Minority populations are American Indian or Alaskan Native, Asian or Pacific Islander, Black, or Hispanic individuals in the affected environment that either: (a) exceed 50 percent, or (b) these populations are meaningfully greater[14] than the minority population percentage in the state (Federal Interagency Working Group on Environmental Justice and NEPA Committee 2016). Low-income populations in an affected area are identified based on the poverty thresholds from the Bureau of the Census Current Population Reports, Series P-60 on Income and Poverty.

California is a diverse state and Table 6-1 shows the minority population in the environmental justice study area (Alameda, San Benito, Santa Clara, San Joaquin, Stanislaus, Merced, and Fresno counties) is similar to that of the State of California as a whole. During the 2016–2020 study period, the racial category with the highest percentage of population in the Project study area is White alone (48.1 percent). The ethnic category in the table of Hispanic or Latino represents those who self-identify themselves as "other Spanish, Hispanic, or Latino" on the census questionnaire. Merced County had the highest percentage of its population that self-identified as Hispanic or Latino (60.2 percent) of those counties included in the Project study area. Table 6-1 also shows that the percentage of low-income persons or families present in the Project study is not meaningfully greater than that of the rest of California. Fresno County had the highest percentage of families living below the poverty threshold (16.7 percent) of those counties included in the Project study area.

[14] 'Meaningfully Greater' is a term used in "Appendix A, Text of Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, Annotated with Proposed Guidance on Terms," which is attached to CEQ's Environmental Justice Guidance under the National Environmental Policy Act (CEQ 1997). A minority or low-income population in the study area that is over 10 percent higher than that of the state would be considered 'meaningfully greater.'

Table 6-1. Demographic Characteristics of the Project Study Area, 2016–2020*

	Counties** Population Numbers	Counties** Percentage of Total	California Population Numbers	California Percentage of Total
Total Population	6,209,225	-	39,346,023	-
White alone	2,986,486	48.1	22,053,721	56.1
Black or African American alone	344,273	5.5	2,250,962	5.7
American Indian alone	45,476	0.7	311,629	0.8
Asian alone	1,015,269	16.4	5,834,312	14.8
Native Hawaii & Pacific Islander alone	30,785	0.5	149,636	0.4
Some other race alone	741,980	11.9	5,623,747	14.3
Two or more races	536,744	8.6	3,122,016	7.9
Hispanic or Latino (of any race)	2,151,600	34.7	15,380,929	39.1
Poverty Prevalence	-	-	-	-
People below Poverty	719,721	11.59	4,853,434	12.3
Families below Poverty	121,836	8.5	808,800	9.0

Source: U.S. Census Bureau 2020.

Notes: *American Community Survey Five-Year Estimates.

** "Counties" refers to combined demographic characteristics of Alameda, San Benito, Santa Clara, San Joaquin, Stanislaus, Merced, and Fresno counties in California.

Based on the data in Table 6-1 and a 'meaningfully greater' analysis of percentages compared to the State of California, no minority or low-income populations are present in the study area that would be adversely affected disproportionately by the Proposed Action described in this EA/IS. In addition, the ability of the DMC to convey designed flows as originally authorized would further support ongoing agricultural activities through greater water supply reliability having a beneficial impact on jobs associated with agriculture. Further, the Proposed Action would not cause dislocation or changes in employment, or increase flood, drought, or disease, nor would it disproportionately adversely impact economically disadvantaged or minority populations.

6.4 Consultation and Coordination

Reclamation and SLDMWA have or will consult with the following regarding the Proposed Action:

6.4.1 Bay Area Air Quality Management District/ San Joaquin Valley Air Pollution Control District

The Proposed Action involves construction activities in Alameda County (within the SFBAAB), for which air quality is under the jurisdiction of BAAQMD. The Proposed Action involves construction activities in San Joaquin, Stanislaus, Merced, and Fresno counties, which lie within the SJVAB, for which air quality is under the jurisdiction of SJVAPCD. If necessary, Reclamation and SLDMWA will coordinate with BAAQMD and SJVAPCD regarding air quality impacts within their jurisdiction. BAAQMD and SJVAPCD will receive a copy of this Draft EA/IS for review.

6.4.2 California Department of Fish and Wildlife

If it is determined that the Project or components of the Project would be subject to compliance with the CESA, then SLDMWA will consult with CDFW regarding CESA permitting requirements.

6.4.3 Central Valley Regional Water Quality Control Board

The Proposed Action would include construction activities that could require permits from CVRWQCB, including a dewatering permit and coverage under a NPDES permit for General Construction. The construction contractor will obtain these permits prior to construction. RWQCB will receive a copy of this Draft EA/IS for review.

6.4.4 Fresno County Department of Parks and Recreation

Fresno County Department of Parks and Recreation (DPR) manages the Mendota Pool Recreation Area. SLDMWA will coordinate with Fresno County DPR regarding potential impacts to recreation from the implementation of the Proposed Action. Fresno County DPR will receive a copy of this Draft EA/IS.

6.4.5 Friant Water Authority

SLDMWA will consult with Friant Water Authority regarding the Proposed Action. Friant Water Authority will receive a copy of this Draft EA/IS.

6.4.6 Local Governments

The Proposed Action involves construction activities in Alameda, San Joaquin, Stanislaus, Merced, and Fresno counties. These counties will receive a copy of the Draft EA/IS for review. If necessary, SLDMWA will coordinate with these counties. In addition, all SLDMWA member agencies were consulted during the development of this Draft EA/IS.

6.4.7 Native American Heritage Commission

SLDMWA is pursuing formal consultation with Native American Tribes consistent with Assembly Bill (AB) 52 (Chapter 532, Statutes of 2014). Letters requesting consultation with SLDMWA were sent out on June 14, 2022. SLDMWA received four positive responses and follow-up letters were sent on August 18, 2022. Pursuant to PRC Section 21074 and consistent with AB 52 (Chapter 532, Statutes of 2014), SLDMWA has initiated consultation with Native American Tribes and interested Native American stakeholders.

6.4.8 State Historic Preservation Officer

Implementation of the Proposed Action would require compliance with 54 U.S.C. Section 306108, commonly known as Section 106 of the NHPA. To complete the Section 106 process, as outlined at 36 C.F.R. Part 800, Reclamation is required to consult with the SHPO and afford the ACHP an opportunity to comment regarding the effects of the proposed undertaking on historic properties. Historic properties are cultural resources that are listed, or eligible for listing, on the NRHP. Reclamation must fully comply with NHPA Section 106 compliance requirements prior to completing NEPA on the Project.

Reclamation has conducted consultations with several Native American Tribes and stakeholders regarding geotechnical work for the Project. In June 2020, the Native American Heritage Commission (NAHC) responded to Reclamation with a list of 34 Native American Tribes or stakeholders who may possess information regarding Indigenous resources within the Project area. Regarding the geotechnical study for the Project, Reclamation initiated consultation with several individuals and tribal organizations in March 2021.

Reclamation is negotiating a Programmatic Agreement (PA), pursuant to 36 C.F.R. Section 800.2(c)(2) and (c)(5) and 36 C.F.R. Section 800.14(b)(2)(1), with the SHPO and other consulting parties, which will be in place before completing the NEPA process. Reclamation has identified potential consulting parties to the PA they are preparing for this undertaking, by contacting the NAHC, historical societies, county agencies, and other public stakeholders (Appendix C of Draft Programmatic Agreement). Reclamation contacted Indian tribes and Native American organizations and individuals that were identified on the NAHC list and invited these groups to be Concurring Parties to the PA. Reclamation is continuing to consult with them throughout the development and implementation of the PA. A draft PA is currently being circulated and is under review by the California State Office of Historic Preservation (OHP).

6.4.9 United States Army Corps of Engineers

Reclamation and SLDMWA will coordinate with the USACE Regulatory Division should permits pursuant to Clean Water Act Section 401 and Section 404 be needed.

6.4.10 United States Fish and Wildlife Service

Reclamation will consult with the USFWS to ensure its actions do not jeopardize the continued existence of any listed species or destroy/adversely modify critical habitat pursuant to the ESA.

Appendix B: DPR 523 Forms

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary # _____
HRI # _____
Trinomial _____
NRHP Status Code 2S2

Other Listings _____
Review Code _____ Reviewer _____ Date _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

P1. Other Identifier: Delta-Mendota Canal

***P2. Location:** ☐ **Not for Publication** ☒ **Unrestricted** ***a. County:** Alameda, Contra Costa, San Joaquin, Stanislaus, Merced, Fresno

***b. USGS 7.5' Quad:** See Continuation Sheet

c. Address: _____ City _____ Zip _____

d. UTM: (Northern endpoint): Zone 10S 626724mE 4186397mN; (Southern endpoint): Zone 10S 734677 mE 4073832 mN

e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate)

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries)

This form presents an inventory and National Register of Historic Places (NRHP) evaluation of the Delta-Mendota Canal (DMC), a component of the US Bureau of Reclamation's (Reclamation) Central Valley Project (CVP) (**Photograph 1**). Completed in 1951 as a key component of the joint state-federal CVP, the DMC spans 116 miles from just upstream from C.W. Bill Jones Pumping Plant (Tracy Pumping Plan) near Tracy to Mendota Pool in western Fresno County at the south end. DMC conveys water along the west side of the San Joaquin Valley in a southerly direction, delivering water to Mendota Pool and to water users at turnouts along its route. For the purposes of this form, the DMC has been divided into 22 segments (**Table 1**), with each segment roughly spanning the distance between successive check structures from north to south. All DMC segments are recorded on the attached Department of Parks and Recreation (DPR) 523E Linear Features Records, and they have been designated Segments 1 through 22 (see Continuation Sheet). Mileposts (M.P.) indicate locations along the canal from north to south.

***P3b. Resource Attributes:** (List attributes and codes) HP11 – Engineering Structure; HP20 – Canal/Aqueduct

***P4. Resources Present:** ☐ Building ☒ Structure ☐ Object ☐ Site ☐ District ☐ Element of District ☐ Other (Isolates, etc.)



P5b. Description of Photo: (View, date, accession#) **Photograph 1:** View of the DMC around M.P. 28.96 with Hamilton Road bridge in distance; camera facing downstream from left bank, May 11, 2022 (A00586).

***P6. Date Constructed/Age and Sources:** ☒ Historic ☐ Prehistoric ☐ Both
1951 (U.S. Bureau of Reclamation)

***P7. Owner and Address:**
U.S. Department of the Interior
Bureau of Reclamation
Mid Pacific Regional Office
2800 Cottage Way
Sacramento, CA 95825

***P8. Recorded by:** (Name, affiliation, address)
Heather Norby, Abigail Lawton, & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

***P9. Date Recorded:** May – June 2022

***P10. Survey Type:** Intensive

***P11. Report Citation:** (Cite survey report and other sources, or enter "none.") Heather K. Norby & Christopher D. McMorris, JRP Historical Consulting, LLC, *Historic Resources Evaluation and Effects Analysis Report for the Delta-Mendota Canal Subsidence Correction Project*, 2022.

***Attachments:** ☐ None ☒ Location Map ☒ Sketch Map ☒ Continuation Sheet ☒ Building, Structure, and Object Record ☐ Archaeological Record ☐ District Record ☒ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐ Other (list) _____

B1. Historic Name: Delta-Mendota Canal
B2. Common Name: Delta-Mendota Canal
B3. Original Use: water conveyance B4. Present Use: water conveyance
***B5. Architectural Style:** utilitarian infrastructure
***B6. Construction History**: (Construction date, alteration, and date of alterations) Construction of DMC began in 1946 and was completed in 1951. Between 1964 and 1970, numerous alterations were made. In 1965 an open channel to the O'Neill Forebay was added at M.P. 69.3, and the DMC was realigned at that area to accommodate this change. At the same time, the concrete-lined sections of the DMC between M.P. 3.50 – 69.00 were raised approximately 18 inches. Around the entrance to the new channel, M.P. 69.00 – 69.25, the lining was raised approximately 24 inches. Throughout the rest of the 1960s, the timber piers and bents of bridges in this span were replaced with concrete piers and bents for reinforcement and to accommodate the raising of the canal wall. Check structures were not raised at that time. As drainage conditions have changed, some inlets have become obsolete. Modifications have been made, including removal of some flap gates.

***B7. Moved?** ☒ **No** ☐ **Yes** ☐ **Unknown** **Date:** _____ **Original Location:** _____
***B8. Related Features:** Other Central Valley Project structures
B9. Architect: U.S. Department of the Interior (USDI), Reclamation, Central Valley Project – California, Delta Division; and USDI, Reclamation, Denver Office
b. Builder: Multiple (see Continuation Sheet)
***B10. Significance: Theme:** Water Conveyance; Engineering **Area:** California
Period of Significance: 1946-1951 **Property Type:** Canal **Applicable Criteria:** A/1 and C/3
(Discuss importance in terms of historical or architectural context as defined by theme, period, and geographic scope. Also address integrity.)

Delta-Mendota Canal meets National Register of Historic Places (NRHP) Criterion A and California Register of Historical Resources (CRHR) Criterion 1 at the state level because of its primary role in accomplishing the visionary goal of the CVP to transfer water between the Sacramento River and San Joaquin River basins. Delta-Mendota Canal is also individually eligible for listing in the NRHP and CRHR under Criterion C and Criterion 3 because its size and scale demonstrate the magnitude of the engineering and construction accomplishment of the CVP, and because it demonstrates Reclamation engineer Oscar Boden's important contributions to design of the Delta Division of the CVP. This property has been evaluated in accordance with Section 106 of the National Historic Preservation Act of 1966 (as amended) (54 U.S.C. 306108) and its implementing regulations (36 CFR Part 800), and Section 15064.5(a)(2)-(3) of the CEQA Guidelines, using the criteria outlined in Section 5024.1 of the California Public Resources Code (See Continuation Sheet).

B11. Additional Resource Attributes: _____

***B12. References:** USDI, Bureau of Reclamation, Delta-Mendota Canal, Technical Record of Design and Construction (Denver: 1959); USDI, Reclamation, "The Contribution of Irrigation and the Central Valley Project to the Economy of the Area and the Nation," (Government Printing Office: Washington, 1956), also see footnotes.

B13. Remarks:

See Continuation Sheet.

***B14. Evaluator:** Heather Norby, JRP Historical Consulting, LLC

***Date of Evaluation:** August 2022

(This space reserved for official comments.)

P3a. Description (continued):

Table 1. Delta-Mendota Canal Segments Presented in Linear Feature Records

DMC Segment No.	Canal Segment	Milepost Span
1	Just below Fish Collecting Facilities to just above Check No. 1	0.09 – 11.34
2	Check No. 1 to just above Check No. 2	11.35 – 16.18
3	Check No. 2 to just above Check No. 3	16.19 – 20.62
4	Check No. 3 to just above Check No. 4	20.63 – 24.42
5	Check No. 4 to just above Check No. 5	24.43 – 29.81
6	Check No. 5 to just above Check No. 6	29.82 – 34.41
7	Check No. 6 to just above Check No. 7	34.42 – 38.67
8	Check No. 7 to just above Check No. 8	38.68 – 44.25
9	Check No. 8 to just above Check No. 9	44.26 – 48.61
10	Check No. 9 to just above Check No. 10	48.62 – 54.40
11	Check No. 10 to just above Check No. 11	54.41 – 58.27
12	Check No. 11 to just above Check No. 12	58.28 – 63.98
13	Check No. 12 to just above Check No. 13	63.99 – 70.00
14	Check No. 13 to just above Check No. 14	70.01 – 74.39
15	Check No. 14 to just above Check No. 15	74.40 – 79.63
16	Check No. 15 to just above Check No. 16	79.64 – 85.08
17	Check No. 16 to just above Check No. 17	85.09 – 90.53
18	Check No. 17 to just above Check No. 18	90.54 – 96.80
19	Check No. 18 to just above Check No. 19	96.81 – 105.05
20	Check No. 19 to just above Check No. 20	105.06 – 111.25
21	Check No. 20 to just above Check No. 21	111.26 – 116.47
22	Check No. 21 to the canal terminus at the Mendota Pool	116.48 – 116.61

DMC Alignment and Cross Sections

Originating at the inlet canal upstream from C.W. Bill Jones Pumping Plant near Tracy, the DMC conveys Sacramento River water along the west side of the San Joaquin Valley in a southerly direction, traversing approximately 116 miles through San Joaquin, San Benito, Stanislaus, Merced, and Fresno counties before terminating at Mendota Pool in western Fresno County. Numerous major and minor appurtenant structures are distributed throughout its span: check structures control DMC flows; turnouts distribute water to adjacent water users and irrigation districts; wasteways evacuate the canal of all flows during emergencies; siphons transport the DMC below adjacent roadways, railways, and water courses; bridges transport adjacent roadways over the DMC; and siphon undercrossings, culverts, overchutes, pipe crossings, and inlet drains convey adjacent water courses below, above, or into the DMC. For a detailed discussion of these appurtenant structural types and subtypes, see typology discussions for the various structures below.

The DMC has a trapezoidal cross-section. It has a lining of earth, concrete, and compacted-earth in different sections. The first section from M.P. 0.19 to M.P. 2.52 is lined with loose and compacted earth until it ends at the inlet transition to the Tracy Pumping Plant (**Photograph 2 - Photograph 5**). From the Pumping Plant, the water is carried for 4,822 feet through discharge

pipes to an outlet transition at M.P. 3.50 where the water is released into the concrete-lined section of the canal which extends for roughly 95 miles to M.P. 98.62 (**Photograph 6 - Photograph 9**). After this point, the DMC transitions to a compacted-earth lining, which continues until the terminus of the canal at M.P. 116.61 (**Photograph 10 - Photograph 12**).[1]



Photograph 2: View of riprap (right) and earth lining (left) at the beginning of Earth Section No. 1 of the Delta Mendota Intake Canal at the Tracy Fish Collection Facility, M.P. 0.09; camera facing upstream from left bank, May 9, 2022 (A00165).



Photograph 3: View of earth lining of Intake Canal at M.P. 0.34, above Bethany-Byron Road siphon; camera facing downstream from left bank, May 9, 2022 (A00166).

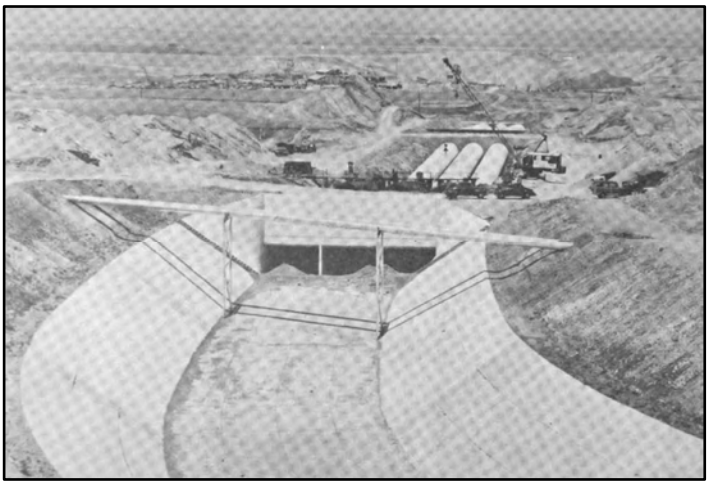


Photograph 4: Downstream view of Intake Canal from M.P. 1.41, showing transition from riprap of Bethany-Byron Road siphon outlet (center right foreground) to earth lining, Pumping Station visible in deep background (top center); camera facing downstream from right bank, May 9, 2022 (A00154)



Photograph 5: End of earth lined Section No. 2 at the beginning of the Pumping Station inlet transition, at M.P. 2.52, which marks the end of the Intake Canal; camera facing left bank from right bank, May 9, 2022. (A00089)

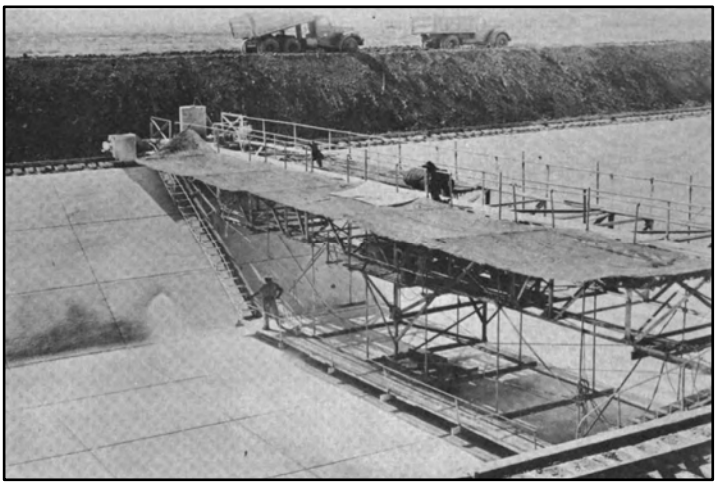
[1] USDI, Reclamation, *Delta-Mendota Canal: Structures List*, May 2020: 1-42.



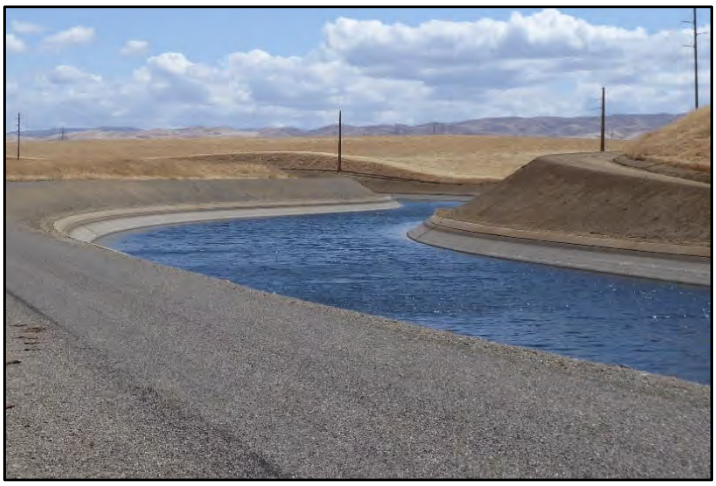
Photograph 6: Historic downstream view of Pumping Station discharge lines and inlet to DMC at M.P. 3.50 (Station L-185+50), ca. 1951.[2].



Photograph 7: Beginning of concrete-lined Section No. 3 at discharge pipes inlet to DMC at M.P. 3.50, raised lining visible at top of canal walls; camera facing west from left bank, May 9, 2022 (A00199).



Photograph 8: Historic view of application of white-pigmented curing compound to finished concrete lining [M.P. unknown]; October 1950.[3]



Photograph 9: View of concrete canal lining and cuts at M.P. 3.78; camera facing downstream from left bank, May 9, 2022 (A00208).

[2] [photograph], DM-534-CV, in USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*, June 1959: Frontispiece.
[3] [photograph], DM-1168-CV, in USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*, June 1959: 136.



Photograph 10: End of concrete lining at 98.62 and riprap transition to beginning of earth-lined Section No. 10 at M.P. 98.64; camera facing downstream from left bank, June 14, 2022 (C0418).



Photograph 11: View of compact-earth lined Section No. 10; camera facing downstream from Farm Bridge at M.P. 99.82, June 14, 2022 (C0430).



Photograph 12: View of Segment 22 from approximately M.P. 116.55, showing the canal's terminus, where it flows into the San Joaquin River; camera facing downstream from right bank, June 15, 2022 (C0537).

The first 3,500 feet of the earthen intake canal are 14.25 feet deep, have a bottom width of 100 feet, and 3:1 side slopes. After the Byron-Bethany Road siphon at M.P. 1.36/1.41, the following 8,600 feet to the inlet transition at the Pumping Station are 16.81 feet deep with a bottom width of 66 feet, to increase the velocity of flow. The concrete-lining is divided into seven sections, each with slightly different dimensions. Overall, the concrete lining originally had a top width of 102.24 feet and depth of 18.08 feet at its start at M.P. 3.50, and gradually narrowed to a top width of 94.62 feet and depth of 15.54 where it terminates at M.P. 98.62.[4]

[4] USDI, Reclamation, *Tracy Pumping Plant and Intake Canal and Discharge Lines: Technical Record of Design and Construction*, May 1959: 9; USDI, Reclamation, Central Valley Project – California (CVP), "Delta-Mendota Canal Subsidence Correction Project: Lining Raise Cross Section Diagrams," Drawing No. DMC1-C-034, September 28, 2021; USDI, Reclamation, Central Valley Project –

The concrete-lining of the first 70 miles was raised 18 inches in 1965 (**Photograph 13**). Near the O'Neill Forebay, M.P. 69 - 69.25, the lining was raised 24 inches. In 1970, subsidence was evident in the lower reach of the canal and this reach, below Mile 70, was scheduled for a lining raise (**Photograph 14**).[5] See **Table 2** for dimensional variations and alterations throughout the DMC.



Photograph 13: View of concrete canal lining on right bank around double-barrel turnout at M.P. 3.54, lining has been raised on either side of the turnout, but the top of the original canal wall is unchanged immediately surrounding the structure; camera facing right bank from left bank, May 9, 2022 (A00203).



Photograph 14: View of canal lining on right bank at M.P. 93.24-93.25, where lining appears to have been raised around a modern turnout and original farm bridge; camera facing right bank from left bank, June 14, 2022 (C0385).

As drainage conditions have changed, some inlets have become obsolete. Modifications have been made, including removal of some flap gates.

Compacted-earth embankments topped with gravel maintenance roads flank both sides of the DMC along its full length (**Photograph 15**). The embankments were generally designed to be a minimum of 25 feet wide, but their exact width and height varies depending on the surrounding topography. The embankments function as levees in many sections where the surrounding land sits below the DMC's normal water surface (**Photograph 16**). In some areas where the canal traverses through a deep cut, the tops of the embankments are at grade with the surrounding land (**Photograph 17**), and at some locations spoils piles are sited along the embankment's outside toe. The width of each maintenance road varies in tandem with the embankment beneath them, but they generally range from approximately 12 to 20 feet. Access to the DMC's maintenance roads are controlled from adjacent public rights-of-way by various types of gates and fencing.

In addition to the major and minor structures enumerated above, the DMC contains other basic repetitive structures distributed throughout its span like ubiquitous steel utility ladders secured to both the left and right embankment interiors.

Deterioration and cracking regularly occurs along the concrete canal lining as well as erosion along the compacted-earth segments. As part of the life cycle of the canal, these conditions are routinely addressed by Friant Water Authority (FWA) O&M staff, who replace and repair concrete panels and repair earth-lined segments.

California (CVP), "Delta-Mendota Canal Subsidence Correction Project: Typical Riprap Lined Section," Drawing No. DMC1-C-035, September 29, 2021

[5] USDI, Reclamation, *Designer's Operating Criteria*, 1971: 4-5, 26; Grimsley, J. O. and M. L. Barmettlor, *Condition of Major Irrigation Structures and Facilities*, Region 2, 1970, Appendix I – 3, 6.



Photograph 15: View of embankment and maintenance road from approximately M.P. 111.28; camera facing downstream from left bank, June 14, 2022 (C0489).



Photograph 16: View of embankment and maintenance road from approximately M.P. 89.56; camera facing downstream from left bank, June 14, 2022 (C0360).



Photograph 17: View of embankment and maintenance road from approximately M.P. 24.89; camera facing downstream from left bank, May 11, 2022 (A00498).

Table 2: DMC Lining Sections[6]

Milepost Span	Lining Material	Base Width	Side Slope	Depth*	Alterations
0.19 – 0.85	Earth	100	3:1	14.25*	None known
0.87 – 2.52	Earth	66	3:1	16.81*	None known
3.50 – 13.66	Concrete	48	1 ½:1	19.58	Canal lining raised on right and left banks approximately 18 inches in 1965
13.70 – 20.62	Concrete	48	1 ½:1	19.37	Canal lining raised on right and left banks approximately 18 inches in 1965
20.66 – 34.41	Concrete	48	1 ½:1	19.17	Canal lining raised on right and left banks approximately 18 inches in 1965
34.45 – 54.4	Concrete	48	1 ½:1	18.96	Canal lining raised on right and left banks approximately 18 inches in 1965
54.44 – 69.00	Concrete	48	1 ½:1	18.75	Canal lining raised on right and left banks approximately 18 inches in 1965
69.00 – 69.25	Concrete	48	1 ½:1	19.25	Canal lining raised on right and left approximately 24 inches in 1965
69.25 – 69.99	Concrete	48	1 ½:1	19.00	Canal lining raised on right and left banks approximately 18 or 24 inches in 1965
70.04 – 85.08	Concrete	48	1 ½:1	15.75	Canal lining possibly raised sometime after 1970
85.10 – 98.62	Concrete	48	1 ½:1	15.54	Canal lining possibly raised sometime after 1970
98.64 – 111.55	Earth	62	2 ½:1	15.40	None known
111.55 – 114.05	Earth	84	2 ½:1	15.40	None known
114.05 – 116.61	Earth	60	2 ½:1	15.40	None known

1. Conveyance Structures

Siphons

Siphons are enclosed structures placed along the canal where the water must be conveyed under a linear feature such as a waterway, roadway, or railroad. The water enters the siphon, passes under the linear feature by force of gravity, and flows back into the canal on the other side. There are 13 extant siphons along the DMC.

Table 3 lists the siphons by DMC segment number as presented in the Linear Feature Records below.

1. Table 3: Geographic Distribution of DMC Siphons

DMC Segment No.	Siphon Totals	Percent of Totals
1	2	15.39%
2	2	15.39%
3	2	15.39%
4	1	7.69%
5	0	--
6	0	--

* Depth refers to depth of excavation, except in non-compacted, loose earth sections of the Delta-Mendota Intake Canal

[6] All measurements in feet. Dimensions, mileposts, and alterations derived from 1959 Technical Records of Design and Construction, 1985, 1992, and 2020 Structures Inventories, historic and modern engineering drawings, and 2022 field survey.

7	1	7.69%
8	0	--
9	0	--
10	1	7.69%
11	0	--
12	1	7.69%
13	0	--
14	0	--
15	0	--
16	1	7.69%
17	0	--
18	0	--
19	0	--
20	1	7.69%
21	1	7.69%
22	0	--
Total	**13**	**100%**

While individual siphon lengths and slopes are determined principally by the surrounding topography, their basic designs are generally uniform, with only slight dimensional or structural variation. Siphons begin at an inlet transition where the canal walls narrow and gradually shift from sloped to vertical at the siphon inlet headwall. The height of each headwall varies, depending on the natural topography around the canal but generally ranging between approximately 23-30 feet tall. The width of each headwall likewise varies depending on the natural topography as well as the number and type of barrels. Of the thirteen siphons, twelve are multiple-barrel siphons composed of either three or four concrete barrel boxes. The only single-barrel siphon is composed of a cylindrical, monolithic concrete barrel. Most multiple-barrel siphons have barrels that are either 16-by-16-feet or 12-by-16-feet (**Photograph 18** - **Photograph 21**). The exceptions include the Byron Bethany Road and Del Puerto Creek siphons. The former has three barrel boxes that are 13 feet and 6 inches by 20 feet while the latter has three barrel boxes that are 15 feet and 6 inches by 15 feet and 6 inches. The Mountain House Road Siphon's single, cylindrical barrel that is 24 feet and 3 inches in diameter (**Photograph 22** - **Photograph 23**). The underground barrels convey the canal's flow to outlet transitions, which are approximately the same size as their respective inlet transitions, and from there the canal walls widen and revert from vertical to sloped. See **Table 4** for quantities and proportions among the different barrel groups.[7] As it is comprised entirely of unaltered original structures, the DMC siphon population retains a high degree of historic integrity of design, materials, workmanship, setting, location, association, and feeling.

2. Table 4: Dimensional Variation Among Siphon Barrel Groupings

Type	Siphon Totals	Percent of Total	Photographic Reference
Single-barrel	1	7.69%	Photograph 22 - Photograph 23
Three-barrel	8	61.54%	Photograph 18 - Photograph 19
Four-barrel	4	30.77%	Photograph 20 - Photograph 21
Total	**13**	**100%**	

[7] Bureau of Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction* (Denver, Colorado: Central Valley Project – California, June 1959), 59-65.

The above table does not include the siphon undercrossings, which transport preexisting waterways under the DMC. For a detailed discussion of these, see the "Siphon Undercrossings" typology discussion on the Continuation Sheet below.



Photograph 18: 3-barrel siphon inlet at M.P. 13.69; camera facing downstream from left bank, May 10, 2022 (A0039).



Photograph 19: 3-barrel siphon outlet at M.P. 79.72; camera facing upstream from right bank, June 14, 2022 (C0293).



Photograph 20: 4-barrel siphon inlet at M.P. 51.18; camera facing downstream from left bank, May 13, 2022 (A00940).



Photograph 21: 4-barrel siphon outlet at M.P. 16.34; camera facing upstream from left bank, May 10, 2022 (B00002).



Photograph 22: Mountain House Road Siphon's inlet headwall at M.P. 4.41; camera facing downstream from left bank, May 9, 2022 (A00216).



Photograph 23: Mountain House Road Siphon's outlet headwall at M.P. 4.49; camera facing upstream from left bank, May 9, 2022 (A00220).

2. Regulating Structures

Check Structures

There are 21 check structures along DMC. These check structures placed across the canal control the flow and depth of water in the upstream section of the canal. They are generally used to raise the water level in the canal in order to divert flow through lateral headgates on the upstream side, or to stop the flow of water further down the canal. All are either trapezoidal in cross section (**Photograph 24**) or rectangular in cross section (**Photograph 25**). Please see Linear Feature Records below for descriptions of each check structure.[8]



Photograph 24: Check No. 16 at M.P. 85.09; camera facing downstream from left bank, June 14, 2022 (C0333).



Photograph 25: Check No. 11 at M.P. 58.28; camera facing downstream from left bank, June 13, 2022 (C0084).

[8] Bureau of Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction*, 59-63; Bureau of Reclamation, "Concrete Checks," specification, on file at Reclamation Design Construction Library (1948).

3. Common Appurtenant Features

Check Buildings

There are currently 21 extant check buildings along the DMC. These structures house measuring and control equipment to regulate the flow of water through turnouts, wasteways, and check structures to provide consistent and accurate delivery of water to users. Each segment recorded on the Linear Feature Records has one check building. These masonry buildings are located on the left bank adjacent to its associated check structure (**Photograph 28**). Installation of the check buildings began in 1966 when a remote control-telemetering system was installed to control canal flows between the Tracy Pumping Plant and the O'Neill Pumping Plant. The equipment inside check buildings replaced the need for a worker to be stationed at check structures 24 hours a day, 7 days a week to manually monitor water levels and operate the gates and the buildings protect this equipment from the weather, particularly the extreme heat in summer and high humidity in winter.[9]

Built after the initial period of DMC construction (1947-1951), the population of check buildings consists of a single type, constructed of rusticated concrete blocks (**Photograph 26** and **Photograph 27**). These buildings are generally of the same standard design with slight dimensional or structural variation. All concrete-block check buildings have rectangular plans with a metal door and flat or slightly slanted roof. Concrete-block check buildings typically measure 6 feet x 8 feet.



Photograph 26: Check building at Check No. 1; camera facing northwest, May 10, 2022 (A00343).



Photograph 27: View of rusticated concrete block construction of check building at Check No. 2; camera facing northeast, May 10, 2022 (A00451).

[9] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, September 1971: 27-28.



Photograph 28: View of check building (left) in relation to associated check structure (Check No. 3, right) with a stilling well in the foreground (bottom right), May 10, 2022 (B00084).

Stilling Wells

There are 41 stilling wells along the length of the DMC. These features were originally installed in 1966, along with the check buildings, as part of a remote control-telemetering system used to control canal flows between the Tracy Pumping Plant at M.P. 2.53 and O'Neill Pumping Plant near the O'Neill/Volta Forebay facilities at M.P. 69.30. Stilling wells were installed close to the upstream and downstream ends of all check structures (**Photograph 29**). An exception to this is Check No. 1, which only has one stilling well associated with it, on the downstream side. The stilling wells are equipped with telemeter transmitters (digital encoders) and are located upstream and downstream at each check structure to provide water level indication. High and low water level alarm contacts are contained in the stilling wells. To prevent false readings or operations resulting from condensation on transmitter equipment, heater strips are provided in the encoder housings at the stilling wells.[10]

All stilling wells are short, concrete cylinders measuring 42-inches in diameter. Access to the equipment inside is gained through a metal hatch on the top (**Photograph 30**). These wells are set down the bank, close to the top of the canal lining, with a short span of metal-pipe handrailing between the well and the canal. If the bank is sloped there is a set of concrete steps with a metal pipe handrail leading from the road to the well. The vast majority (36 out of 41) are located on the left bank, but five of the stilling wells at the southern end of the canal are located on the right bank.

[10] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, September 1971: 2, 27-28.



Photograph 29: View of stilling well upstream of Check No; camera facing downstream from left bank June 13, 2022 (C0200).



Photograph 30: View of stilling well, access hatch, and stairs to access the stilling well from the road; camera facing upstream from left bank, May 11, 2022 (A00482).

Wasteways

There are five wasteway structures along the DMC that regulate the flow of water from the canal into creeks and rivers (**Photograph 31** - **Photograph 32**). These structures are usually used for one of two purposes, either to protect the canal from overtopping or dewater the canal system below in case of an emergency or for scouring out silt deposited in the canal above. Four of the wasteways (Westley, Newman, Volta, Firebaugh) are channels that receive water by radial gate turnouts from DMC and convey it one to six miles to the San Joaquin River. The other wasteway is an overspill apron on the right bank of the canal. Please see Linear Feature Records below for descriptions of each wasteway.[11]



Photograph 31: Newman Wasteway inlet structure; camera facing upstream from left bank, May 13, 2022 (A00994).



Photograph 32: View of Firebaugh Wasteway, showing where the stilling well transitions into the earth-lined canal; camera facing downstream from right bank, June 14, 2022 (C0484).

[11] Bureau of Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction*, 65, 70-76.

Turnouts

The DMC has 277 turnouts distributed throughout its course between M.P. 1.05 and 109.45. Turnouts are structures along the canal bank that divert and regulate water from the DMC to various water users. These facilities are operated by designated water and irrigation districts and other official users. See **Table 5** for the number of turnouts along each DMC segment as presented in the Linear Feature Records below. The following typology discussion does not attempt to provide an exhaustive inventory of DMC turnouts, but rather to give an overview of the historic and modern structural types and subtypes as observed during the current survey recordation and as compared with the historical record.

Table 5: Geographic Distribution of DMC Turnouts

DMC Segment No.	Turnouts Totals	Percent of Total
1	17	6.14%
2	15	5.42%
3	18	6.50%
4	12	4.33%
5	19	6.87%
6	16	5.78%
7	14	5.05%
8	18	6.50%
9	14	5.05%
10	13	4.69%
11	13	4.69%
12	12	4.33%
13	18	6.50%
14	10	3.61%
15	12	4.33%
16	13	4.69%
17	15	5.42%
18	14	5.05%
19	10	3.61%
20	4	1.44%
21	0	--
22	0	--
Total	**277**	**100%**

The original turnout population consists almost entirely of concrete barrel types (**Photograph 33** - **Photograph 34**). The forms of these barrel-type turnouts slightly vary but overall follow a standard design. The openings and water conduits are either box-shaped or round and vary in size from three to five feet in cross section. The openings are covered by metal grates or trash racks, which are typically angled to match the slope of the canal's walls but sometimes stand vertically. Just inside the openings, vertical or sloping lift gates slide up and down to control the flow of water into the concrete pipe and through the canal banks. A concrete hoist equipment deck sits above the gates, usually on the sloping canal bank just above its concrete lining, and concrete steps with a metal-pipe rail often provide access from the top of the levee while a similar metal railing lines the deck canal edge. Approximately 3-foot-tall cast-iron gate-hoist mechanisms to raise and lower the gates are mounted on the deck. Most have manual gear wheels on top. The bulk of these structures retain their original design features, but there

are some common alterations throughout the population (**Photograph 35**). The most common has been replacing the manual gate-hoists with automatic electronic gate-operating systems (**Photograph 36**).[12]

Some turnouts have been added along the DMC since its initial period of construction. Most of these structures have been constructed in accordance with Reclamation's original design specifications, following the basic form of concrete construction and vertical lift gates (**Photograph 37**), though some consist two or three barrels (**Photograph 38 - Photograph 39**). Additionally, some new turnouts consist of a basic steel pipe extending either through or over the canal lining (**Photograph 40**).[13]



Photograph 33: Concrete pipe turnout along the right bank at M.P. 49.56, showing the original, manual gate-hoisting equipment; camera facing from left bank, May 13, 2022 (A00911).



Photograph 34: Concrete pipe turnout along the left bank at M.P. 23.81, showing a slight variation from the turnout in **Photograph 33**; camera facing downstream from left bank, May 11, 2022 (A00465).

[12] Bureau of Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction*, 78; Bureau of Reclamation, "Concrete Pipe Turnouts," specification, on file at Reclamation Design Construction Library, (1948); Bureau of Reclamation, "18" Dia. Screw Lift Vertical Wedge Gate," specification, on file at Reclamation Design Construction Library, (1948); Bureau of Reclamation, "24" Dia. Screw Lift Vertical Wedge Gate," specification, on file at Reclamation Design Construction Library, (1948); Bureau of Reclamation, "Lateral Turnout," specification, on file at Reclamation Design Construction Library, (1946);

[13] Bureau of Reclamation, "Turnouts Along Delta-Mendota Canal" (n.d.).



Photograph 35: An original turnout that has been altered by a replacement screen at M.P. 38.14 (foreground) and an original concrete pipe turnout along the left bank at M.P. 38.15 (background) along left bank; camera facing downstream from the left bank, May 12, 2022 (B00289).



Photograph 36: Concrete pipe turnout altered by the addition of an automatic, electronic gate-operating system along the right bank at M.P. 61.37; camera facing from left bank, June 13, 2022 (C0118).



Photograph 37: An original turnout altered by the addition of an automatic, electronic gate-operating system (left) and a modern turnout (right) along the right bank at M.P. 90.53; camera facing from left bank, June 14, 2022 (C0365).



Photograph 38: Modern, two-barrel concrete pipe turnout along right bank at M.P. 78.56; camera facing from left bank, June 14, 2022 (C0270).



Photograph 39: Modern, three-barrel concrete pipe turnout along right bank at M.P. 81.08, camera facing left bank, June 14, 2022 (C0304).



Photograph 40: Modern overlining turnout along right bank at M.P. 81.80; camera facing southwest, June 14, 2022 (C0310).

4. Protective Structures

Overchutes

Overchutes are structures that carry water from larger streams and drainages over the DMC to prevent erosion and damage to the canal bank. There are 13 structures on the DMC identified as overchutes. They consist of an open concrete flume with flat bottoms and vertical sides that extends across the canal and concrete inlet and outlet structures constructed on the exterior sides of the canal's banks (
Photograph 41). They are designed so that the bottom of the concrete box sits above the canal's full water elevation. Most are reinforced with concrete crossbeams, but two of the thirteen are not (
Photograph 42 - **Photograph 43**). Outlets often have a stilling basin or riprap to prevent erosion (**Photograph 44**).[14]

[14] Bureau of Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction*, 78, 80-81; Bureau of Reclamation, "Quinto Creek Overchute," specification, on file at Reclamation Design Construction Library, (1948); Bureau of Reclamation, "Romero Creek Overchute: Inlet and Flume," specification, on file at Reclamation Design Construction Library, (1948); Bureau of Reclamation, "Quinto Creek Overchute: Outlet," specification, on file at Reclamation Design Construction Library, (1948).



Photograph 41: Concrete overchute at M.P. 7.25 looking downstream; camera facing downstream from left bank, May 9, 2022 (A00253).



Photograph 42: Overchute at M.P. 21.91, showing the reinforced box; camera facing right bank from left bank, May 10, 2022 (B00127).



Photograph 43: Overchute at M.P. 78.59, showing the unreinforced box; camera facing right bank from left bank, June 14, 2022 (C0275).



Photograph 44: Outlet of overchute at M.P. 66.70, with riprap to guard against erosion; camera facing right bank from left bank, June 13, 2022 (C0171).

Inlet Drains

Inlet drains are structures built into the canal wall that allow water to drain into the canal. The DMC currently includes several hundred inlet drains distributed throughout its span. All the DMC inlet drains, originally referred to as "drainage inlets" intercept and channel storm runoff from surrounding drainage areas for release into the canal. The following typology discussion does not attempt to provide an exhaustive inventory of DMC inlet drains, but rather to give an overview of the historic and modern structural types and subtypes as observed during the current survey recordation and as compared with the historical record.

The original population of inlet drains was principally comprised of reinforced concrete structures and, in general, one of two types, free-flowing or flap-gate. Free-flowing inlet drains were designed to drain areas that sit level or above the canal's designed water level. They typically consist of precast concrete pipes or concrete box-culverts that project from the top edge of the canal lining (**Photograph 45** - **Photograph 46**). Flap-gate inlet drains were designed to drain areas that sat at or below

the expected average operating water level but above its maximum designed water level. They typically consist of concrete box-culverts that pierce through the canal and metal flap gates that open to allow drainage into the canal but mostly remain closed to prevent reverse flow (**Photograph 47 - Photograph 48**). The number of flap gates varies between one and three. As with other minor appurtenant water conveyances, the dimensions of both types varied in consideration of the surrounding topography.[15]

Since its initial construction, the population of DMC inlet drains has been somewhat modified by alterations to the original structures or the addition of new types of inlet drains. Typical alterations included replacing the flap gates on a box-culvert type (**Photograph 49**), rebuilding a deteriorated concrete box-culvert (**Photograph 50**), replacing a deteriorated precast concrete pipe with a corrugated metal pipe (CMP), and deleting original flap-gate inlet drains (**Photograph 51**). Most new types of inlet drains were simple, unadorned corrugated metal pipes embedded in the embankment for discharge into the canal (**Photograph 52**). As with the original structures, these CMPs came in varying sizes, sometimes comprising multiple pipes. While basic CMP structures comprise the majority of new additions to the inlet drain population during this period, a few additional concrete structures were likewise added. Some of these drains resembled earlier reinforced concrete structures, as they feature sidewalls, and are built directly into the canal lining (**Photograph 53**). They are likewise outfitted with CMPs.



Photograph 45: Free-flowing inlet drain along the right bank at M.P. 67.66; camera facing from left bank, June 14, 2022 (C0349).



Photograph 46: Free-flowing inlet drain along the right bank at M.P. 77.58; camera facing from left bank, June 14, 2022 (C0261).

[15] Bureau of Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction*, 78, 83-85; Bureau of Reclamation, "Concrete Drainage Inlet," specification, on file at on file at Reclamation Design Construction Library (1946).



Photograph 47: Triple flap-gate inlet drain along the right bank at M.P. 76.64; camera facing from left bank, June 14, 2022 (C0253).



Photograph 48: Flap-gate inlet drain along the right bank at M.P. 76.64; camera facing from left bank, June 14, 2022 (C0253).



Photograph 49: Altered flap-gate inlet drain along the right bank at M.P. 8.01; camera facing from left bank, May 9, 2022 (A00266).



Photograph 50: Altered flap-gate style, concrete inlet drain along the right bank at M.P. 33.88; camera facing from left bank, May 11, 2022 (A00699).



Photograph 51: Deleted flap-gate inlet drain along the right bank at M.P. 20.71; camera facing from left bank, May 10, 2022 (B00070).



Photograph 52: CMP shoulder drain along the right bank at M.P. 7.29; camera facing from left bank, May 9, 2022 (A00258).



Photograph 53: Modern inlet drain along the right bank at M.P. 28.53; camera facing from left bank, June 14, 2022 (C0472).

5. Miscellaneous

Bridges

There are 120 extant bridge crossings associated with the DMC, including three (3) roadways located above sites where the canal is siphoned underground and 16 bridges constructed after the period of significance, post-1958, as replacements of existing bridges or to establish a bridge crossing where there was none[16]. This total does not include four pairs of bridge abutments where bridges have been demolished, but not replaced. As originally designed and constructed, the DMC included four distinct bridge types: Railroad Bridges, State Highway Bridges, County Highway Bridges, and Miscellaneous Bridges, which included Operating Bridges, Farm Bridges, and County Road Bridges. The only Railroad Bridge associated with the

[16] The three crossings over siphons included in the bridge population are identified as such because they are categorized as bridges within the *DMC Structures List* (2020).

DMC is located on the Westley Wasteway. Because this bridge is not located on the DMC itself, it is not included in the population of DMC bridges, however it is discussed in detail within the Linear Feature Record for DMC segment 6. Each of the original bridge types are still in use along the DMC, although Miscellaneous Bridges have since been reclassified as Farm Bridges or Operating Bridges, and County Road Bridges have been reclassified as County Highway Bridges. Bridges have also been raised in those concrete-lined sections of the DMC where the lining was raised, in the 1960s and 1970s. Most timber bridges crossing the canal were rehabilitated between 1964-70, by replacing their timber piers with concrete piers, while a few bridges were rehabilitated later in 1977.[17] The following discusses bridge typologies, sub-typologies, and common appurtenant features along the DMC as observed during the current survey recordation and as compared with the historical record. See **Table 6** for an inventory of bridge types appurtenant to the DMC.

Table 6: DMC Bridge Inventory

Bridge Type	Total	% of Total
County Highway Bridge	57	47.50
Farm Bridge	33	27.50
Operating Bridge	10	8.33
State Highway Bridge	4	3.33
Post-1958 Bridge	16	13.34
Total	120	100.00

County Highway Bridges

County Highway Bridges are the most prevalent of the bridge types appurtenant to the DMC, totaling 57 bridges or a plurality of about 47.50% of all bridges included in this inventory. The County Highway Bridge type may be further divided into five subtypes:

- Concrete Bridges with concrete piers or bents, totaling 47 or about 82.46% of all County Highway Bridges
- Wasteway Crossing Bridges integrated into forebay structure, totaling 4 or 7.02% of population; and
- Timber Bridges with replacement concrete piers, totaling 3 or 5.26% of population; and
- Roads crossing siphons, totaling 2 or about 3.51% of population; and
- A single Timber Bridge with timber bents, about 1.75%

Concrete Bridges make up the majority of the County Highway Bridge population. All County Highway Bridges were designed according to the "Standard Specifications for Highway Bridges," published by the American Association of State Highway Officials (AASHO). The Concrete Bridges all have concrete decks covered by asphalt-paved road, measuring from 16-feet-wide to 40-feet-wide, through the vast majority measure 24- or 20-feet-wide (**Photograph 54** and **Photograph 55**). Bridges of this subtype are all supported, as originally designed, by concrete piers or bents: sets of solid-type piers and sets of square, multi-columned bents (**Photograph 54** and **Photograph 56**). Most of the bridges located in the concrete-lined sections of the canal are supported by two piers or bents, while bridges located in the earth-lined and earth sections are supported by a set of three bents (**Photograph 57**). The exception to this is the bridge at M.P. 68.03, which is supported by three concrete solid-type piers (**Photograph 58**). Most of these Concrete County Highway Bridges were originally designed with, and retain, metal guard-rails secured to wooden posts embedded in the concrete curbs. Once again, an exception to this is the bridge at M.P. 68.03, which has concrete parapet walls integrated into the deck construction with short spans of steel guard-railing

[17] USDI, Reclamation, *Designers' Operating Criteria, Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 26; Structures List, 2000.

extending from both ends (**Photograph 58**). Generally, bridges in this subtype retain strong historic integrity of design, materials, workmanship, setting, location, association, and feeling.

Wasteway Crossing bridges are the second most common County Bridge subtype. Although these bridges are not included in the *DMC Structures List*, they are maintained by the County and thus included in the County Highway Bridge population for the purpose of this survey. These four bridges are integrated into the forebays of the Westley Wasteway at M.P. 34.32, the Newman Wasteway at M.P. 54.38, the San Luis Wasteway at M.P. 69.98, and the Firebaugh Wasteway at M.P. 111.22. They have concrete decks measuring approximately 20 feet wide x 120 feet long, supported by a single concrete pier that also divides the two bays of the inlet structures. Their abutments are the walls of the intake forebasy. All of these bridges have metal-pipe handrails, though the bridge at the Firebaugh Wasteway is outfitted with chain-link fencing in addition to these handrails (**Photograph 59** and **Photograph 60**).

The Timber Bridges are the third most common County Highway Bridge subtype. As discussed above, all County Highway Bridges were designed according to specifications drafted by the AASHO, and these Timber Bridges conform to the original design for County Road Bridges for two lanes of H15 loading.[18] These three timber bridges, located at M.P. 62.09, 72.33, and 77.63, were all rehabilitated in 1965-6, at which time the timber members of their decks were replaced, as needed, and the original timber bents were removed and replaced with sets of three solid-type concrete piers (**Photograph 61**). They have retained their timber decks, which measure 18- to 20-feet-wide. For a detailed discussion of the Farm Bridges' attributes, see discussion of "Farm Bridges" below.

This bridge type is comprised of two (2) roadways that traverse DMC siphons. The siphon crossing are asphalt paved roads that run across DMC siphons. The first is at M.P. 23.99, where Blewett Road crosses the DMC (**Photograph 62**). The second is at M.P. 110.99, where State Highway 33 crosses the DMC (**Photograph 63**).

The last subtype consists of a single Timber Bridge supported by timber bents (**Photograph 64**). This bridge is located at M.P. 0.33 along Lindemann Road, adjacent to the Tracy Fish Facility. The deck measures 28 feet wide. It has timber curbs and no handrails, but chain-link fence is secured to both sides along the full length of the deck. This is the only bridge within the whole DMC bridge population to retain its timber bents.

Farm Bridges

The second most prevalent bridge type appurtenant to the DMC is the Farm Bridge, totaling 33 bridges or approximately 27.50% of all bridges included in this inventory. As the DMC traversed vast agricultural acreage throughout its span, Farm Bridges were designed and constructed to allow adjacent farmers continued access to lands that construction of the DMC had bifurcated. Originally, virtually the entire Farm Bridge population was designed by Reclamation as standard timber bridges, with specifications similar to the original timber county road bridges. Their design included wood-plank decks, timber bents, and reinforced concrete abutments. A rehabilitation project from 1964-1970 replaced timber members of the decks, as needed, and replaced all timber bents with solid-type concrete piers. Two bridges within the Farm Bridge population were rehabilitated in 1977.[19] As a result, the modern DMC Farm Bridge type may be divided into three subtypes:

- Farm Bridges with replacement solid-type concrete piers that have retained their timber decks, totaling 29 or about 87.88% of all Farm Bridges;
- Farm Bridges with replacement concrete bents and timber-decks, totaling 3 or 9.09% of the population; and
- a single Farm Bridge with replacement concrete piers and replacement concrete deck, about 3.03%.

The majority of Farm Bridges are those that have retained their timber decks, which measure between 16-feet-wide and 30-feet-wide and are supported by three replacement solid-type concrete piers (**Photograph 65**). The exception to this is the

[18] *Delta-Mendota Canal-Station 2588+40.4, County Road Bridge*, Drawing No. 24, 214-D-15874
[19] USDI, Reclamation, Central Valley Project – California (CVP), "Delta Mendota Canal-Sta.4128+25, Timber Farm Bridge and 20" Irrigation Crossing" dwg. no. 214-215-4149, [date illegible]; USDI, Reclamation, *Designers' Operating Criteria, Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 26; Structures List, 2000.

bridge at M.P. 15.10, the deck of which measures 12 feet wide and is supported by four concrete piers (**Photograph 97**). Originally outfitted with timber handrails many Farm Bridges of this subtype have been subsequently modified by the installation of modern steel guard-railing (**Photograph 65**). A few bridges still retain their timber handrails, but these have been reinforced by the addition of modern steel guard-rails (**Photograph 66**). The timber handrails on one bridge, at M.P. 13.96, have been doubly reinforced by the addition of corrugated steel sheets and modern steel guard-railings **(Photograph 67**). There are also other bridges that do not possess any handrails, only wooden beam curbs, such as those at M.P. 85.47, 88.62, 90.91, 92.73, 95.45 (**Photograph 68**). The bridge at M.P. 93.24 has only one handrail, a modern steel guard-raid, on the upstream side (**Photograph 69**). A fire damaged bridge at M.P. 9.87, which has been cordoned off, still retains one of its original timber handrails (**Photograph 70**).

The second subtype of Farm Bridges also retain their timber decks, but they are supported by five concrete bents, square beams supported by multiple square columns. Two of these bridges, at M.P. 99.82 and M.P. 105.55, both of which were rehabilitated in 1969, measure 20-feet-wide and do not possess any handrails (**Photograph 71**). The bridge at M.P. 100.85, which measures 30-feet-wide, is outfitted with modern steel guard-rails (**Photograph 72**). The date of rehabilitation of this bridge is unknown.

The last subtype among the Farm Bridge population consists of a single Farm Bridge with replacement concrete deck and replacement concrete supports, located at M.P 98.74. The deck of this bridge is 30-feet-wide, supported by five square, multi-columned bents. It does not possess handrails of any kind (**Photograph 73**).

Operating Bridges

There are ten (10) Operating Bridges, or roughly 8.33% of all bridges included in this inventory. Operating Bridges comprise a small population of crossings for maintenance purposes, of which there are four subtypes:

- Timber Operating Bridges, totaling seven (7) or about 70.00% of this population;
- a single Concrete Operating Bridge crossing Del Puerto Creek, about 10.00%; and
- a single Siphon Crossing at Los Banos Creek, about 10.00%; and
- a single Wasteway Intake Bridge crossing the open intake channel to the O'Neill Pumping Plant, about 10.00% of this population.

The most common subtype among this population are the Timber Operating Bridges, which were designed according to similar specifications as the original timber farm and county road bridges. Located at the sites of appurtenant waterway crossings, three bridges of this subtype have 16-foot-wide timber decks, two have 20-foot-wide decks, and one has a deck 30-feet-wide (**Photograph 74, Photograph 75,** and **Photograph 76**). Individual lengths are determined by the width of the traversed waterway. A rehabilitation project from 1964-1970 replaced timber members of the decks, as needed, and replaced all timber bents with solid-type concrete piers (**Photograph 77**). All seven (7) of these bridges were rehabilitated in 1965-6. Every bridge of this subtype has replacement steel guard-railing, with the original timber railing removed at an unknown date (**Photograph 75**).[20] For a detailed discussion of the Farm Bridges' attributes, see discussion of "Farm Bridges" above.

The single Concrete Operating Bridge is located at M.P. 37.28, where it crosses Del Puerto Creek, adjacent to the siphon at this location (**Photograph 78**). This bridge has a concrete deck supported by concrete two bents. For a detailed discussion of the Concrete Operating Bridge, see Linear Feature Record for DMC Segment 7.

Another subtype is the roadway traversing the DMC siphon at Los Banos Creek, located at M.P. 79.69 (**Photograph 79**). This structure replaced the original Timber Operating Bridge at this location which carried the O&M road over the creek and siphon. Reportedly, the timber bridge burned and was replaced with a three-barrel corrugated metal pipe (CMP) arch culvert in the

[20] USDI, Reclamation, Central Valley Project – California (CVP), "Delta Mendota Canal-Sta.3535+75, Timber Operating Bridge" dwg. no. 214-D-16002, ca. 1949; USDI, Reclamation, *Designers' Operating Criteria, Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 26; *2020 Structures List*.

late 1970s, with additional modifications in the late-1990s and 2010s.[21] For a detailed discussion of the Los Banos Creek Siphon Crossing, see Linear Feature Record for DMC Segment 16.

The final subtype consists of a single bridge that spans the entrance to the open intake channel at M.P. 69.30, which leads to the O'Neill Pumping Plant and Reservoir (**Photograph 80** and **Photograph 81**). This bridge is concrete, and its deck measures approximately 20 feet wide x 135 feet long. It is supported by a single concrete solid-type pier in the center of the span and has metal guard-rails secured to timber posts embedded in concrete curbs. For a detailed discussion of the Wasteway Intake Operating Bridge, see Linear Feature Record for DMC Segment 13.

State Highway Bridges

State Highway Bridges comprise four (4) structures, or roughly 3.33% of all bridges included in this inventory and have no subtypes. These bridges (originally called "Highway Bridges") were designed according to AASHO standards for an H 20-S 16-44 loading, which called for concrete slab and beam construction with abutments and piers of reinforced concrete on spread footings.[22] Consequently, they feature wider roadways on average, typically measuring 26-feet-wide (**Photograph 82**). State Highway Bridges were originally designed with metal guard-rails, however, all but one State Highway Bridge at M.P. 71.31 (**Photograph 83**) has had their historic railings replaced with concrete parapets at an unknown date (**Photograph 84**). Some of the parapet walls have had metal-pipe railings or fencing added to them (**Photograph 82** and **Photograph 85**). All of the State Highway Bridges are supported by a pair of concrete solid-type piers.

Non-Original Bridge Types

The remainder of the DMC bridge population consists of 16 bridge crossings constructed after 1958 (the end of the period of significance) either to replace existing bridges or to establish a bridge crossing where there was none. This is roughly 13.34% of all bridges included in this inventory. Four (4) replacement County Highway Bridges, at M.P. 9.29, 10.28, 10.62, and 39.81, have concrete decks measuring 30-feet-wide with parapet walls, large abutments and no support piers (**Photograph 86**). The old abutments and footings of the demolished bridges are still present at these locations. Two (2) more replacement County Road Bridges, at M.P. 29.93 and 34.39, have concrete decks measuring 24-feet-wide, supported by three concrete solid-type piers, with steel guard-rails (**Photograph 87**). These two bridges were rebuilt by the County in 1965.

Also in 1965, seven (7) State Highway Bridges were built for Route 132 and Route 5, using the AASHO design standards for an H20-S16-44 loading.[23] Unlike the original State Highway Bridge design, the concrete decks of these bridges are supported by steel stringers reinforced with interior steel trusses (**Photograph 88**). On five (5) of these bridges the deck extends beyond the stringer to abutments set further back in the embankment (**Photograph 89**). The decks of these bridges measure either 26-feet-side (two spans) or 50-feet-wide (4 spans). However, the abutments bridge for Interstate 5 at M.P. 72.80 sit right next to the canal lining and the stringers are embedded in the abutments (**Photograph 90**). At another bridge for Interstate 5, at M.P. 65.89, the abutments on the right bank sit directly next to the canal and support the stringers, while on the left bank, the stringer terminates at a monolithic concrete pier, while the deck extends over the O&M road adjacent to the canal and terminates at an abutment further up the embankment (**Photograph 91**). Both of these bridges have decks measuring 39-feet-8-inches-wide. All of these State Highway Bridges have steel-pipe handrails embedded in concrete curbs.

Two (2) replacement Farm Bridges, at M.P. 102.03 and 106.58, constructed in 2014 and 2004, respectively, have concrete decks that measure 22-feet-wide and 20-feet-wide, respectively, supported by five concrete bents, with steel guard-rails (**Photograph 92**). The last replacement bridge, constructed in 1998 to replace a Timber Operating Bridge, is located at M.P. 33.29, and has a timber deck, measuring 16-feet-wide, supported by three concrete piers, with modern steel guard-rails (**Photograph 93**).

[21] *Design Summary, Road Crossing Replacement at Los Banos Creek Check and Siphon*, 2001, 2; Google Earth
[22] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*, 1959: 88.
[23] USDI, Reclamation, *Designer's Operating Criteria*, 1971: 26

Common Appurtenant Features

Metal cattleguards are a common appurtenant feature to the DMC Farm Bridge population. Reclamation adapted designs first employed along the Contra Costa Canal to accompany some Farm Bridges along the northern reaches of the DMC, where hilly ranchland surrounds the winding canal (**Photograph 94**). Cattle guards are simple structures, with each consisting of a shallow, concrete-lined, 12-foot x 8-foot depression in the roadway topped by a grid of steel pipe rails spaced approximately eight inches apart and secured by steel stringers. All cattle guards are flanked on either side by triangular metal sideguards (**Photograph 95**).

The other common feature among the whole DMC bridge population is pipe crossings, appended to bridges where they span the canal width. For a detailed discussion of pipe crossings, including those attached to bridge crossings, see typology discussion of "Pipe Crossings" in P3a. Description on Continuation Sheets.



Photograph 54: View of 20-foot-wide County Highway Bridge with concrete deck and solid-type concrete pier supports at M.P. 24.48 along Koster Road; camera facing downstream from left bank, May 11, 2022 (A00490).



Photograph 55: View of 30-foot-wide County Highway Bridge with concrete deck at M.P. 39.21 along Rogers Road; camera facing upstream from left bank, May 12, 2022 (B00336).



Photograph 56: Detail view of concrete bents supporting County Highway Bridge with concrete deck at M.P. 53.43 along Shiells Road; camera facing upstream from left bank, May 13, 2022 (A00979).



Photograph 57: View of 26-foot-wide County Highway Bridge with concrete deck supported by three (3) concrete bents at M.P. 105.03 in earth-lined section of DMC along Jerrold Avenue; camera facing upstream from left bank, June 14, 2022 (C0454).



Photograph 58: View of 24-foot-wide County Highway Bridge at M.P. 96.28 along McCabe Road, with three concrete piers and concrete parapet walls with metal guard-rail extensions on both ends; camera facing downstream from left bank, June 13, 2022 (C0178).



Photograph 59: Deck of Wasteway bridge at Newman Wasteway forebay, M.P. 54.38; camera facing downstream on left bank, May 13, 2022 (A00988).



Photograph 60: View of chain-link fence and metal-pipe handrails on Firebaugh Wasteway bridge at M.P. 111.22, as well as central pier and left abutment/wall of forebay; camera facing southwest, June 14, 2022 (C0485).



Photograph 61: View of County Highway Bridge with timber deck supported by three concrete piers at M.P. 72.33 along Hilldale Avenue; camera facing downstream from left bank, June 14, 2022 (C0243).



Photograph 62: View of Blewett Road crossing the DMC siphon at M.P. 23.99; camera facing upstream from left bank, May 11, 2022 (A00475).



Photograph 63: View of State Highway 33 crossing the DMC siphon at M.P. 110.99; camera facing upstream from left bank, June 14, 2022 (C0479).



Photograph 64: View of County Highway Bridge with concrete deck supported by timber bents, at M.P. 0.33 along Lindemann Road, next to the Tracy Fish Facility; camera facing upstream from left bank, May 9, 2022 (A00158).



Photograph 65: View of Farm Bridge at M.P. 12.31 with 16-foot-wide timber-deck, replacement concrete piers, and modern steel guard-rails; camera facing upstream from left bank, May 10, 2022 (A00365).



Photograph 66: Detail view Farm bridge with timber deck at M.P. 5.67, with its original timber handrails reinforced by the addition of modern steel guard-rails; camera facing west from the left bank, May 9, 2022 (A00232).



Photograph 67: Detail view of Farm Bridge with timber deck at M.P. 13.96, with its original timber handrails reinforced by the addition of corrugated steel sheets and modern steel guard-railings; camera facing southwest from left bank, May 10, 2022 (A00397).



Photograph 68: View of Farm Bridge with timber deck at M.P. 85.47, where original timber handrails have been removed and not replaced; camera facing downstream from left bank, June 14, 2022 (C0338).



Photograph 69: : View of Farm Bridge with timber deck at M.P. 93.24 which has only one modern steel guard-rail on the upstream side, but no handrail on the downstream side; camera facing downstream from left bank, June 14, 2022 (C0384).



Photograph 70: View of fire-damaged Farm Bridge at M.P. 9.87, with timber deck and timber railing on upstream side; camera facing southwest from left bank, May 9, 2022 (A00297).



Photograph 71: View of 20-foot-wide Farm Bridge at M.P. 99.82, with original timber deck supported by five replacement concrete bents, with no handrails; camera facing downstream from left bank, June 14, 2022 (C0428).



Photograph 72: View of 30-foot-wide Farm Bridge at M.P. 100.85, with original timber deck supported by five replacement concrete bents, with modern steel guard-rails; camera facing downstream from left bank, June 14, 2022 (C0436).



Photograph 73: View of 30-foot-wide Farm Bridge at M.P. 98.74, with replacement concrete deck supported by five replacement concrete bents, with no handrails; camera facing downstream from left bank, June 14, 2022 (C0422).



Photograph 74: View of 16-foot wide Timber Operating Bridge at M.P. 16.65 along with replacement concrete piers and modern steel guard-rails; camera facing upstream from left bank, May 10, 2022 (B00007).



Photograph 75: Detail view of Timber Operating Bridge with 20-foot-wide deck at M.P. 34.89, with modern steel guard-rails; camera facing west from left bank, May 12, 2022 (A00807)



Photograph 76: Detail view of Timber Operating Bridge with 30-foot-wide deck at M.P. 36.81, with steel guard-rails; camera facing west from left bank, May 12, 2022 (B00226).



Photograph 77: Detail view of replacement concrete piers on Timber Operating Bridge at M.P. 36.81; camera facing southwest from left bank, January 16, 1948 (B00225).



Photograph 78: View of Concrete Operating Bridge at M.P. 37.28 crossing over the Del Puerto Creek culvert; camera facing south from left bank, May 12, 2022 (B00257).



Photograph 79: View of Operating Bridge roadway traversing DMC siphon at Los Banos Creek, M.P. 79.69 along Raines Road; camera facing downstream from left bank, June 14, 2022 (C0280).



Photograph 80: View of open O'Neill forebay intake channel with bridge crossing it at M.P. 69.30; camera facing right bank from left bank, June 13, 2022 (C0189)



Photograph 81: View of bridge across open O'Neill forebay intake channel at M.P. 69.30; camera facing right bank from left bank, June 13, 2022 (C0190).



Photograph 82: View of 26-foot-wide State Highway Bridge at M.P. 6.6 along Old Highway 50, with replacement parapet walls with additional metal-pipe railing on top; camera facing upstream from left bank, May 9, 2022 (A00245).



Photograph 83: View of State Highway Bridge at M.P. 71.31 along Jensen Road / State Route 207, with original steel guard-railing; camera facing downstream from left bank, June 13, 2022 (C0210).



Photograph 84: View of State Highway Bridge at M.P. 75.84 along State Highway 152, with replacement concrete parapet walls; camera facing upstream from left bank, June 13, 2022 (D2237).



Photograph 85: Detail view of State Highway Bridge at M.P. 7.67 along Interstate 205, with replacement concrete parapet walls with additional metal fencing on top; camera facing downstream from left bank, May 9, 2022 (A00261).



Photograph 86: View of replacement County Highway Bridge at M.P. 9.29, along International Parkway, with 30-foot-wide concrete deck, original piers and abutments visible just upstream of current bridge; camera facing downstream from left bank, May 9, 2022 (A00287).



Photograph 87: View of replacement County Road Bridge at M.P. 29.93, along McCracken Road, with 24-foot-wide concrete deck, supported by three concrete solid-type piers, and steel guard-railing; camera facing upstream from left bank, May 11, 2022 (A00612).



Photograph 88: Detail view of steel stringers and interior trusses on non-original (post-1958) State Highway Bridge at M.P. 22.73, along State Highway 5 Northbound; camera facing south from left bank, May 10, 2022 (B00165).



Photograph 89: View of non-original (post-1958) State Highway Bridge at M.P. 22.73, along State Highway 5 Northbound, with 50-foot-wide concrete deck supported by a steel stringer strung between two monolithic concrete piers, abutments further back in embankment; camera facing downstream from left bank, May 10, 2022 (B00162).



Photograph 90: View of non-original (post-1958) State Highway Bridge at M.P. 72.8, along Interstate 5 Westbound, 39-foot-8-inch-wide concrete deck on steel stringer strung directly between abutments; camera facing upstream from left bank, June 15, 2022 (D2206).



Photograph 91: View of non-original (post-1958) State Highway Bridge at M.P. 65.89, along Interstate 5, with steel stringers strung between the abutment on the right bank and a monolithic concrete pier on the left bank, while the deck extends over the O&M road adjacent to the canal and terminates at an abutment further up the embankment; camera facing upstream from left bank, June 13, 2022 (C0164).



Photograph 92: View of replacement Farm Bridge built in 2004 at M.P. 106.58, with 20-foot-wide concrete deck, supported by five concrete bents; camera facing downstream from left bank, June 14, 2022 (C0460).



Photograph 93: View of replacement Timber Operating Bridge, constructed in 1998, at M.P. 33.29, with a 16-foot-wide timber deck supported by three concrete piers, with steel guard-rails; camera facing downstream from left bank, May 11, 2022 (A00684).



Photograph 94: View of cattle guards (left) adjacent to Farm Bridge (right) at M.P. 13.96; camera facing downstream on left bank, May 10, 2022 (A00396).



Photograph 95: Detail view of cattle guard adjacent to Farm Bridge at M.P. 50.53; camera facing downstream on left bank, May 13, 2022 (A00927).

Pipe Crossings

The DMC currently includes 67 pipe crossings distributed throughout its span.[24] Pipe crossings transport or divert irrigation water, natural gas, oil, and fuel. The following typology discussion does not attempt to provide an exhaustive inventory of DMC pipe crossings, but rather to give an overview of the historic and modern structural types and subtypes as observed during the current survey recordation and as compared with the historical record.

[24] The DMC Structures List refers to pipe crossings as either irrigation crossings and utility crossings.

The original population of pipe crossings was principally comprised of thin-walled steel pipes ranging from 4 to 20 inches in diameter that moved irrigation water over the canal (**Photograph 96**). This population was originally referred to as irrigation crossings. Most are mounted on support piers rising from the canal, but some are mounted atop check structures or along the sides of bridges (**Photograph 97**). Typically, they consist of a single pipe but a few triple-pipe irrigation crossings span the DMC (**Photograph 98**). Additional pipe crossings for moving natural gas, oil, and fuel were installed either during or after the initial period of construction. This varying population was originally referred to as utility crossings. They, too, principally consist of steel pipes ranging from 18 to 26 inches (**Photograph 99**), and most are mounted on support piers rising from the canal while some are mounted within steel truss structures (**Photograph 100** - **Photograph 101**).[25]

Since its initial construction, the population of DMC pipe crossings has been modified by the addition of both metal and PVC pipes. All PVC pipe crossings were added at various dates and are typically attached to bridge curbs. Modern metal pipe crossings were added at various dates after the initial period of construction and typically follow Reclamation's original design specifications.



Photograph 96: Irrigation crossing at M.P. 101.27 (left), shown alongside a well discharge (right); camera facing right bank from left bank, June 14, 2022 (C0439).



Photograph 97: Irrigation crossing attached to the downstream side of bridge at M.P. 15.10; camera facing upstream from left bank, May 10, 2022 (A00426).

[25] Bureau of Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction* (Denver, Colorado: Central Valley Project – California, June 1959), 74, 77-78; Bureau of Reclamation, "16" Irrigation Pipe Crossing," specification, on file at Reclamation Design Construction Library (1949).



Photograph 98: Triple-pipe irrigation crossing at M.P. 90.57 (right); camera facing right bank from left bank, June 14, 2022 (C0370).



Photograph 99: Two oil utility crossings at M.P. 16.78; camera facing right bank from left bank, May 10, 2022 (B00009).



Photograph 100 Modern, high pressure oil utility crossing at M.P. 71.59; camera facing downstream from left bank, June 14, 2022 (C0237).



Photograph 101: Modern, gas utility crossing at M.P. 71.69, with abandoned oil utility crossing in the foreground; camera facing downstream from left bank, June 14, 2022 (C0238).

Siphon Undercrossings

There are 28 identified siphon undercrossings distributed throughout the DMC. Siphon undercrossings convey natural drainage channels and preexisting water courses underneath the DMC. All siphon undercrossings inventoried here, originally called "siphon crossings" in the *Delta-Mendota Canal Technical Record of Design and Construction* and alternately called "culvert crossings" or "siphon crossings" in the Delta-Mendota Canal Structures List, use gravity to carry established irrigation water conveyances under the canal. See

Table 7 for an inventory of the geographic distribution of siphon undercrossings as sorted by JRP-designated DMC segment numbers.

Table 7: Geographic Distribution of DMC Siphon Undercrossings

DMC Segment No.	Siphon Undercrossing Totals	Percent of Totals
1	5	17.9%
2	1	3.6%
3	0	--
4	0	--
5	0	--
6	1	3.6%
7	0	--
8	1	3.6%
9	1	3.6%
10	2	7.1%
11	3	10.7%
12	0	--
13	2	7.1%
14	2	7.1%
15	0	--
16	0	--
17	0	--
18	0	--
19	6	21.4%
20	4	14.3%
21	0	--
22	0	--
Total	**28**	**100%**

While individual siphon undercrossing lengths and slopes are principally determined by the surrounding topography, their standard designs are generally uniform, with only slight dimensional or structural variation. All the siphon undercrossings inventoried here are either steel pipes encased in concrete, concrete pipes, or reinforced concrete-box siphons that include one, two, or three barrels. The inlets and outlets of the concrete-box siphons are framed by concrete wingwalls, which may consist of either flat or curved walls with angled transitions back to the watercourse (**Photograph 102** - **Photograph 103**). The dimensions of the siphon inlets and outlets are likewise determined by the surrounding topography as well as the hydrological properties of the water source being conveyed, with greater water volume necessitating large siphons.[26]

[26] Bureau of Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction*, 74, 78-79.



Photograph 102: Two-barrel siphon undercrossing outlet at M.P. 45.75 (left); camera facing southeast, May 12, 2022 (B00475).



Photograph 103: Three-barrel siphon undercrossing outlet at M.P. 30.63; camera facing south, May 11, 2022 (A00633).

Culverts

There are 32 identified culverts distributed throughout the DMC. Culverts, along with wash overchutes and drainage inlets, convey natural drainage channels and preexisting water courses underneath the canal. See

Table 8 for an inventory of the geographic distribution of culverts as sorted by DMC segments recorded on Linear Feature Records below.[27]

Table 8: Geographic Distribution of DMC Culverts

DMC Segment No.	Culvert Totals	Percent of Total
1	7	21.87%
2	2	6.25%
3	0	--
4	0	--
5	0	--
6	1	3.12%
7	0	--
8	1	3.12%
9	1	3.12%
10	2	6.25%
11	3	9.38%
12	0	--
13	2	6.25%
14	3	9.38%
15	0	--
16	0	--

[27] Most of the culverts inventoried here were heavily obscured by vegetative overgrowth or otherwise inaccessible from the FKC embankments at the time of recordation. Structural information was chiefly derived from engineering drawings, final reports, and structures inventories.

17	0	--
18	0	--
19	6	18.76%
20	4	12.50%
21	0	--
22	0	--
Total:	**32**	**100%**

While individual culvert lengths and slopes are principally determined by the surrounding topography, their basic designs are generally uniform, with only slight dimensional or structural variation. All of the culverts inventoried here are reinforced concrete box culverts with cutoff collars, which were historically constructed to include one, two, or three barrels (**Photograph 104**). The number of barrels and the dimensions of the box culvert inlets and outlets are likewise determined by the surrounding topography as well as the hydrological properties of the water source being conveyed, with greater hydro volume necessitating large, multi-barreled culverts. Inlets and outlets are framed by concrete wingwalls, which may consist of either flat walls that extend at right angles or curved walls with angled transitions back to the conveyed watercourse.[28]



Photograph 104: Culvert channeling the O'Neill Forebay Wasteway beneath the DMC at M.P. 69.62; camera facing northwest, June 13, 2022 (C0214).

Well Discharges

There are dozens of well discharges along DMC, concentrated primarily in segments 18 to 21. They are all very similar in appearance and consist of metal pipes projecting from the canal wall with an upward bend at its outlet. They are all modern additions.

[28] Bureau of Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction*, 78.



Photograph 105: Well discharge at M.P. 90.39; camera facing right bank from left bank, June 14, 2022 (C0364).

DMC Signs

There are 6 signs along DMC, typically adjacent to major roadways (**Photograph 106**). They are all very similar in appearance and are either single or double sided, constructed of horizontal wood planks affixed to square wood posts.



Photograph 106: Delta-Mendota Canal, Central Valley Project sign at M.P. 1.41; camera facing west, May 9, 2022 (A00152).

B9b. Builder (continued):

Builder	Canal Segment(s)	Completion Date	Description of Work
Hubert H. Everist, Sr.	M.P. 27.00 – 39.88	November 13, 1948	Earthwork, concrete lining, and structures and Westley wasteway
Morrison-Knudsen Co., Inc., / M. H. Hasler	M.P. 3.51 – 13.66	March 9, 1949	Earthwork, concrete lining, and structures

Morrison-Knudsen Co., Inc. / M. H. Hasler	M.P. 13.66 – 27.00	August 31, 1950	Earthwork, concrete lining, and structures
Hubert H. Everist, Sr.	M.P. 39.88 – 54.45		Earthwork, concrete lining, and structures, and timber operating bridge
Western Contracting Corp.	M.P. 54.43 – 70.04	July 5, 1951	Earthwork, concrete lining, and structures
Morrison-Knudsen Co., Inc./ M.H. Hasler	M.P. 70.04 – 90.54	July 8, 1951	Earthwork, concrete lining, and structures
Morrison-Knudsen Co., Inc./ M.H. Hasler	M.P. 90.54 – 98.64	July 5, 1951	Earthwork, concrete lining, and structures
United Concrete Pipe Corp., and Vinnell Co., Inc.	M.P. 98.64 – 116.59	November 30, 1951	Earthwork and structures, Delta Mendota Canal, and Firebaugh wasteway
A. Teichert and Sons, Inc.	M.P. 0.03 – 1.48	October 27, 1951	Newman wasteway
United Concrete Pipe Corp., and Vinnell Co., Inc.	M.P. 1.48 – 8.20 M.P. 0.027 – 2.81	November 3, 1951	Newman wasteway, earthwork, concrete lining and structures, and service lateral
Western Contracting Corp.	M.P. 0.06 – 11.88	April 9, 1952	San Luis wasteway and holding reservoir dike
Johnson Western Constructors			Columbia Pumping Plant No. 1, Mowry Pumping Plant and delivery systems
Plainview Water District/ Stolte, Inc.		1954	Earthwork, pipelines, and structures including pumping plants, laterals 8.7 to 20.0, inclusive, and sublaterals
Crest Contracting Co.	M.P. 58.18 - 96.62		Pump turnouts
Hubert Sykes	M.P. 12.99 – 25.88		Furnishing, hauling and placing gravel
E.A. Pollard			Erection of right-of-way fence
M.J. Ruddy and Son	M.P. 3.50 – 14.96 M.P. 17.99 – 24.02 M.P. 12.29 – 13.05		Furnishing or processing, hauling and placing gravel
H. Sykes	M.P. 25.80 – 36.56 M.P. 38.16 – 40.72		Furnishing or processing, hauling and placing gravel
Claude C. Wood Co.			Furnishing or processing, hauling and placing gravel

B10. Significance (continued):

Historic Context

When viewing a topographic map of California, one particularly outstanding geographic feature presents itself above all others: an immense oblong alluvial plain in the interior of the state that extends nearly 500 miles from north to south and varies from about 60 to 100 miles in width (Figure 1). This Great Central Valley Basin occupies more than one-third of the entire state. It covers 18,810 square miles and is bounded on the east by a pair of formidable mountain ranges and on the west by a less

imposing coastal mountain range. The valley itself contains three major drainage areas. The northern one-third is drained by the southerly flowing Sacramento River and its tributaries. The Sacramento is the longest river in the state and the largest, contributing about one-third of the total outflow of all river systems in the state. The southern and largest portion of the valley is drained by the San Joaquin River and its tributaries. The San Joaquin River flows west and north and drains a larger, but much more arid region. The two major rivers converge in the "Sacramento-San Joaquin Delta," a 153 square-mile labyrinth of reclaimed tule islands, river channels, and sloughs. The Delta also receives freshwater inflows directly from other rivers draining the imposing central region of the Sierra Nevada range to the east. These watercourses include the Cosumnes, Mokelumne and Calaveras rivers along with numerous other minor rivers and creeks. The flow from all of these waterways move westerly through the Delta, entering Suisun Bay and, together with the Sacramento and San Joaquin rivers, flow through Carquinez Straits into San Francisco Bay, a salt water tidal basin, and ultimately through the Golden Gate into the Pacific Ocean.

California's water supply and development challenges stretch back to the mid-nineteenth century gold rush decade when gold miners in the mountains and foothills of the Sierra Nevada began diverting water from streams to expose placer deposits in streambeds and to process gold using a variety of hydraulic methods. The gold rush caused many significant changes in riverine ecosystems of the Central Valley. Hydraulic mining destroyed miles of riparian vegetation and habitat. Debris formed sandbars in streams, impaired navigation, and elevated riverbeds leading to massive flooding and destruction of thousands of acres of agricultural land, while in the mountains and foothills the hydraulic giants left behind barren amphitheaters and miles of waste tailings. Nevertheless, mining remained the most important economic use of water in California for some three decades following the mass migration of gold miners from around the world to California starting in 1849.[29]

Even during the height of the gold rush, some Californians already had begun to dream of converting the Central Valley into an agrarian wonderland. The Central Valley was a phenomenally rich and broad alluvial plain and was destined to become the state's most productive agricultural center. It was watered by streams flowing from the Sierra Nevada on the east and the coastal ranges on the west, but water was in short supply when needed the most during the rainless summer growing season. As a result, during the gold rush decade, open range grazing of sheep and cattle remained the principal land use on the natural pasture lands of the Great Central Valley.

In the middle to late 1860s, wheat culture emerged as an increasingly prominent land use and contributed to the decline, and later demise, of the open range cattle industry in the Central Valley in the ensuing decades. When planted in the fall and harvested in the spring, winter wheat and barley were two of only a handful of crops that could be successfully raised in the Central Valley without irrigation. All that was needed was access to a navigable stream or a railroad line to ship the grain to market and intermittent rainfall from November through April. In the San Joaquin Valley fifteen inches of rain produced bumper crops, although ten inches, if properly distributed, was enough to yield an acceptable harvest. The Great Valley offered rich, flat land that required little preparation, and grain farmers needed little farming experience because wheat or barley was easy to plant and virtually took care of itself. In many cases, grain farming did not even require a house, barn, or quarters. A remarkably diverse group of migrant workers, including down on their luck miners, performed the greatest portion of the required agricultural work. They were needed for only a span of three or four weeks during winter plowing and sowing and again in the summer for threshing and harvest. Most of these workers packed the necessities of life in a bindle and drifted between farms and agricultural districts. The wheat barons themselves mostly resided in the state's urban centers – Sacramento, Stockton, Oakland, and San Francisco – and left the comfort of their homes and families only to supervise the annual harvest or planting.[30]

[29] Robert Kelley, *Gold vs. Grain: The Hydraulic Mining Controversy in California's Sacramento Valley* (Glendale, CA: Greenwood Press, 1979).

[30] Richard Allen Eigenheer, "Early Perceptions of Agricultural Resources in the Central Valley of California" (PhD dissertation in Social Geography, University of California, Davis, 1976), 325-349; David Igler, *Industrial Cowboys: Miller & Lux and the Transformation of the Far West, 1850-1920* (Berkeley: University of California Press, 2001); Richard S. Street, *Beasts of the Field: A Narrative History of California Farmworkers, 1769-1913* (Stanford, California: Stanford University Press, 2004), 89-177.

Land speculators like E. H. Miller, George D. Roberts, William S. Chapman, Isaac Friedlander, Miller & Lux, and a host of others used generous federal and state land laws to monopolize land ownership in the Central Valley. For about three decades wheat was king in the valley, but its reign ended abruptly in the 1890s. Historians have identified numerous factors that explain the sharp decline of the California wheat industry, among them increasing competition in the international wheat market, soil exhaustion, new superior varieties of wheat, the increasing value of farmland devoted to irrigation and horticulture, and growing opposition to "land monopoly."[31]

As wheat production declined, farmers turned increasingly to irrigated crops. Irrigation grew steadily in California from 60,000 acres in 1860 to nearly 400,000 acres in 1880, and by the early years of the twentieth century it had become the dominant feature of California's agriculture with more than 2,644,000 acres under irrigation.[32] The Central Valley developed a virtual monopoly on several irrigated crops: cotton in the arid southern portion of the San Joaquin Valley; rice in the clay soils of the trough lands of the Sacramento Valley; vineyards or orchards on the alluvial fans on the east side of the Great Valley where water was accessible; truck crops in the Delta peat soils; grapes in eastern Fresno County and nuts and olives in the Sacramento Valley; and orange groves occupied the sheltered coves on alluvial fans up and down the eastern edge of the Great Valley.[33]

The greatest problems with agriculture in the Central Valley were two-fold: the regional unevenness of water supply and the Mediterranean-type of climate characterized by prolonged dry summers that required irrigation of summer maturing crops. The San Joaquin Valley has a hot desert climate, accentuated near the southern end, where there is a mean annual precipitation of less than five inches. Northward, rainfall increases through a transitional zone to a Mediterranean climate in the Sacramento Valley with hot summers. Exposed to cooling summer west winds through Carquinez Straits, the Delta has a cooler Mediterranean climate. A decrease in rainfall from north to south is also a prevailing condition of climate in California and this differential is exaggerated in the Central Valley. A rain shadow is also associated with the Coast Ranges, resulting in the eastern margins of the valley receiving on average 50 percent more precipitation than the west side of the valley. The regional distribution of streamflow is even more unequal because of the high elevation and long slope of the Sierra Nevada on the east side of the valley compared to the short slope of the lower Coast Ranges on the west side. These factors make it imperative that any valley-wide plan for irrigation development needed to store surplus winter water and make it available in the summer months, and that surplus northern and eastern water needed to be made available for use in the southern and western portions of the valley, if irrigation of irrigable land was to be maximized in the Central Valley.[34]

Irrigation developed initially in the Central Valley under private initiative and financing, using the natural flow of local streams. These early projects were concerned with relatively small tracts of land and not with the valley, or even an entire watershed, as a unit. In general, irrigation grew earlier and was more extensive in the southern portion of the San Joaquin Valley where growing crops without the benefits of irrigation was more tenuous. Settlers along the south bank of the Merced River began to irrigate alfalfa land, vineyards, and orchards in the vicinity of Snelling in the early 1850s. Ditches on Mill Creek and the Kaweah River irrigated grain fields and gardens as early as 1853. Settlers along the Tule River constructed several small ditches between 1859 and 1865. Once the Southern Pacific Railroad laid its tracks down the east side of the San Joaquin Valley in the early 1870s more extensive irrigation development ensued and company officials became avid promoters of irrigation as an essential component of economic development and land subdivision. The first large regional diversion project to be constructed was the San Joaquin and Kings River Canal (1871) that ran northwest from the bend of the San

[31] Eigenheer, "Early Perceptions of Agricultural Resources in the Central Valley of California," 325-349; Igler, *Industrial Cowboys*, 60-91; William L. Preston, *Vanishing Landscapes: Land and Life in the Tulare Lake Basin* (Berkeley: University of California Press, 1981), 85-120.

[32] Harding, *Water in California*, 80; Donald J. Pisani, *From the Family Farm to Agribusiness: The Irrigation Crusade in California and the West, 1850-1931* (Berkeley: University of California Press, 1984), 54-77.

[33] Joseph A. McGowan, *History of the Sacramento Valley*, 3 vols. (New York: Lewis Publishing Company,1961); J. J. Haley, "California's Change to Irrigation from Dry Farming," *Western Construction News*, 3 (February 1928): 83-84; William Reich, "King Cotton in California," *Land* 9 (Spring 1950): 65-71; William S. Richards, "Geographical Aspects of Rice Cultivation in California" (M.A. thesis, University of California, Berkeley, 1969).

[34] Peveril Meigs, "Water Planning in the Great Central Valley, California," *Geographical Review* 29, no. 2 (April 1939): 252-273.

Joaquin River where it turns northward. The plan included subsequent construction phases that would extend the canal to Suisun Bay and utilize Tulare Lake as a reservoir connecting to the canal by way of Fresno Slough. Just a few years later Charles Crocker, one of the founders of the Central Pacific Railroad that built the western portion of the transcontinental railroad, invested his private capital in the Crocker-Huffman Land & Water Company's irrigation and land subdivision project utilizing water from the Merced River to irrigate more than 20,000 acres in the vicinity of the town of Merced. In 1880 when State Engineer William Hammond Hall conducted the first statewide irrigation survey in California, it showed that the San Joaquin Valley with 188,000 acres was the most heavily irrigated region of the state with forty-seven percent of the irrigated acreage statewide. In contrast, the wetter Sacramento Valley remained mostly dry farmed with only 13,400 acres irrigated.[35]

Irrigation in the San Joaquin Valley proceeded under many forms of organization using surface water supplies flowing in creeks and rivers, artesian waters, and groundwater. While irrigation was achieved on a small scale within land colonies organized by land speculators, large areas of land were also amassed within former Mexican-era land grants, as swamp and overflowed land, railroad grant land, by use of land script, and a host of other methods under the public land laws. In the 1870s and 1880s, private irrigation companies developed the San Joaquin and Kings River Canal along San Joaquin River, along with canals diverting water from the Kern, Kings, and Merced rivers. The companies that succeeded in delivering water to farmers frequently did so at the price of creating unpopular land and water monopolies. Some farmers, with the encouragement of private canal companies, experimented with creation of "mutual water companies," owned by the farmers themselves who raised money and acquired rights to use water through the purchase of company "stock."[36]

Private irrigation companies enjoyed only limited success during the latter decades of the nineteenth century and the largest projects undertaken inevitably failed. These institutional efforts at planning and financing irrigation projects fell into four general categories: private water companies; land colonies, mutual water companies, and irrigation districts.[37] The economic turmoil of the era and high rate of failure of these irrigation efforts helped popularize other institutional alternatives, including a proposal for a unique unified, coordinated, and centralized canal network designed to be built and operated by the state. Efforts by private investors to build mammoth irrigation schemes such as the San Joaquin and Kings River Canal aroused the interest of Congress and in 1873 an act was passed directing the War Department to appoint an investigating committee to examine irrigation. "The Alexander Commission," led by Lieutenant Barton Stone Alexander, an U.S. Army Engineer, was organized in 1873 to conduct the first federally funded irrigation survey and plan for coordinated irrigation development of the Central Valley. This federal irrigation commission carried out what State Engineer Edward Hyatt, "father of the State Water Project," later called "one of the earliest attempts at water resources planning on a regional scale." As detailed surveys were lacking, the report was a mere sketch of a development plan. However, the first state water agency, the State Engineers Office under William Hammond Hall, labored from 1878 to 1888 to implement many of the basic recommendations suggested by the Alexander Commission.[38]

The Alexander Commission's federal irrigation survey was grossly underfunded and was conducted over a scant six weeks in the field, but the report contained much valuable information and captured the imagination of future generations of water resources planners in California. The Commission predicted that 8.5 million acres could be irrigated in the Central Valley and 12 million if the low foothills surrounding the valley were included. The Commission proposed a complex network of canals.

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[35] William Hammond Hall, *The Irrigation Question in California: Appendix to the Report of the State Engineer to His Excellency George C. Perkins, Governor of California* (Sacramento: California State Printing Office, 1881).

[36] Harding, *Water in California*, 79-83; JRP Historical Consulting Services and California Department of Transportation, *Water Conveyance Systems in California: Historic Context Development and Evaluation Procedures* (Sacramento: California Department of Transportation Environmental Program, Cultural Studies Office, December 2000), 8-15.

[37] Of these institutional models, the quasi-public irrigation district proved the most successful in development of large-scale irrigated tracts in California, but only a few of the irrigation districts organized under the original Wright Act of 1887 survived into the twentieth century. Changes in irrigation district law in 1911, gave these districts greater financial stability and irrigation districts had much greater success in the twentieth century.

[38] Edward Hyatt, "National Broadcast on California Agricultural Programs, Under the Auspices of the State Grange, NBC Studios, San Francisco, November 10, 1939," Edward Hyatt Papers 2, Water Resources Collection and Archives, University of California, Riverside.

On the west side of the Central Valley, a north-south canal was suggested leaving the Sacramento River near Red Bluff, following the foot of the Coast Range to Fairfield with several west-east laterals irrigating land as it passed through Yolo County. From Antioch, the canal was to run south along the west side of the San Joaquin Valley connecting to Tulare, Buena Vista, and Kern lakes, three natural bodies of water fed by creeks, sloughs and rivers in Tulare and Kern counties. Because of the many streams flowing out of the Sierra Nevada, the commission did not favor a continuous canal down the east side of the Central Valley as the cost of siphons or aqueducts to bridge these streams was prohibitive. The report also paid little attention to construction of storage reservoirs, but did advocate damming many westerly flowing Sierra streams to raise water over the river bank into east-west distribution ditches running across the valley floor.

Because of the state's limited population and tax base, the Alexander Commission predicted that progress toward full construction of the massive water project would undoubtedly proceed at a slow pace and that it might take as long as 50 years to achieve full implementation. In other respects, the report was also prescient. The commissioners predicted that water conflicts would occur and require settlement before construction of any comprehensive water system and that the state needed to institute legal mechanisms to regulate the acquisition and distribution of water; that farmers be limited to "reasonable use" to reduce water waste; that drainage canals accompany construction of irrigation canals; and that a topographic and hydrologic survey precede adoption of a system of reclamation for the Central Valley. Finally, the Commission was prophetic in recognizing the fundamental principal behind the future State Water Project proposed in the late 1920s and the CVP launched by the federal government in the 1930s -- the need to transfer water from the water rich Sacramento Valley to the water deficient San Joaquin Valley.[39]

At the state level, the California legislature passed an act in 1878 providing for investigation regarding irrigation and appointment of a State Engineer. William Hammond Hall, another former officer in the U.S. Army Engineering Corps with experience as a hydrographer, draftsman and field engineer, was appointed California's first State Engineer. Over the next decade, Hall proposed an increasingly activist stance by the state in navigation improvement projects, flood control, water storage, irrigation and drainage, compilation of statewide data on rainfall and streamflow, public ownership and control of navigable waterways, and proposed regional and statewide water planning for development of water resources. In 1880, Hall published a report on the subject of irrigation that described the principal irrigation districts of the state and made recommendations on legislation to promote irrigation development in California, including recommendations for an "irrigation district bill." Hall also prepared the first detailed map of the Central Valley (like the later one shown in Figure 1) depicting every stream correctly located, the topography of adjacent foothills, and the slope and fall of the plains where irrigation would occur. He also prepared a more detailed map of the San Joaquin Valley in ten sheets displaying every ditch and irrigation canal in the San Joaquin Valley and the extent of actual irrigation.[40]

Hall was reappointed four times as State Engineer serving until his resignation in 1889 when he was appointed Supervising Engineer of the United States Irrigation Investigation (predecessor of Reclamation), within the U.S. Geological Survey. The U.S. Geological Survey carried on the vital work of stream gauging and topographic mapping in the Central Valley. Following Hall's departure, Robert B. Marshall, an experienced California geographer, became the chief champion of a statewide water program during the late nineteenth and early twentieth centuries. Marshall outlined a plan for the coordinated development of the Central Valley with a series of dams, canals, and aqueducts to bring water to twelve million acres of land. Marshall was

[39] B. S. Alexander, C. H. Mendell, and George Davidson, *Report of the Board of Commissioners on the Irrigation of the San Joaquin, Tulare, and Sacramento Valleys of the State of California*, House Executive Document No. 290, 43rd Cong. 1st Sess. (serial no. 1615) (Washington, D.C.: Government Printing Office, 1874), 16-38; Pisani, *From the Family Farm to Agribusiness*, 102-128; W. Turrentine Jackson, Rand F. Herbert, and Stephen R. Wee, "Introduction," *Engineers and irrigation: Report of the Board of Commissioners on the Irrigation of the San Joaquin, Tulare, and Sacramento Valleys of the State of California, 1873: Engineer Historical Studies No. 5* (Fort Belvoir, Virginia: Office of History, U.S. Army Corps of Engineers, 1990), 1-36.

[40] William Hammond Hall, "Statement of William H. Hall of the U.S. Geological Survey, Supervising Engineer for the Pacific Coast, U.S. Irrigation Survey," Report of the Special Committee of the U.S. Senate on the Irrigation and Reclamation of Arid Lands: Report of Committee and Views of the Minority, 51st Cong., 1st Sess., Senate Report No. 928 (Washington, D.C.: Government Printing Office, 1890), 208-220.

determined to submit a plan that demonstrated its feasibility from an engineering perspective and spent twenty-five years perfecting his comprehensive state water development plan, gathering survey data and mapping proposed canals and reservoir locations.

Marshall arrived in California in 1891 and surveyed continuously in the state for the U.S. Geological Survey until 1903 when he was given administrative charge of topographic work in California. His duties spread to other arid western states working on proposed reclamation projects in Arizona, Oregon, Nevada, Washington, Idaho, and Utah. By 1908, at age 40, he had reached the pinnacle of his profession being appointed Chief Geographer in charge of the Topographic Branch of the U.S. Geological Survey with administrative charge of the entire United States. For years he directed the expenditures of the United States government in its geological surveys of California methodically putting together a plan of construction for his proposed system of canals and reservoir sites. Working co-operatively with the State of California, the U.S. Geological Survey, under Marshall's guidance, precisely mapped the Sacramento and San Joaquin valleys, co-operatively gauged streams, made profiles, and surveyed reservoir sites along the larger principal streams of the state, gathering all the field data necessary to begin the construction work. In the fall of 1919, he announced the main outlines of his one great comprehensive plan for statewide water development, including reclamation of the Central Valley of California:

From a high dam to be built across the Sacramento River near Red Bluff water will be carried in large canals down each side of the Sacramento Valley and thence up each side of the San Joaquin Valley. These main canals will operate by gravity, siphons, or pumps, or through tunnels. . . . On the main West Side Canal . . . a large supply will be diverted for the use of the "San Francisco and Bay Cities Unit.". . . The main East Side Canal will be twice dropped and twice again started at new and higher levels on the east side of the San Joaquin Valley. . . . Separate in construction and operation from the two Valley of California Systems as above referred to, but necessarily co-operative in a State-wide sense, is a third system . . . "the Los Angeles unit." This system must always be dependent upon the Kern River, which will be diverted through a long tunnel for use in southern California. To offset the diversion of the Kern River waters from the San Joaquin Valley the Klamath River will be diverted below Klamath Falls and carried into the upper Sacramento River near Shasta Springs. Above all these grand canals the tributary streams will be drawn upon through reservoirs, to be built along their courses, and further flexibility of the total flow will be provided by additional storage below the canals.[41]

California and planning for irrigation therein changed greatly during the first decades of the twentieth century. Growing migration into the state brought increased tax revenue and an expanded political bureaucracy. Having suffered the effects of a succession of drought years from 1917-1920, California state government exhibited an interest in comprehensive water planning. In 1921, the governor directed the State Engineer to come up with a statewide water management proposal addressing conservation, flood control, storage, distribution, and uses for California water and an estimated cost for implementation of the plan. The legislature appropriated funds to investigate a statewide water resources development and management plan. While the initial report was completed in 1923, it was the more than a dozen detailed engineering reports on various aspects of water management and control made by State Engineer Edward Hyatt between 1920 and 1932 that formed the basis of what became known as "The State Water Plan." During this period, shifts in water use included increasing numbers of water storage and power projects in the Sacramento Valley and the northern portion of the San Joaquin Valley, while further south complex water rights issues and lack of surplus water available for storage led irrigators to substitute groundwater storage for on-stream surface storage in reservoirs.[42]

The expansion of irrigated acreage in the early twentieth century was achieved by using surface water supplies and groundwater. By the mid-1920s water shortages had initiated several privately funded storage projects paid for by the irrigators

[41] Col. Robert Bradford Marshall, *Irrigation of Twelve Million Acres in the Valley of California* (Sacramento: California State Irrigation Association, 1919), 6-12.

[42] Paul Bailey, *Supplemental Report on Water Resources in California, Bulletin No. 9*, California Department of Public Works, Division of Engineering and Irrigation (Sacramento: California State Printing Office, 1925); Paul Bailey, *Summary Report on the Water Resources in California and a Coordinated Plan for their Development, Bulletin No. 12*, California Department of Public Works, Division of Engineering and Irrigation (Sacramento: California State Printing Office, 1927).

themselves on irrigation projects in the San Joaquin Valley, such as in the Modesto, Turlock and Merced irrigation districts. As a by-product of storage, these districts were able to generate hydroelectric power to pay for construction costs and expansion of their distribution systems. Storage and power development in the 1920s, however, did not extend to the southern portion of the valley. From the San Joaquin River south, the water rights situation was more complicated as streams had been developed early by multiple diverters complicating adjustment of water rights and financing of storage facilities. Furthermore, there was less unused surplus surface water and more of the Sierra Nevada's runoff reached the irrigated lands on the valley floor as groundwater. Realization that productivity of agriculture could be greatly increased by utilization of groundwater, the US Geological Survey and Reclamation issued a preliminary report in 1908 on the quality, occurrence, accessibility, character, and proper use of groundwater in the San Joaquin River basin.[43]

In the early twentieth century, underground water sources were used for an increasing amount of irrigation in California. From 1909 to 1919, land irrigated by these sources increased from 32,539 acres to 299,841 acres in the state. Many of the farms in what later became the Friant Division of the CVP were irrigated using a combination of groundwater and the limited supplies from local rivers and creeks. From 1919 to 1929 groundwater use in the southeastern San Joaquin Valley nearly tripled, increasingly relying on the capacity of pumped wells. With the exception of the Kern River and its alluvial fan, from the Kaweah River south and in the area from Mendota to Kettleman City, available local surface water supplies were negligible. Water for irrigation was primarily achieved through drilling thousands of large and deep irrigation wells. By 1930 overdraft on groundwater supplies and major land subsidence had become widespread along the eastside of the valley. A bit later subsidence became an issue on the westside of the San Joaquin Valley as much of its agricultural land came to rely on groundwater or conjunctive use of surface water and groundwater to meet irrigation needs.[44]

The nearly complete use of natural streamflow and overdraft of groundwater in areas not replenished from streamflow, focused local interests on more comprehensive plans for importing additional water supplies. Water shortages in the San Joaquin and Sacramento valleys had caused the State of California to initiate planning for major reservoir projects on the Kings, Tuolumne, San Joaquin, Kern, Merced, and Sacramento rivers between 1917 and 1924.[45] Legislative investigations of the State Water Plan that had begun in 1921 aimed to obtain a comprehensive inventory of water resources and an estimation of probable future water requirements in the Central Valley. As noted, this plan was first completed in 1923, and after further financial

[43] W. C. Mendenhall, *Preliminary Report on the Groundwater of the San Joaquin Valley, California: U.S. Geological Survey Water Supply Paper No. 222* (Washington, D.C.: Government Printing Office, 1908); W. C. Mendenhall, *Report on the Groundwater in the San Joaquin Valley, California: U.S. Geological Survey Water Supply Paper No. 398* (Washington, D.C.: Government Printing Office, 1916).

[44] Poland, J. F., and Evenson, R. E., "Hydrology and Land Subsidence, Great Central Valley, California," in Bailey, E. H., ed., *Geology of Northern California,* Vol. 2. (Sacramento: California Division of Mines and Geology, Bulletin 190, 1966), 239-247; Mitten, H. T., *Groundwater Pumpage in San Joaquin Valley, California* (U.S. Geological Survey, Open-file Report, 1967-68); N.P. Prokopovich and D.J. Hebert, "Land Subsidence Along the Delta-Mendota Canal, California," *Journal American Waterworks Association*, 60, n. 8 (Aug. 1968): 915-920. Water levels in wells within the future service area of the Friant Kern Canal declined from 1921 to 1951 but showed signs of substantial recovery over the next two decades as a reduction of pumping within the canal's service area through imported supplies delivered by the canal caused a reduction in groundwater pumping and increased recharge of the aquifer. A number of U.S.G.S. Professional Papers have been published on the land subsidence issue in the San Joaquin Valley. Two examples of investigations valley-wide in scope that address the early beneficial impacts of the Friant Kern Canal are: J. F. Poland, G. H. Davis, and B. E. Lofgren, "Progress Report on Land Subsidence Investigations in the San Joaquin Valley, California, through 1957," (U.S. Geological Survey, 1958) and J. F. Poland, B. E. Lofgren, R. L. Ireland, and R. G. Pugh, *Land Subsidence in the San Joaquin Valley, California, As of 1972. USGS Survey Professional Paper 137-11* (Washington, D.C., United States Printing Office, 1975). Other studies are narrower in scope focusing on specific regions within the valley such as B. E. Lofgren and R. L. Klausing, *Land Subsidence Due to Groundwater Withdrawal, Tulare-Wasco Area, California. USGS Survey Professional Paper 437-B* (Washington, D.C., United States Printing Office, 1969). This study notes that within the southeastern portion of the study area subsidence nearly stopped in the late 1950s, as water levels recovered some 130 feed in response to reduced pumping and groundwater recharge from imported water delivered by the Friant Kern Canal.

[45] William L. Kahrl, *The California Water Atlas* (Sacramento: California Office of Planning and Research, Department of Water Resources, 1979).

studies, the plans were revised in 1925, 1927 and 1929. These investigations led the state to consider plans for a coordinated water management and development program that resulted in the adoption of the CVP in the 1930s.[46]

The story of the development, planning, political background, and construction of the CVP is well known and often told. The CVP is widely recognized as one of the greatest pieces of water planning, engineering, and conservation development ever undertaken and represents one of the most ambitious and successful water development projects ever built. It significantly altered California's natural hydrologic system in order to enhance water supplies for irrigated agriculture, municipalities, and hydroelectric power. Within the contexts of hydraulic engineering, the politics of public works, state-federal conflict over reclamation policy, and the economics of large-scale irrigation, the CVP is recognized as a great achievement on the national and even the international scale, although every component of the CVP is located within the boundaries of California.

The concept of a CVP was originally devised by the State of California to resolve chronic intra-state water shortage problems, but ultimately it was built by the federal government. The "State Water Plan" that resulted from the studies undertaken by State Engineers Edward Hyatt and Paul Bailey between 1927 and 1930 called for a vast system of canals, massive dams, and reservoirs throughout the state, and a massive north to south water transfer plan including most of what became the CVP. The essential units of the Central Valley portion of the plan included Shasta dam and reservoir (originally called Kennett Dam) on the Sacramento River, one of the highest overflow dams in the world with a storage capacity of 4.5 million acre feet; a 50-mile long industrial and irrigation conduit in the Delta diverting water to supply areas in Contra Costa County; a cross canal in the Sacramento-San Joaquin Delta; pumping plants and canals in the San Joaquin River and valley; Friant Reservoir on the San Joaquin River in the foothills north of Fresno and canals running north from the reservoir to supply lands in Madera County and south to irrigate lands between the reservoir and Kern River. To implement the plan the state needed to purchase the so-called "grass land" water rights of riparian owners on the lower San Joaquin River between Friant and the mouth of Merced River. With these water rights of early priority and large quantity satisfied, practically the whole flow of the San Joaquin River at Friant would become available for diversion to other water deficient areas of the valley. Thus, the implementation of the initial Central Valley unit of the State Water Plan entailed these fundamental requirements: regulation of stream flow by means of storage, exportation of water between watersheds, and exchanges of existing water supplies for imported water. Subsequent units of the ultimate State Water Plan would be adopted over time as demand for additional water warranted.[47]

In 1933, California voters approved the "Central Valley Project" portion of the State Water Plan, but the state needed the federal government to bring this project to life. With the depressed financial circumstances of the period, the state was unable to borrow money at a low enough interest rate to market the bonds necessary to fund the plan. California officials responded by lobbying the federal government to undertake the project as a federal reclamation project. Up until this point, federal reclamation had little impact on California agriculture or state water policies. Now after nearly three decades, Reclamation finally got the chance to build the largest integrated water and power project ever undertaken in California. This occurred just as the doctrine of multiple use emerged, wherein federal agencies were mandated to serve various interests simultaneously,

[46] California Department of Public Works, Division of Engineering and Irrigation, *Water Resources of California: A Report to the Legislature of 1923, Bulletin No. 4* (Sacramento: California State Printing Office, 1923); Bailey, *Supplemental Report on Water Resources of California: A Report to the Legislature of 1925, Bulletin No. 9*; Paul Bailey, State Engineer, *Summary Report on the Water Resources of California and a Coordinated Plan for their Development: A Report to the Legislature of 1927, Bulletin No. 12*, California Department of Public Works, Division of Engineering and Irrigation (Sacramento: California State Printing Office, 1927); Edward Hyatt, State Engineer, *Report to the Legislature of 1931 on State Water Plan, Bulletin No. 25,* California Department of Public Works (Sacramento: California State Printing Office, 1930).

[47] Pisani, *From Family Farm to Agribusiness*, 381-439; Norris Hundley, Jr., *The Great Thirst: Californians and Water, 1770s-1990s* (Berkeley: University of California Press, 1992), 232-248; Hyatt, *Report to the Legislature of 1931 on State Water Plan, Bulletin No. 25,* 177-180; Edward Hyatt, State Engineer, *Sacramento River Basin, 1931, Bulletin No. 26*, California Department of Public Works, Division of Water Resources, Sacramento (Sacramento: California State Printing Office, 1931); Edward Hyatt, State Engineer, *San Joaquin Basin, 1931*, *Bulletin No. 29*, California Department of Public Works, Division of Water Resources (Sacramento: California State Printing Office, 1931).

which freed Reclamation to build and operate the project for a wide variety of water interests both urban and rural. By 1935, the state and federal governments reached an agreement and Reclamation was charged with construction of the CVP.[48]

President Franklin D. Roosevelt, amenable to almost any job creation proposal that would diminish the severity of the Great Depression, was responsive to California's appeal for assistance in funding the proposed CVP. In 1935 President Roosevelt approved the Secretary of the Interior's feasibility report and released federal emergency relief funds in order to initiate survey and investigations of proposed project works.[49] What had begun as a state project now became a federal undertaking under the auspices of the Secretary of the Interior and Reclamation. During 1936 Reclamation established its administrative headquarters at Sacramento and three field division offices at Redding (Kennett Division) covering works on the upper Sacramento River; at Antioch (Contra Costa / Delta Division) covering surveys for the Contra Costa Canal; and Friant (Friant Division), located 20 miles northeast of Fresno, covering the Friant dam/reservoir site and surveys for the Madera and Friant-Kern canals. A year later, Congress gave Reclamation final authority to take over control of the construction of the massive public works project. Construction of the federal project proceeded on a piecemeal basis.[50]

Reclamation designed the CVP with five fundamental units, operating as an integrated system: Shasta Dam, Delta-Mendota Canal, Friant Dam, the Madera and Friant-Kern Canals, and the Contra Costa Canal. The smallest of the canals, the Contra Costa Canal in eastern Contra Costa County, provided irrigation and industrial water for the area south of Suisun Bay between Antioch and Martinez. In 1937, the canal was the first facility to be undertaken and the 48-mile canal was completed by Reclamation in 1939. The core of the system, however, involved the coordinated operation of the other four units for the purposes of delivering Sacramento River water to the arid San Joaquin Valley and to impound the flow of the upper San Joaquin River for distribution on the east side of the San Joaquin Valley.[51]

Reclamation designed the project's main four units to operate in two groups of works. Shasta Dam and Delta-Mendota Canal operated together to store and deliver Sacramento River water on the westside of the San Joaquin Valley as far south as Fresno County, to irrigate new areas and to supply water for San Joaquin River diverters with riparian and senior appropriative water rights. Friant Dam, located on the San Joaquin River 25 miles northeast of Fresno, conserved and stored flood flows in Millerton Lake for release and diversion into the Madera and Friant-Kern canals. These three water-storage and conveyance features operated together to store and divert San Joaquin River water as far as the southern extremes of the San Joaquin Valley near Bakersfield (through the Friant-Kern Canal) and north to Ash Slough near Chowchilla (through the Madera Canal). As noted, these units worked in conjunction with one another, the Shasta Dam/Delta-Mendota Canal system providing "replacement water" to west side "Exchange Contractors" (senior holders of water rights from the San Joaquin and Kings River Canal and Irrigation Company and Miller & Lux's corporate descendants) for that which was transported southward

[48] Erwin Cooper, *Aqueduct Empire: A Guide to Water in California, Its Turbulent History, and Its Management Today* (Glendale, California: A. H. Clark Co., 1968); Hundley, *The Great Thirst, 243-252*.

[49] The proposed construction project by the federal government stirred up controversies over the Reclamation's 160-acre limitation imposed under the 1902 Federal Reclamation Act, ownership of water rights, public vs. private hydroelectric power generation, as well as state vs. federal ownership and operation of the project. Given the early history of the Central Valley as an area dominated by large cattle ranches and bonanza wheat farms, the 160-acre limitation was deemed as particularly egregious where, as one landowner's attorney noted, "10 per cent of the ranches contain 80 per cent of the land," "Big Water 'Transfusion' Operation Taking Shape: World's Longest Canal to Carry Much Needed Moisture Through Central Valley," *Los Angeles Times," March 16, 1947;* and Bassett, "Water Limit Fight Stirs San Joaquin: Controversy Over How Much Land One Owner May Irrigate Features Valley Project Work," *Los Angeles Times*, March 17, 1947.

[50] Pisani, *From Family Farm to Agribusiness*, 416-438; Hundley, *The Great Thirst*, 252-262; "Active Construction Nears on Central Valley Project," *Western Construction News*, January 1937, 22.

[51] U.S. Department of the Interior (USDI), Reclamation, Central Valley Projects: Issues and Legislation, October 15-2018 – June 21, 2019, https://www.everycrsreport.com/reports/R45342.html#_Toc12259578.

and northward on the east side of the San Joaquin Valley by the Friant Dam/Friant-Kern Canal/Madera Canal system. Reclamation completed these five major units of the CVP by the early 1950s.[52]

Groundwater issues quickly became part of the Delta Division's management. As noted, much of the agricultural land in western San Joaquin Valley had relied upon groundwater or conjunctive use of surface water and groundwater to meet their irrigation needs before the CVP was built. According to one U.S. Geological Survey study in the mid-1950s, about 4,500,000 acres of land in the San Joaquin Valley was irrigated, with 50% of that land supplied solely with groundwater from wells and land subsidence had been noted.[53] Thus, almost immediately after water was turned in the newly completed Delta-Mendota Canal, land subsidence began to impact the structure, especially the downstream 40 miles, causing the need for repairs and extensive modifications to raise the height of canal structures.[54]

Reclamation designed Delta-Mendota Canal to carry out one of the key features of the CVP, exchanging water from the Sacramento River basin to the San Joaquin River basin. Delta-Mendota Canal was built to convey water from the Sacramento-San Joaquin Delta in a southerly direction along the west side of the San Joaquin Valley, replacing flows in the San Joaquin River to permit diversion of San Joaquin River water at Friant Dam for delivery in Madera Canal and Friant-Kern Canal. It was designed to serve a total of approximately one million acres of irrigable land on the west side of the San Joaquin Valley in San Joaquin, San Benito, Stanislaus, Merced, and Fresno counties. Reclamation designed DMC to deliver water to Mendota Pool and the planned San Luis Reservoir, as well as to water users along its route. At the upstream end, the canal was designed with a maximum capacity of 4,600 cubic feet per second, diminishing as it traverses the valley to its southern terminus. Original plans called for a series of lifts to advance the water south up the valley; however, Reclamation modified the design to a single pumping plant that lifted the water approximately 200 feet before discharging it into DMC. The north portion of the canal is lined with concrete and the sound is compacted earth. DMC was built with repetitive structure types like concrete checks, concrete siphons, culverts and overchutes, drainage inlets, irrigation turnouts, canal crossings, wasteway turnouts, highway and farm bridges, and much smaller number of discrete, specialized structures. For most of the major structures like wasteways and siphons, Reclamation engineers prepared site-specific designs and drawings. For structures installed repetitively along the canal like culverts, inlet drains, and farm bridges, Reclamation prepared standardized drawings for multiple applications. Through the DMC, availability of a more reliable water supply to parts of the San Joaquin Valley contributed significantly to the success of agriculture and industry in the region.[55]

When completed, Delta-Mendota Canal was instrumental in accomplishing the goals of the CVP and it was second largest capacity canal in the state after the All-American Canal, which was an 80-mile-long aqueduct built in the 1930s conveying Colorado River water to Imperial Valley and several Southern California cities. Engineering and constructing Delta-Mendota Canal was a monumental task because of the natural and built features it had to traverse over a long distance: the alignment crossed multiple waterways, major roadways, and transmission lines; existing irrigation structures had to be tied in or crossed; and road and farm bridges, and major canal water control features like check structures and wasteways had to be built. In addition to the engineering challenges, Reclamation also had to negotiate the sale of project water delivered by Delta-Mendota Canal with various water users and address a complex right-of-way acquisition. Water first entered the canal for delivery to downstream users in 1951 but was not officially complete until April 9, 1952.[56]

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[52] L. B. Christiansen and R. W. Gaines, *Central Valley Project: Its Historical Background and Economic Impacts* (Sacramento, California: USDI, Reclamation, Mid-Pacific Region, 1981).

[53] G.H. Davis, J. H. Green, F.H. Olmstead, and D. W. Brown, *Groundwater Conditions and Storage Capacity in the San Joaquin Valley California.* Geological Survey Water Supply Paper 1469 (Washington, Government Water Supply Paper No. 1469, 1959), III, 4, 8-10, 114-124, 129-131.

[54] N.P. Prokopovich and D.J. Hebert, "Land Subsidence Along the Delta-Mendota Canal, California," *Journal American Waterworks Association,* 60, n. 8 (Aug. 1968): 915-920.

[55] USDI, Bureau of Reclamation, *Delta-Mendota Canal,* Technical Record of Design and Construction (Denver: 1959), 1 and 13.

[56] "First Contract on Friant-Kern Canal," *Western Construction News* (Sept 1945): 112-113; US Department of the Interior, Bureau of Reclamation, *Delta-Mendota Canal,* Technical Record of Design and Construction (Denver: 1959), 5.

One of the most renowned engineers employed by the Bureau of Reclamation, Oscar Boden spent sixteen years out of his forty-year-long tenure with the Bureau working in the Central Valley. Boden undertook the role of construction engineer for the Delta Division of the Central Valley Project (CVP) from 1935 until his death in June 1951. Born in 1885 in Kellogg, Iowa, Boden studied civil engineering at Iowa State University, graduating in 1910. Boden started at the Bureau of Reclamation in 1911 performing operation and maintenance work for the first five years of his career. From there, he moved on to survey work, lateral design, and lay-out of several irrigation projects in Wyoming and Nebraska. He also worked on projects in Idaho, Oregon, and Washington where he served as head of construction of various irrigation distribution systems. Dubbed "Mr. Canal" for his work supervising the construction of 76 miles of main canal and 200 miles of laterals for the Kittitas Project near Yakima, Washington in 1926, Boden's prowess as a team leader eventually led him to the Central Valley. At the request of the supervising engineer for the CVP, Boden relocated to California in 1935, serving as the project's first government construction engineer. Boden engineered surveys for the Friant-Kern and Contra Costa canals and led the construction of the Contra Costa Conduit. Boden's acclaim increased during his role as engineering administrator who oversaw the construction of Delta-Mendota Canal structures and the Tracy pumping plant. Additionally, Boden took charge of the investigations, planning, and lay-out necessary for Delta-Mendota Canal's features. Posthumously, Boden received nomination into the Reclamation's Hall of Fame. In total, Boden is credited with the construction of 1500 miles of canal.[57]

Delta-Mendota Canal's concrete lining extends down to Milepost 98.64. This portion of the canal has a 48-foot bottom width. The approximately 18 miles of canal between that point and the outfall at Mendota Pool are compacted earth-lined with bottom widths of 60, 62, and 84 feet at different reaches. After Tracy Pumping Plant lifts the water 200 feet, the water is moved down the canal at a gentle grade of 3 inches per mile, controlled by concrete check structures (**Figure 1**).[58] Specifications called for the concrete to be 4 inches thick and placed on the canal's 1 ½:1 side slopes. Check structures, placed an approximately 5-mile intervals along the canal, are composed of two standardized types. Three of the check structures are rectangular and the rest are trapezoidal in cross section.[59]

57 D. L. Goodman, "Oscar G. Boden – Builder of Lifelines," *Reclamation Er*a vol. 38 (February 1952), 30-31, 38; "'Mr. Canal' Builds Miles of Them in His Life Project," *Stockton Record* (California), May 15, 1951; "Pittsburg Ends 3 Dates of Fete," *Stockton Record* (California), October 15, 1940; "Boden Ranked High Among Canal Builders," *Tracy Press* (California), April 9, 1951.
58 Martin H. Blote, "Water Runs Uphill," *Reclamation Era* (October 1947): 213.
59 US Department of the Interior, Bureau of Reclamation, *Delta-Mendota Canal*, Technical Record of Design and Construction (Denver: 1959), 1.

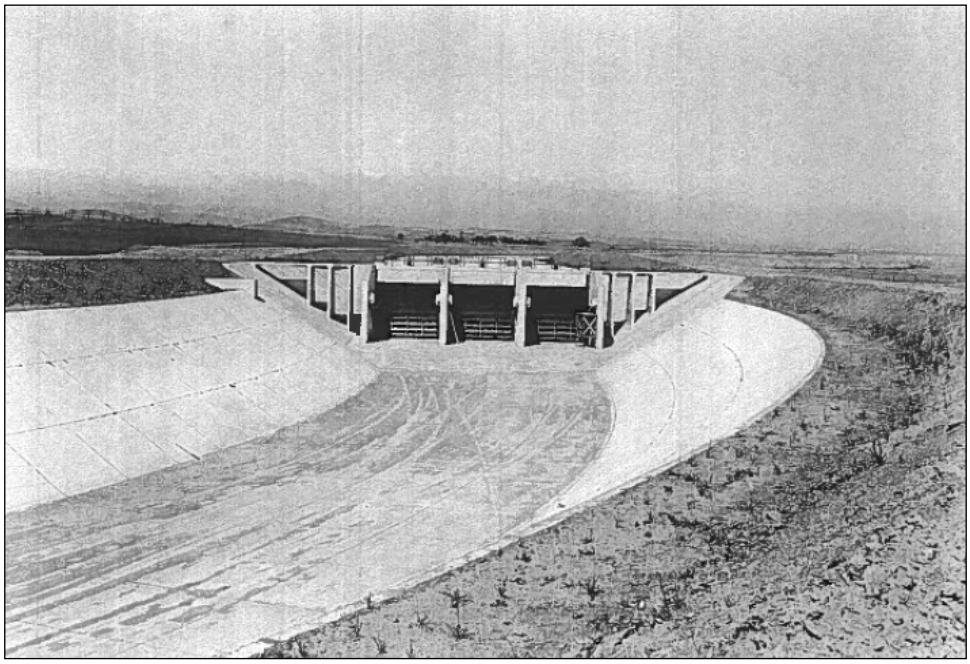


Figure 1: Complete check No. 1 (M.P. 11.35), camera facing upstream, April 18, 1949.[60]

Along its course, Delta-Mendota Canal is siphoned across streams, railroads, and irrigation canals. Siphons convey the water across seven streams, three railroad crossings, two highway crossings, one combined highway and railroad crossing, and one irrigation canal. The single siphon under an existing irrigation canal (Miller & Lux Outside Canal) was unique because all other existing irrigation ditches were siphoned under Delta-Mendota Canal. The Mountain House Road Siphon carried Delta-Mendota Canal 1,200 feet through a monolithic concrete structure with an inside diameter of 24 feet 3 inches (**Figure 2**). Morrison-Knudsen and Hasler constructed the siphon under specifications No. 1435.

Wasteways to carry flood water out of Delta-Mendota Canal and to the San Joaquin River channel are among the largest appurtenant structures to the canal and were designed and constructed as part of the canal. Reclamation designed the canal's four wasteways to handle the full capacity of Delta-Mendota Canal at the turnouts into the wasteways in the event of flooding or canal failure. Studies of the topography and disposal of canal water informed the site selection of the wasteways. The wasteway turnouts were designed with radial gates to allow the flow of water into the channels. Westley Wasteway is a 3.9-mile long, mostly concrete-lined trapezoidal channel. Newman Wasteway is approximately 8.2 miles long, about 1.5 miles of which are concrete lined. Volta Wasteway (originally known as San Luis Wasteway) is 11.9 miles long and Firebaugh Wasteway is the shortest at 1.1 miles long.[61]

[60] Morrison-Knudsen Company, Inc. and the M. H. Hasler Construction Company, *Final Report Contract No. I2r-16675 – Specifications No. 1435, Delta-Mendota Canal – Central Valley Project*, 1949, 22.
[61] USDI, Reclamation, *Friant-Kern Canal: Technical Record of Design and Construction*, 12; "Friant-Kern Canal – Myriad of Huge Structures Involved," *Western Construction News* (May 1948): 93.



Figure 2: Construction of Mountain House Road Siphon showing concrete placement in progress, October 24, 1948.

Delta-Mendota Canal and all of its appurtenant structures were constructed by five contractors under 10 major construction specifications, starting in 1946 and completed in 1951. Hubert Everist, Sr. won the first contract and began work in June 1946. Each of the major contractors engaged many subcontractors to supplement their own work forces.

On April 30, 1946, bids opened for Specifications No. 1183, which comprised of two schedules including earthwork, concrete lining and structures (schedule one) and the construction of the Westley wasteway (schedule two). Everist placed the lowest bid, winning the contract for both schedules on June 14, 1946. His firm also served as the contractor for Specification 2460, the earthwork, concrete lining and structures from M.P. 25.88 to M.P. 40.72, and the timber operating bridge at M.P. 23.28. Educated as an engineer at Purdue Univeristy, Everist came from a family of leaders in the construction industry. Born in Beardstown, Illinois but raised in Sioux City, Iowa, Everist played an instrumental role in the growth of his family's company, L.G. Everist, Inc., as well as the establishment of two other businesses: Western Contracting Corp. based in Sioux City and Intercontinental Engineering and Manufacturing Corp. of Parkville, MO. Branches of all three businesses existed in the West. At the time of the bidding for Delta-Mendota Canal, Everist lived in San Francisco.[62]

On December 30, 1946, Morrison-Knudsen Company, Inc., partnering with the Los Angeles-based M.H. Hasler Construction Company, won the first of its four contracts for "earthwork, canal lining, and structures" along Delta-Mendota Canal. This first contract included a segment measuring approximately 11.15 miles, completed on April 18, 1949. Between October 1949 and April 1951, Morrison-Knudsen Co. and M.H. Hasler engaged in three other contracts pertaining to Delta-Mendota Canal. All the work involved earthwork, concrete lining and structures (**Figure 3**). The Morrison-Knudsen Company, headquartered

[62] US Department of the Interior, Bureau of Reclamation, *Delta-Mendota Canal*, Technical Record of Design and Construction (Denver: 1959), 103; "Hubert H. Everist Sr Obituary," *Sioux City Journal*, July 20, 1990; L.G. Everist, Inc., "Company Overview," https://www.lgeverist.com/companies.php.

in Boise, Idaho, specialized in construction of large civil and military projects. Founded in 1912 by Harry W. Morrison and Morris H. Knudsen, the firm had become the preeminent dam-building company after its successful contribution to the construction of Hoover Dam, contracted in 1931. In the ensuing decades, Morrison-Knudsen emerged as one of America's largest civil engineering contractors. The company's portfolio of work went on to include some of the world's biggest dams and bridges. During World War II, the company was in prime position to take on large contracts for construction of military bases and airfields. After the war, the company embraced opportunities created by the expansion of the American military presence overseas, as well as the push to rebuild and expand American infrastructure at home. By the end of the 1950s, the company had diversified and expanded to various worldwide locations. Morrison-Knudsen's work along Delta-Mendota Canal is illustrative of the company's participation in domestic infrastructure expansion in the post-war period.[63]

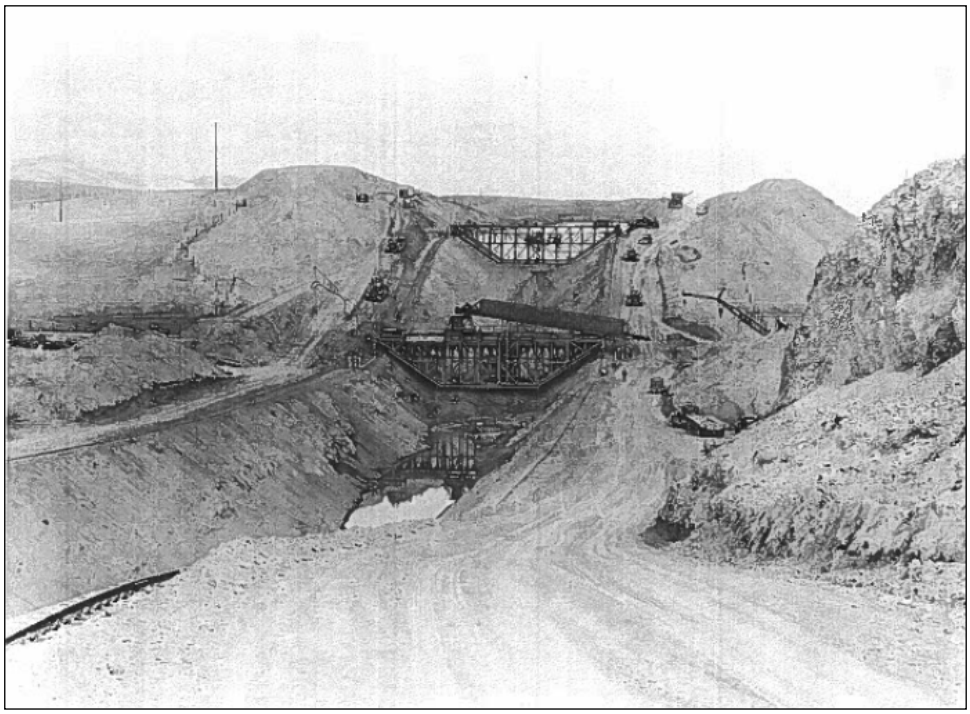


Figure 3: Morrison-Knudsen Company, Inc. and the M. H. Hasler Construction Company operating canal trimmer and slip form at Mountain House Road Siphon excavation, June 10, 1948.[64]

In addition to constructing four segments of Delta-Mendota Canal under Specifications 1435, 2197, 2732, and 2799, the Morrison-Knudsen Company, Inc. and the M.H. Hasler Construction Company also collaborated on multiple segments of the Central Valley Project's Friant-Kern Canal. In the late 1930s, M.H. Hasler also assisted Morrison-Knudsen in the construction of the All-American Canal and its branch Coachella Canal. Morrison-Knudsen and Hasler built over 75 miles of the 122-mile-

[63] Donald E. Wolf, *Big Dams and Other Dreams: The Six Companies Story* (Norman: University of Oklahoma Press, 1996), 204, 254-265; "Earth Mover," *Time* (May 3, 1954): 86, 90-93; "Morrison Knudsen Corporation," Jay P. Pedersen, ed., *International Directory of Company Histories*, vol. 28 (Detroit, Michigan: St. James Press, 1999); "Morrison-Knudsen Company, Inc.," Harvard Business School Baker Library Historical Collections, Lehman Brothers Collection, Twentieth-Century Business Archives; "Top Twelve Hit Over $100 Million," *Engineering News-Record*, July 2, 1964, 53; "Construction's Man of the Year," *Engineering News-Record*, February 17, 1966, 99-106; David P. Billington and Donald C. Jackson, *Big Dams of the New Deal Era: A Confluence of Engineering and Politics* (Norman: University of Oklahoma Press. 2006).

[64] Morrison-Knudsen Company, Inc. and the M. H. Hasler Construction Company, *Final Report Contract No. I2r-16675 – Specifications No. 1435, Delta-Mendota Canal – Central Valley Project*, 1949, 12.

long Coachella Canal between 1939 and 1941, including construction of 14 siphons, 31 double siphon boxes, one round barrel siphon, five checks, four automatic spillways, and five drainage inlets. During World War II, Hasler worked with the U.S. Army Corps of Engineers in building air bases at Blythe, Reno, and Kingman. The company's collaborative work on four segments of Delta-Mendota Canal between 1946 and 1951 appears to be illustrative of the general work performed by the M. H. Hasler Construction Company during this period.[65]

Another of Hubert Everist Sr.'s companies, Western Contracting Corporation, won the contract for earthwork, concrete lining, and structures for a 15.61-mile-long segment of Delta-Mendota Canal on June 22, 1949. The company completed the work on June 1, 1951. Additionally, on June 29, 1950, Western Contracting Corporation bid on and received Contract No. I2r-19060, for construction of the San Luis Wasteway and holding reservoir dike, split into two schedules (**Figure 4**). Western Contracting Corporation completed the work on April 9, 1952, and June 14, 1951, respectively. Everist established Western Contracting in 1917, headquartered in Sioux City, Iowa. For the work on Delta Mendota, the corporation operated out of an office in Westley, California. Today, the company predominantly constructs Army Corps of Engineer flood control, and wetland and river mitigation projects in the Midwest.[66]

In 1946, Reclamation Commissioner Straus authorized a contract of $5,888,000 for the two and a half mile long Delta-Mendota Intake Canal, which included the Tracy Pumping Plant (later renamed C.W. Bill Jones Pumping Plant) (**Figure 5** - **Figure 6**). Located nine miles northwest of Tracy, California, the pumping plant was to "lift water from the Delta-Mendota Intake Canal to a height of 200 feet and send it flowing for a distance of 120 miles" through the DMC to the west side of the San Joaquin Valley utilizing six 22,500 horsepower motors (**Figure 7**). With these motors, the plant had the capacity to lift 4,600 cubic feet of water per second. Construction of the pumping plant began September 2, 1947, through a joint venture between Stolte Inc., United Concrete Pipe Corporation, Duncanson-Harrelson Company, and Ralph A. Bell. The companies, all of which consolidated and operated under S.U.H.B. Company, completed the work on December 30, 1949. Construction engineers included Bureau of Reclamation's Oscar Boden and C.H. Spencer, both of whom spent a considerable portion of their careers working on the Central Valley Project. However, the location of the Tracy Pumping Plant created a unique problem for Reclamation; it aligned with the route that young salmon and bass are swept along by the early spring runoff in their migration towards the ocean. To prevent a detrimental loss in fish population, the Bureau of Reclamation and the U.S. Fish and Wildlife Service experimented to find the most promising solution. This experimentation resulted in a diversion using a series of vertical louver structures, which transferred the young fish to holding tanks and then onto tank trucks to be hauled "about 50 miles to waters destined for the ocean" (**Figure 8**). By 1959, the Tracy Pumping Plant operators collected and transported upwards of 250,000 fish a day, and a record 12 million for the entire year.[67]

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[65] Eric A. Stone (edited by Brit Storey), *All-American Canal: Boulder Canyon Project,* (Denver: United States Bureau of Reclamation, December 2009), 6-28; USDI, Reclamation, *Technical Record of Design and Construction, Delta-Mendota Canal: Constructed 1946-1952, Central Valley Project – California* (Denver, June 1959), 103; "M. H. Haslers of Laguna Buy Walter Botthof Home," *Desert Sun (Palm Springs)*, May 19, 1950, 5.

[66] US Department of the Interior, *Delta-Mendota Canal:* Technical Report, 104; Associated General Contractors of Iowa, "Western Contracting Corporation," http://www.agcia.org/memberDetails.asp?memberID=19795.

[67] USDI, Bureau of Reclamation, "Final Construction Report on Delta-Mendota Canal Intake and Tracy Pumping Plant and Discharge Lines," *Specifications No. 1810* – Central Valley Project (Denver: March 1952); USDI, Reclamation, "Commissioner Authorized to Award Top Value Contracts," *Reclamation Era* vol. 33, January 1947; USDI, Reclamation, "Fish and the Tracy Pumping Plant," *Reclamation Era* vol. 36, January 1950; USDI, Reclamation, "Well Worth Celebrating," *Reclamation Era* vol. 37, January 1951; USDI, Reclamation, "Reclamation Pioneers in Fish Conservation Techniques," *Reclamation Era* vol. 42, January 1956; USDI, Reclamation, "C.H. Spencer Succeeded by B.P. Bellport," *Reclamation Era* vol. 43, January 1957; USDI, Reclamation, "A Story about the USBR and Millions of Fish," *Reclamation Era* vol. 46, January 1960; "Construction Begins on Huge Central Valley Pump Plant," *Western Construction* vol. 22, no. 11, November 1947.

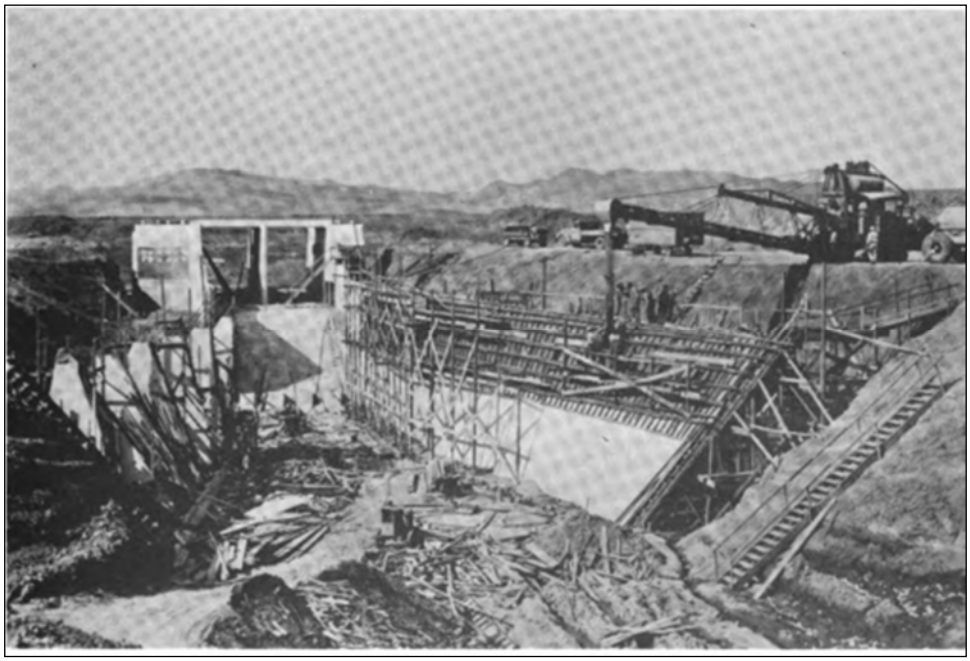


Figure 4: Placing concrete in transition walls of San Luis wasteway turnout, July 26, 1950.[68]

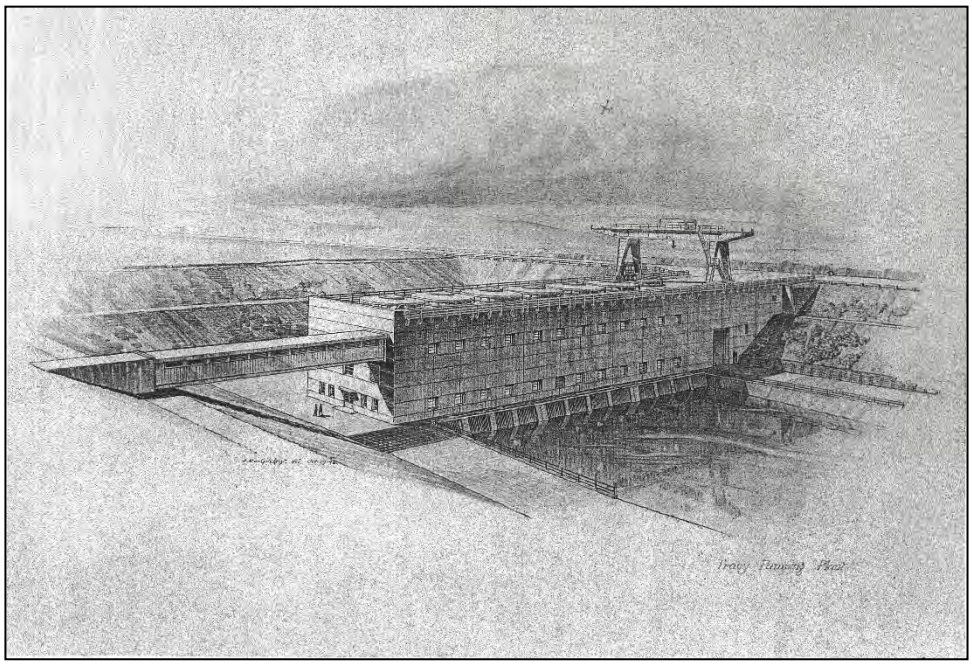


Figure 5: Artist rendering of Tracy Pumping Plant, 1948.

[68] [Photograph], DM-889-CV in USDI, Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 123; At left are counterforts which were placed independently of the warped walls.



Figure 6: Tracy Pumping Plant, January 1951.[69]



Figure 7: One of six 84-in. vertical shaft bottom suction twin volute centrifugal pumps.[70]

[69] [Photograph] USDI, Reclamation, "Well Worth Celebrating," *Reclamation Era* vol. 37, January 1951.
[70] [Photograph] "A Pictorial Review of Tracy Pumping Plant Construction," *Western Construction News* vol. 26, no. 5, May 1951.

On January 18, 1950, United Concrete Pipe Corporation and Vinnell Co. entered a joint contract to construct the earthwork and structures along Delta-Mendota Canal from M.P. 85.89 to M.P. 109.89, which spanned approximately 17.95 miles, and the Firebaugh wasteway, located at M.P. 98.50 (**Figure 9**). The government accepted the completed work on November 30, 1951. The two companies also worked together on the earthwork, concrete lining and structures, and service lateral, and part of the Newman Wasteway. They won this second contract on May 16, 1950 and finished the work on April 4, 1852. United Concrete Pipe Corporation can trace its origins to 1919 in Ventura, California. Serbia native Tom Polich started the company, first naming it Polich Construction Company until 1924, when he partnered with Steve Krai and B.J. Ukropina. Polich came to the United States in 1905 at the age of 17, and first entered the concrete business under the employ of Bent Brothers. Polich's first self-employed contract involved the installation of an irrigation system for the California Packing Corporation at their orchard at Tuttle. United Concrete Pipe Corporation went on to complete projects in Merced County such as the John Muir school building, concrete bridges and highways, sanitary sewers, and irrigation for the Merced Irrigation District. For this project, the Vinnell Company operated from a plant in Baldwin Park. Originally founded in 1931 by Allan S. Vinnell in Alhambra, the company began as a hauling and excavating contractor. The Vinnell Co. also constructed roads, buildings, portions of the Pan-American Highway and the Grand Coulee Dam. By the 1960s, the United States government employed Vinnell as contractors in Vietnam.[71]

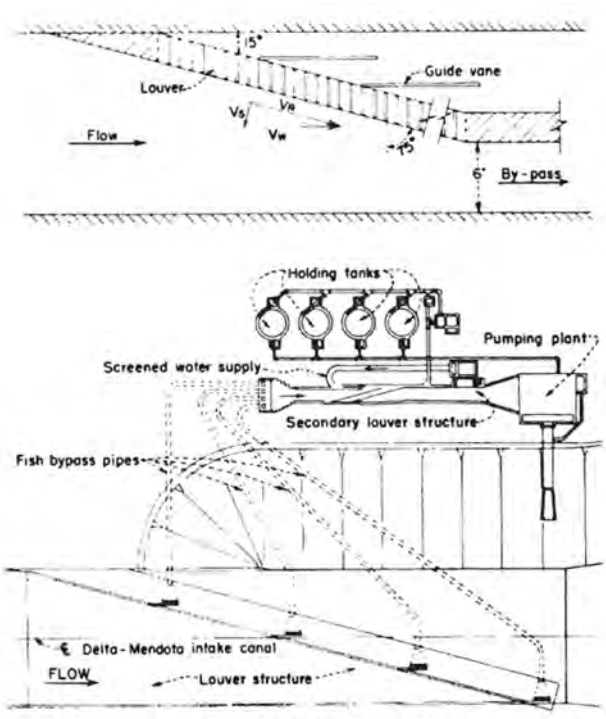


Figure 8: Fish Collecting Facilities at Tracy Pumping Plant, January 1956.[72]

[71] *Delta-Mendota Canal:* Technical Report, 105; John Outcalt, "Merced-Ventura-Los Angeles County CA Archives Biographies: Polich, Tom (Merced: 1925); "Dirt Lined Section of Delta-Mendota Canal Progresses," *Fresno Bee*, November 27, 1950.

[72] [Photograph] USDI, Reclamation, "Reclamation Pioneers in Fish Conservation Techniques," *Reclamation Era* vol. 42, January 1956; drawing at the top shows plan arrangement of louvers or slats; drawing at the bottom shows layout of permanent structure.

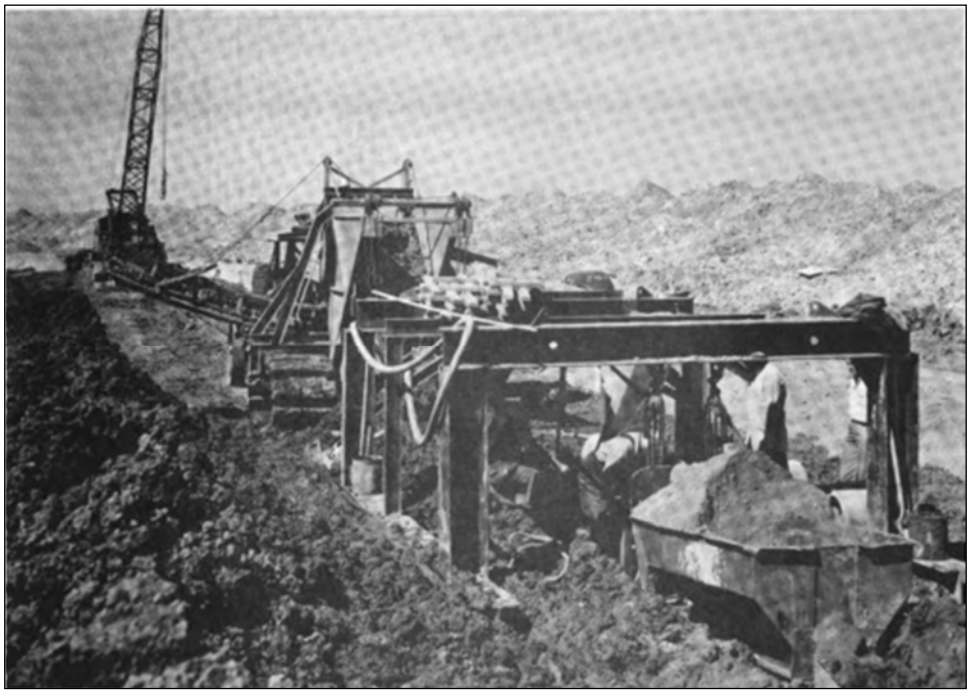


Figure 9: Converted ditcher and pipe laying machine used by United-Vinnell Co., March 1951.[73]

Construction of another small part of Newman wasteway and its service lateral went to A. Teichert and Sons, Inc., of Sacramento, California. The government awarded the contract on May 16, 1950, and Teichert completed the work on June 29, 1951. Both Teichert and United Concrete Pipe Corporation and Vinnell Company's portions of the Newman Wasteway fell under Specification 2951, albeit separate schedules. Teichert lined the wasteway by hand methods given the small size of the job (**Figure 10**). The company's founder, Adolph Teichert, immigrated to the United States in 1866 from Germany, finding success as a craftsman in San Francisco. He started his own business, Artificial Stone: Adolph Teichert, in 1887 in Sacramento. In 1912, Adolph Teichert Jr. joined his father as a partner in the concrete paving business under the name, A. Teichert and Son. The company played an integral role in the development of the road and highway system in Northern California, employed by the likes of the State of California Highway Department (later Caltrans) and the cities of Sacramento, Davis, Woodland, Placerville, and Fresno. In addition to paving roads, Teichert expanded its repertoire to include the production of rock product and ready-mixed concrete and the construction of dams, beginning with the North Fork Dam on the American River in 1938. A. Teichert and Son also partook in joint ventures with companies like United Concrete Pipe and Ralph A. Bell. In 1939, the companies worked together to construct tunnels and relocate telephone and railroad lines around the Shasta Dam. During World War II, A. Teichert and Son supported the war effort through the construction of airports; ammunition storage facilities; runways; and water, light, and fuel systems. By the early 1950s, the company's growth spurred the establishment of district offices in the Woodland/Davis area and in Stockton.[74]

[73] [Photograph,] DM-1471-CV in USDI, Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal,* 115; Machine used for laying drains in the lower reaches of canal. The machine digs a trench and men working inside shield lay the drain pipe which is covered by gravel from the hopper.

[74] *Delta-Mendota Canal:* Technical Report, 105; "Our History," *Teichert Way,* file:///J:/22-015%20Delta-Mendota%20Canal%20Subsidence/Research/Contractors/A.%20Teichert%20&%20Sons/Our%20History%20-%20Teichert.html.



Figure 10: Placing alternate panels of reinforced concrete in Newman wasteway, April 1951.[75]

On November 8, 1951, Johnson Western Constructors won the bid for construction of structures for distribution to water agencies along the canal rouate. The firm built the Columbia Pumping Plant No. 1, Mowry Pumping Plant, and their respective delivery systems. The work was broken into two schedules under Specification DC-3989. Headquartered in San Pedro, Johnson Western had additional offices in San Diego and Oakland. The company specialized in heavy engineering construction, waterfront construction, and gunite construction. Born in 1885, William Arthur began his career at age 21 at a small pipe company, working on construction projects there until he became president of the National Bank of Riverside. Johnson stayed at the National Bank from 1918 to 1923, at which time he established the Hall Johnson Company. Throughout his career, Johnson started numerous firms, including American Pipe, Johnson, Inc., and Johnson Western Constructors. His companies helped construct the Shasta Dam from 1938 to 1944. At the time of the construction of Delta-Mendota Canal, Larry Sullivan of San Pedro served as president of Johnson Western.[76]

The government awarded Plainview Water District and Stolte Inc. Contract No. 14-06-D-542 which "covered construction of earthwork, pipelines, and structures, including pumping plants, laterals 8.7 to 20.0 inclusive, and sublaterals" on September 1, 1953. Divided into three schedules, the contract with Stolte, Inc. allocated $441, 893.11 for the work, but only "a portion of the costs [$81, 686.99] was chargeable to Delta-Mendota Canal." Plainview Mutual Water Company is based in Strathmore, California, and had been one of the first companies formed with the aim of negotiating with the Central Valley Project for irrigation water. At the time of the bidding, Plainview Water District fell under the Delta-Mendota Canal distribution system. The company formed in 1950, with an irrigation request of about 4,200 acres. Stolte Inc. can trace its origins to Ferdinand Charles Stolte, whose dreams of becoming a gentleman farmer were foiled by the stock market crash of 1929. Based in Alameda, Stolte Inc. began with specializing in homebuilding, but expanded to include work on hotels, medical facilities, high-rise commercial construction, and heavy construction like dams and tunnels. In 1932, engineer George Loorz joined

[75] [Photograph], DM-1496-CV in USDI, Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal,* 128.
[76] Technical Report, 106; "Johnson, Shasta Dam Builder, Dies," *News Pilot,* San Pedro: May 11, 1956; "William A. Johnson, 71, Industrialist, Succumbs," *San Bernadino County Sun* May 11, 1956; "San Pedran Elected President of Johnson Western Company," *News Pilot,* December 2, 1950.

Stolte Inc. as a partner, and the company went on to build Hearst Castle for William Randolph Hearst. In 1976, National Medical Enterprises purchased Stole Inc.[77]

Crest Contracting Company won the contract for construction of pump turnouts from mile 58.18 to mile 96.62 on May 2, 1958. Floyd Hardwick, a former Rio Vista city administrator, owned the company. While working on the Dela-Mendota Canal, Crest Contracting also undertook projects constructing culverts for Merced County.[78]

Contracts for "furnishing, hauling, and placing gravel" from various stations along Delta-Mendota Canal and the Westley wasteway were awarded to H. Sykes Construction Company. Under Specification R2-32, Sykes's company performed work along M.P. 12.99 to M.P. 25.88 and the start of the Westley wasteway to M.P. 0.37. The company specialized in road oiling, paving, and ready-mix concrete. Hubert Sykes headquartered his company in Patterson, California. Born in England in 1895, Sykes came to Patterson in 1919, having become a naturalized US citizen in 1918.[79]

E.A. Pollard won the contract for the "erection of right-of-way fence," which cost the government $5,407. Prior to his work on the Delta Mendota Canal, Pollard and his employees worked in Martinez, constructing a bridge across Marsh Creek on County Road E-44 and in Mendocino, grading and improving roads in Wages Creek. Born in 1897 in Oregon, it is not clear when Pollard came to California and established a home in Richmond. He operated his business out of Fairfax.[80]

To aid in the furnishing, processing, hauling, and placing of gravel along stations, the government also developed contracts with M.J. Ruddy and Son of Modesto, California (**Figure 11**). The company emphasized the "prompt delivery" of sand and gravel, including washed concrete sand and crushed rock. Though the company's establishment dates to the 1930s, it did not file as a stock corporation until October 15, 1954. Other work done by M.J. Ruddy and Son involved highway bridges and overpasses from Firebaugh throughout the San Joaquin Valley, and paving on the Tuolumne-Sonora Road. At the time the government accepted the bid for the Delta Mendota Canal, M.J. Ruddy and Son's managers included M.J. Ruddy, Jr, project manager; Fred Sattler, chief engineer; Warren Shields, project superintendent; and Paul Snyder, office manager.[81]

The Claude C. Wood Company also won a bid for "furnishing or processing, hauling and placing gravel" for Delta-Mendota Canal. Based in Lodi, California, Claude C. Wood Co. operated a gravel plant which manufactured rock, sand, and gravel and offered ready-mix concrete for purchase. The company also provided asphalt road oils to eliminate dust on driveways along farmland. During World War II, the Claude C. Wood Co. supported the war effort by assembling parts for floating drydocks, operating under a sub-contract for the United States Navy. Wood himself led an active role in his community; he served as secretary-treasurer for the Turlock Exchange Club in the 1920s and served on the board of trustees for Galt High School in the 1940s. Trained as an engineer, Wood came to California from Wisconsin in 1905 at the age of 20.[82]

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[77] Technical Report, 106; "County Ok's Tax Rate for New Plainview District," *Tracy Press*, May 4, 1951; "More Acreage Wanted in New Water District," *Tracy Press* October 2, 1950; Evelyn De Wolfe, "San Simeon Builder's Forgotten Notes : Cache Enriches Castle Lore," *LA Times*, January 25, 1985; "Carol Louise Stolte Paden," *Alameda Sun*, May 14, 2020.

[78] Technical Report, 106; "New Southbay Business Licenses," *The Redondo Reflex*, April 16, 1948; "Gasoline, TV Thefts Reported," *Merced Express*, January 29, 1959.

[79] Technical Report, 147; "Advertisement," *West Side Index*, June 2, 1960; United States Federal Census, "Hubert Sykes," 1940 and 1950.

[80] Technical Report, 146; United States Federal Census, "E A Pollard," 1940; "Official Report of the Board of Supervisors," *Contra Costa Gazette*, May 6, 1949; "Mendocino Beacon Files," *Mendocino Coast Beacon*, January 2, 1959.

[81] Technical Report, 146; "Modestan's Bid On Road Work is Low," *Modesto Bee*, February 24, 1939; "Advertisement," *Modesto Bee*, February 26, 1947; "Supervising the Jobs," *Western Construction*, vol. 32 (Cornell: King Publications, Jan. 1957); Gene Phillips, "Obituary- Cirgus H. Rumbaugh," *Rogers County Archives*, November 28, 2006.

[82] Technical Report, 146; "Neel Re-elected Club President," *Modesto Bee*, July 2, 1926; "Farmers and Grape Growers Attention," *Lodi News-Sentinel*, April 27, 1943; "Wood Given Contract to Assist Navy," *Lodi News-Sentinel*, June 18, 1943; United States Federal Census, "Claude C. Wood," 1940; US City Directories, 1822-1995, "Claude C. Wood," 1905.

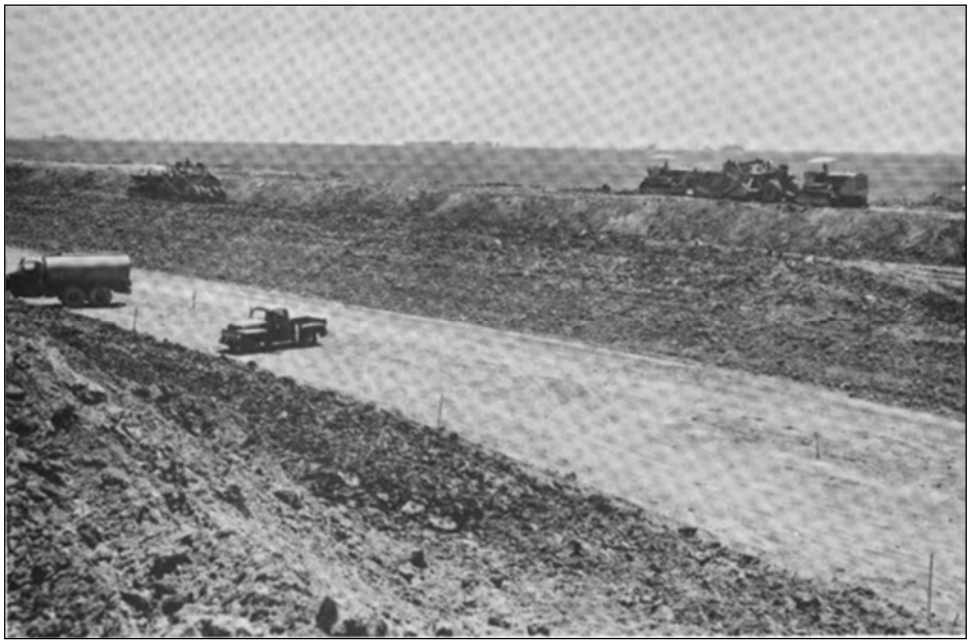


Figure 11: Placing and compacting lining material on side slope of canal, July 26, 1950.[83]

The high groundwater level, some large storms, and labor issues were among the biggest obstacles during construction. The high groundwater table caused water intrusion into the canal excavations and required contractors to de-watered those areas moving the water into a pilot ditch or other drain structures. Heavy storms in November and December 1950 also slowed progress when the deluge caused high water in Los Banos and San Luis creeks, which both breached constructed portions of Delta-Mendota Canal, causing damage to the canal and to some of the siphons. The storms also caused excess water in Garzas Creek to undermine an overchute pier and damaged some of the canal lining. After the delays caused by the storms and the subsequent repairs, a series of labor strikes in May 1951 halted constructed for about two weeks. Once the workforce returned the main branch of the canal was completed in summer 1951, but Delta-Mendota Canal was not considered complete until April 1952 when the San Luis Wasteway was completed (later renamed Volta Wasteway).[84]

Completion of the CVP was an economic boon to the Central Valley. In 1953, two years after the major canals of the project were complete, the project provided 1,500,000 acre-feet to irrigate nearly 720,000 acres of land. That year, the project delivered 134,000 acre-feet of irrigation water along Delta-Mendota Canal to districts composed of almost 120,000 acres. Reclamation planned for ultimate development of 225,000 acres in the Delta-Mendota service areas to be achieved upon the completion of Folsom Dam (1956) on the American River in Sacramento County and the Trinity Division in Trinity County (1959-1967), which transfers water from the Klamath River Basin into the Sacramento River Basin.[85]

Completion of the CVP also came with controversy. The century or so after California's Gold Rush witnessed exploitation of the Delta not only for irrigation purposes, but for other water resources, including chinook salmon. Canneries appeared in Sacramento as early as 1864, but the California Fish Commission noted a severe decline in fish populations by 1880 – attributed to overfishing and the prevalence of sediment in spawning beds from hydraulic mining. As detrimental as overfishing and mining were to the salmon runs, the most adverse effects came from the changes in the Delta landscape and ecosystem from the Central Valley Project and the State Water Project. Delta-Mendota Canal provided water to the west side

[83] [Photograph], DM-895-CV, in USDI, Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal,* 141.
[84] USDI, Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal,* 142-144.
[85] USDI, Reclamation, "The Contribution of Irrigation and the Central Valley Project to the Economy of the Area and the Nation," (Government Printing Office: Washington, 1956), XIII, 21.

of the San Joaquin Valley, but left "the 59-mile stretch of the river from Mendota upstream to Friant Dam with little water, and within this reach, the 23 miles directly above Mendota were completely dewatered." The dry river channel and the 319-foot-high concrete dam rendered the salmon helpless, with no way to continue their traditional migration and spawning runs. Not until 2009 did legislation pass to provide "substantial river channel improvements and sufficient releases from Friant Dam" to sustain the fish population from downstream to the Merced River, allowing water to flow freely through the San Joaquin River. The impacts of this San Joaquin River Restoration Settlement Act are still being observed.[86]

Further negative effects on the fish populations of the San Joaquin River system have been caused by altered hydrology, recirculation of water, and poor water quality caused by polluted runoff and dissolved oxygen. Though fish are entrained at the C.W. Bill Jones Pumping Plant (formerly Tracy Pumping Plant) to mitigate impact on the fish population, increased pumping alters the hydrodynamic conditions of the water, creating problems for fish who rely on habitat condition indicators to make their run. The Central Valley Project Improvement Act of 1992 allocated 800,000 acre-feet per year of CVP water "dedicated for anadromous fish enhancement and wildlife purposes," managed by the Sacramento division of the U.S. Fish and Wildlife department. A portion of this water is reserved to reduce pumping from the Jones plant, as efficient fish diversion via entrainment continues to decrease.[87]

By 1959 when Reclamation published its final report on Delta-Mendota Canal's construction, entitled *Delta-Mendota Canal Technical Record of Design and Construction*, most of the turnouts supplying water to individual water districts had been completed, nearly all according to Reclamation's standardized specifications. A few more, also designed according to specifications, were over the next several decades.[88] Individual water districts are responsible for maintaining turnouts into their own distribution systems and adding turnouts from Delta-Mendota Canal as needed and approved by Reclamation. Most of the physical changes made to Delta-Mendota Canal since its completion fall into five categories 1) maintenance, 2) capacity correction, 3) water district turnout additions and changes, 4) drainage / erosion control, 5) automation. Since October 1992 San Luis & Delta-Mendota Water Authority (Authority) has been responsible for maintenance of Delta-Mendota Canal.

The Authority is responsible for maintaining the concrete lining of the canal. Natural processes including land subsidence and soil characteristics cause deterioration of the concrete panels that line the canal. As noted, land subsidence and the damage it caused to Delta-Mendota Canal became apparent almost as soon as Reclamation turned water into the canal. Writing retrospectively about subsidence in 1968, geologist N.P. Prokopovich, and engineer D.J. Hebert noted that the most widespread soil bed in the upper part of the San Joaquin Valley was an "ancient lake bed known as the Corcoran or Blue Clay," in which a substantial storage of artesian groundwater lays. This groundwater reserve constituted a large portion of the irrigation supply before the CVP and continued to be a source even after the canal was built. Since 1960, the Bureau of Reclamation recognized a phase of subsidence caused by well-developed ground water overdraft, denoting it as "prominent and publicized." However, a different phase of subsidence called "lag," which occurs even when the area experiences little or no pumping of groundwater, and despite a decrease or disappearance of overdraft.[89]

Prokopovich and Hebert explained that the last 30-40 miles of Delta-Mendota Canal offer a remarkable example of lag subsidence (**Figure 12**). Preconstruction and construction surveys had not recognized any land subsidence in the lower reaches of the DMC, and any changes in elevation were attributed to earthquakes. By 1952, however, professionals identified

[86] Philip Garone, "Managing the Garden: Agriculture, Reclamation, and Restoration in the Sacramento-San Joaquin Delta," in in Delta Protection Commission, Delta Narratives: Saving the Historical and Cultural Heritage of the Sacramento-San Joaquin Delta, prepared by the Center for California Studies, California State University, Sacramento (West Sacramento: Delta Protection Commission, 2015), 77-86.

[87] USDI, Bureau of Reclamation, "Delta-Mendota Canal Recirculation Feasibility Study – Plan Formulation Report," (Sacramento: September 2010), 58-62; USDI, Reclamation, "Delta-Mendota Canal/California Aqueduct Interie – Final Environmental Impact Statement, vol 1: Main Report," (Sacramento: November 2009), 99-102.

[88] USDI, Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction;* USDI, Reclamation, "Milepost at Structure Sites Delta-Mendota Canal," 1985.

[89] N.P. Prokopovich and D.J. Hebert, "Land Subsidence Along the Delta-Mendota Canal, California," *Journal (American Water Works Association)* vol. 60, no. 8, August 1968.

subsidence as responsible for past changes in elevation. At the time of article, Prokopovich and Hebert noted that 22 miles of the concrete-lined section and all 18 miles of earth-lined section were affected by subsidence, causing the linings to become submerged below the water. Bridges and pipe crossings showed extensive effects of subsidence, where their clearance to the water was reduced sometimes to within inches or none at all. In some cases, the subsidence caused timber bridges and pipe crossings to flood (**Figure 13**). Prokopovich and Hebert stated that subsidence had not negatively affect the capacity of the canal, nor was there damage to either canal linings or structures. Despite the lack of impacts to the canal's capacity and its linings and structures, subsidence caused enough of a maintenance and operations problem to warrant a plan to rehabilitate the canal that was proposed for the 1968-1969 fiscal year. Reclamation staff estimated that the lag subsidence would increase up to two feet a year.[90]

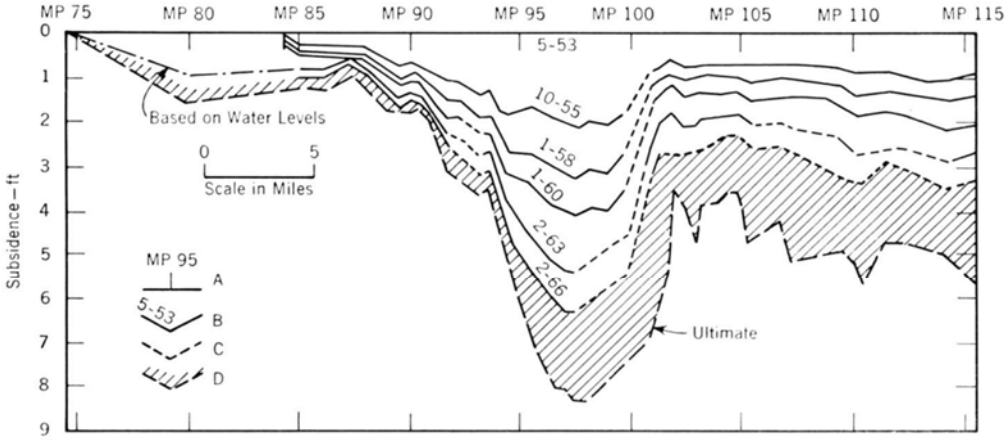


Fig. 5. Past and Future Land Subsidence in Downstream Reaches of the Delta-Mendota Canal

A is mile post (distance from intake); B is date of survey data; C is interpolations to bridge data gaps; D is predicted ultimate subsidence.

Figure 12: From Prokopovich and Hebert, graph showing past and future subsidence, 1968.[91]

[90] N.P. Prokopovich and D.J. Hebert, "Land Subsidence Along the Delta-Mendota Canal, California," *Journal (American Water Works Association)* vol. 60, no. 8, August 1968.

[91] [Photograph] in Prokopovich and Hebert, "Land Subsidence Along the Delta-Mendota Canal, California," 917.



Fig. 7. Effect of Subsidence on Bridge at Near Capacity Flow

This is a partially submerged timber bridge at Mile Post 98.21, in an area affected by deep subsidence. Concrete lining of the canal is completely flooded.

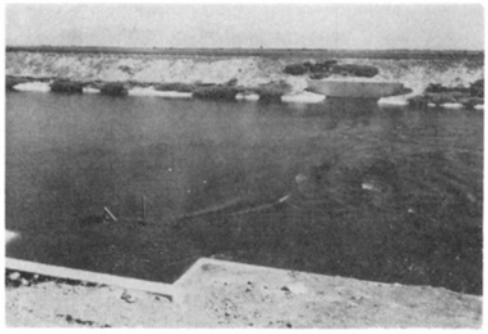


Fig. 9. Effect of Subsidence on Pipe Crossing at Near Capacity Flow

This is a submerged pipe crossing at Mile Post 91.71 in an area affected by deep subsidence.

Figure 13: Effects of subsidence on DMC, 1968.[92]

In December 1952, members of the canal's Central Valley Project Operations and Tracy Operations divisions conducted a biennial inspection of Delta-Mendota Canal, the first of which took place in October 1951, just a few months after the canal first delivered water. The report contained comments on the intake structure and intake canal; concrete and earth lining; and structures. It also provided recommendations and a general remark noting that "this was the first time the upper 100 miles of canal has been [dewatered] since water was turned in the canal in July 1951." The inspectors noted minor bank erosion and beaching on a curve of the canal near M.P. 0.5, no leakage in the discharge lines, and concrete and earth linings in good condition aside from "minor trouble spots" such as bulging and cracking and settlement of berms (**Figure 14**). Concerning the structures, the inspectors observed problems like leakage in the Mountain House Road siphon, canal silting at M.P. 42, drain pumps out of service, and inaccurate measurements from sparling meters.[93]

In June 1965, the Bureau of Reclamation Chief of Engineers received a report on the condition of Delta-Mendota Canal, including Tracy Fish Collecting Facilities and Tracy Pumping Plant. Overall, the canal appeared to be in excellent condition at the time, including its structures, gates, and operating roads. Subsidence was described as "slow and not yet stabilized." At the time of the inspection, no maintenance issues caused by the subsidence presented themselves; therefore, no corrective action occurred. The report also mentioned that several bridges had been replaced, with others needing replacement as well, such as the bridge at M.P. 90.56 (**Figure 15**). The turnouts and gates and wasteways looked to be in good condition, only requiring minor aesthetic maintenance. The inspectors observed the Tracy Pumping Plant to be well-maintained and in excellent condition, but did note a horizontal crack in the wall along the construction joint on the discharge side of the motor room. However, the inspectors found no evidence of leakage. Regarding cross drainage siphons and channels, the examination team noticed some leakage that seems to decrease as the weather and water warm. To mitigate this leakage and degradation, baffled-apron drops were under construction (**Figure 16**). The report concluded with the recommendation that the unwatered canal be watched during the winter of 1965-1966 to determine the necessity of repairing the flap-valve underdrain outlets

[92] [Photograph] in Prokopovich and Hebert, "Land Subsidence Along the Delta-Mendota Canal, California," 918.
[93] United States Department of the Interior, Bureau of Reclamation, Divisions of Design and Construction Operation and Maintenance, *Report on Inspection of Friant-Kern, Madera, Contra Costa, and Delta-Mendota Canals, 1-5.*

because that winter would likely be the last year of the "normal operating procedure" because once the San Luis Unit began operations (built in the early 1960s), the canal would be in continuous use. [94]

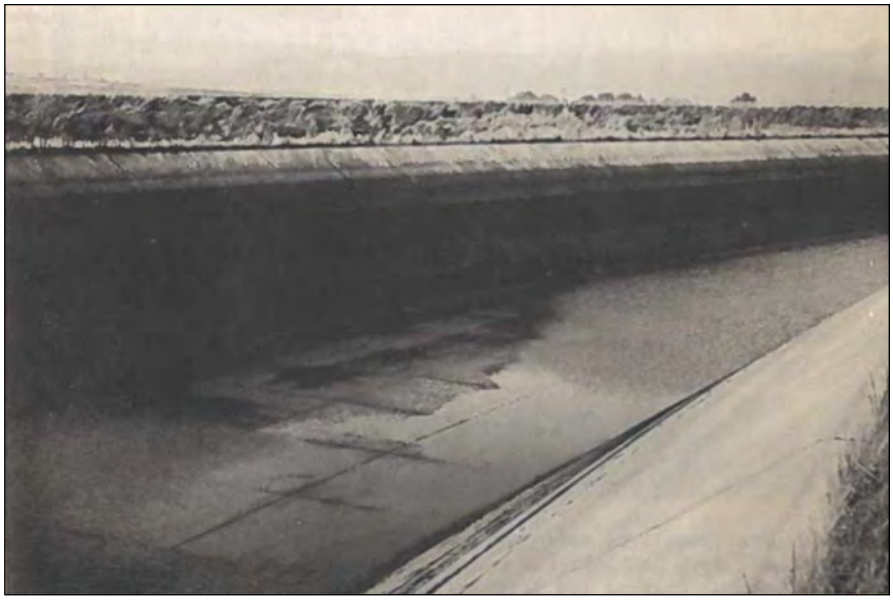


Figure 14: M.P. 11.15, concrete lining and heaving of bottom slab.[95]



Figure 15: Bridge, Mile 90.56, scheduled for replacement. May 14, 1965.[96]

[94] United States Department of the Interior, Bureau of Reclamation, *Condition of Major Irrigation Carriage Systems and Appurtenant Features – Central Valley Project* (Denver: June 21, 1965), 3-8.
[95] [Photograph], DM 2294 in USDI, Divisions of Design and Construction Operation and Maintenance, *Report on Inspection of Friant-Kern, Madera, Contra Costa, and Delta-Mendota Canals.*
[96] [Photograph], Photo No. 5, P214-D-48741 NA, in USDI, Reclamation *Condition of Major Irrigation Carriage Systems and Appurtenant Features,* 20.



Figure 16: Baffled apron drop under construction, May 12, 1965.[97]

The Bureau of Reclamation authored a similar report on June 5, 1970, examining "major irrigation structures and facilities operated and maintained by Tracy Field Division, Central Valley Project." Overall, the structures were found to be in good condition. The most pressing concern was the prevalence of people and expanding use of the canals for recreational activities like fishing. On Delta-Mendota Canal, the inspectors noted some erosion in the earth-lined section, but the concrete-lined sections appeared to be in excellent condition. As stated in previous inspection reports, some cracking in the lining on Mile 75 was evident but did not seem to be increasing. The examination team commented on the disruption of the canal by the public, including agricultural pipe crossings on the canal or farmers who discharged barnyard waste into the canal (**Figure 17**). The report recommended fencing around the checks to prevent fishing and any risk of people falling into the canal and drowning. The team found the overall condition of the canal's radial gates and turnouts and drain inlets to be satisfactory and without need for repair but recommended the removal of cottonwood trees growing in the San Luis wasteway channel.

The 1970 inspection report did, however, note some issues concerning subsidence, seepage, and silt deposits. The team noticed subsidence in the lower reaches of the canal, below M.P. 70. At the time of the inspection, the reach was already scheduled for a lining raise, to alleviate the effects of future subsidence. The team also witnessed significant seepage at two locations

[97] [Photograph], Photo No. 9, P214-D-48732 NA, in USDI, Reclamation *Condition of Major Irrigation Carriage Systems and Appurtenant Features*, 21; baffled apron drop under construction to control retrogression at Coral Hollow Creek Siphon.

along the canal, with the most detrimental between M.P. 56 and 57. According to the report, a prior inspection observed seepage; thus, the maintenance division added a layer of butyl rubber over the concrete lining sometime in 1966. This remedy proved to be insufficient and a plan to completely replace the concrete lining was in development. Silt deposits became more prevalent after the construction of the O'Neill Pumping Plant (at B.F. Sisk Dam and part of the San Luis Unit) and with the "increased operation of the check gates" downstream of the Tracy Pumping Plant (**Figure 18**). Due to a lack of funding for studies, no sufficient method of removing sediment existed in 1970 for the Tracy Field Division.[98]



Figure 17: Discharge of barnyard manure into the canal, May 16, 1970.[99]

[98] United States Department of the Interior, Bureau of Reclamation, *Condition of Major Irrigation Structures and Facilities – Central Valley Project – Report of Examination* (Denver 1970).
[99] [Photograph], 5-70-49D in USDI, Reclamation, *Condition of Major Irrigation Structures and Facilities – Central Valley Project – Report of Examination*, 14; government is starting legal action if this is not stopped by July.



Figure 18: Note rough silty water below gates at Check No. 19, May 16, 1970.[100]

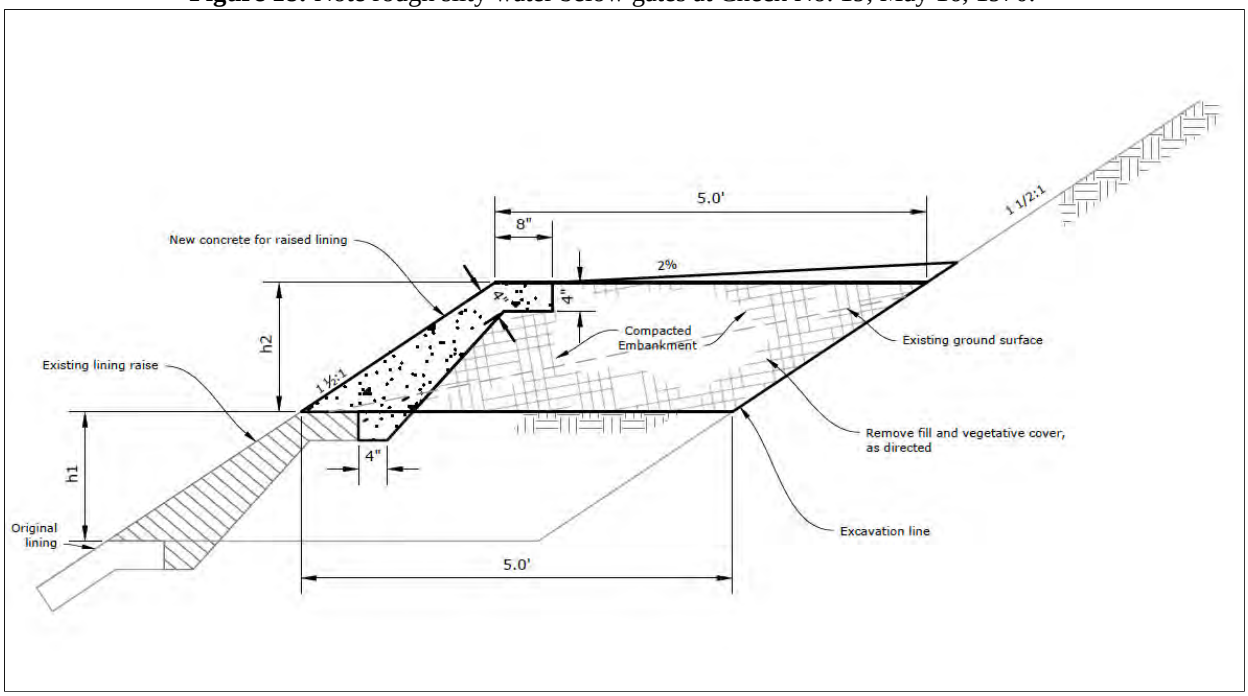


Figure 19: DMC typical cross section showing placement of original concrete lining, previous lining raise, and proposed lining raise.

[100] [Photograph] 214-D-67155 in USDI, Reclamation, *Condition of Major Irrigation Structures and Facilities – Central Valley Project – Report of Examination*, 16; gate pins partially submerged.

Over time various points along the canal have required modifications to correct the carrying capacity of the canal. Reclamation undertook one of the earliest, and most extensive capacity corrections in 1969, raising approximately 70 miles of the concrete-lined canal 18 inches and 24 inches.[101]

Wet conditions and soil characteristics make drainage and erosion control a perpetual issue that requires maintenance, the placement of drains where needed, and abandonment of drains that have become obsolete. As farming intensified around the canal following its completion, drainage water diminished as it was captured by surrounding farmlands. Many original concrete inlet drains have either become obsolete or have deteriorated.

Other changes have taken place to structures that span the canal like bridges and pipe crossings / overchutes since completion of Delta-Mendota Canal. In the 1960s, Reclamation undertook a bridge rehabilitation project that converted timber farm bridges piers from wood to concrete. Pipe crossings are changed frequently, and Reclamation maintains separate license agreements with utility companies for each crossing of water, oil, gas, transmission lines etc. Pipelines are removed, replaced with a new type of pipe, and added at new locations as dictated by local demand.

The massive length and capacity of Delta-Mendota Canal has largely been an obstacle to execution of a comprehensive modernization or upgrade plan because the cost would be prohibitive. Instead, the original design specifications have continued to serve as the basis for maintaining the canal, which has resulted in a high retention of many of the features and the overall character of Delta-Mendota Canal.

[101] USDI, Reclamation, *Designer's Operating Criteria*, 1971: 4-5, 26; Grimsley, J. O. and M. L. Barmettlor, *Condition of Major Irrigation Structures and Facilities*, Region 2, 1970, Appendix I – 3, 6.

NRHP / CRHR Evaluation

Criteria for Evaluation

The eligibility criteria for designating historic properties under federal and state criteria are essentially the same. The criteria for listing properties in the National Register of Historic Places (NRHP) are codified in 36 CFR 60 and expanded upon in numerous guidelines published by the National Park Service. Buildings, structures, objects, sites, and districts listed in, eligible for listing in, or that appear eligible for listing in the NRHP are considered historic properties under the regulations for Section 106 of the National Historic Preservation Act (NHPA). Eligibility for listing buildings, structures, objects, sites, and districts (i.e., historic properties) in the NRHP rests on twin factors of *historic significance* and *integrity*. A resource must have both significance and integrity to be considered eligible. Loss of integrity, if sufficiently great, will overwhelm the historic significance a property may possess and render it ineligible. Likewise, a property can have complete integrity, but if it lacks significance, it must also be considered ineligible. Historic significance is judged by applying the NRHP criteria, identified as Criteria A through D. The NRHP guidelines state that a historic property's "quality of significance in American history, architecture, archeology, engineering, and culture" must be determined by meeting at least one of the four main criteria. Properties may be significant at the local, state, or national level. The NRHP criteria are:

Criterion A: association with "events that have made a significant contribution to the broad patterns of our history;"

Criterion B: association with "the lives of persons significant in our past;"

Criterion C: resources "that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values;"

Criterion D: resources "that have yielded, or may be likely to yield, information important to history or prehistory."[102]

Integrity is determined through applying seven factors to the historic resource: location, setting, design, workmanship, materials, feeling, and association. These seven can be roughly grouped into three types of integrity considerations. Location and setting relate to the relationship between the property and its environment. Design, materials, and workmanship, as they apply to historic buildings, relate to construction methods and architectural details. Feeling and association are the least objective of the seven criteria and pertain to the overall ability of the property to convey a sense of the historical time and place in which it was constructed.

Central Valley Project Draft Multiple Property Listing

In 2009 Reclamation prepared a *Draft National Register of Historic Places Multiple Property Documentation Form: Central Valley Project* (CVP MPL), and updated it in 2018.[103] The CVP MPL identifies the period of significance for the CVP as 1935 when the project received its first authorizations to 1956 when the last of the major project components was completed. The document provides registration criteria regarding NRHP significance and integrity. The subsections of the registration requirements relied upon for this evaluation of Friant-Kern Canal for individual eligibility for listing in the NRHP are the subsection for "Main Canals," and for "Appurtenant Canal Features," as quoted below. The NRHP and CRHR evaluation of Friant-Kern Canal contained in this report utilizes the framework provided in the CVP MPL.

[102] USDI, National Park Service, *Guidelines for Applying the National Register Criteria for Evaluation, National Register Bulletin 15* (Washington, D.C.: USDI, National Park Service, 1990, rev. 1997).
[103] Jim Bailey, "National Register of Historic Places Multiple Property Documentation Form, Central Valley Project: Planning and Construction of the First Four Divisions, 1935-1956," draft prepared for Reclamation, 2009, updated 2018.

The following is excerpted from the CVP MPL:

Main Canals

Construction on the first main canal of the CVP, the Contra Costa Canal of the Delta Division, commenced in 1937 and was completed in 1948. In 1940, construction began on the Madera Canal of the Friant Division, with construction completed in 1945. In 1945, construction on the Friant-Kern Canal began. The following year, construction on the Delta-Mendota Canal commenced. Finally, in 1950, construction on the Delta Cross Channel began. The Friant-Kern Canal, Delta-Mendota Canal, and Delta Cross Channel were all completed in 1951. The longest main canal is the Friant-Kern Canal at 151.8 miles, while the shortest is the Delta Cross Channel at 1.2 miles. All main canals are located on Reclamation fee title or easement land.[104]

Significance

In conjunction with the storage and diversion dams, canals form the CVP's backbone. They provide the means to transfer, transport, and deliver water through the system and ultimately to the water users. Traversing across hundreds of miles, the canals form a significant feature of the physical landscape and define the geographical limits of the project. In keeping with the original CVP plan of large-scale water transfers, canals are the primary means behind the geographical redistribution of fresh water from the valley's wetter northern reaches to the drier southern stretches.[105]

Registration Requirements for CVP Canals

The period of significance for historic water conveyance structures begins in 1937 with the initial construction of the first CVP canal, the Contra Costa Canal, and ends in 1951 with the completion of the Friant-Kern, Delta-Mendota, and Delta Cross Channel canals. Like the dams, these canals are part of the initial CVP authorizations. The main canals within the period of significance for this historic context are all considered individually eligible because of their primary role in operating the CVP. The main canals can be individually eligible for the National Register under one or more of the criteria, as follows:[106]

Criterion A: They have had a significant impact on the settlement, agricultural economy, or development patterns of the project area; they have been defining elements in the evolution of the cultural landscape; they are directly associated with important events.

Criterion B: They are the result of the direct efforts of a prominent individual associated with the CVP and are the most prominent feature associated with that individual.

Criterion C: They represent the distinctive characteristics of Reclamation canal design and/or methods of construction used on the CVP; they involved challenging engineering design problems due to topography, grade, length, natural obstacles, and resulted in complex or innovative solutions; they are among the best or a rare surviving example of a distinctive type of water conveyance structure; they represent the evolving technology in the engineering, design, and construction of water conveyance structures; they were identified during the construction period as an individually significant feature; or they embody the work of a significant engineer or builder.

Criterion D: They have the ability to yield information important to understanding the history of the CVP.[107]

Integrity

The need for continual maintenance and repairs to canals requires special consideration of integrity. Irrigation systems are constantly evolving as features are upgraded, repaired, or replaced. Alterations made to canals during the period of significance, and even subsequent **thereto**, may not nullify eligibility if a canal retains certain key qualities. Most important are integrity of location, association, and overall design configuration of the conveyance prism (i.e. depth and width) and water

[104] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 106.
[105] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 106.
[106] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 107.
[107] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 108.

control features. A canal which has retained its original form and associated appurtenant features has a high degree of integrity. It is not uncommon for canal lining to be replaced, or for previously unlined segments to be lined. Such changes may not preclude a canal's eligibility if replacement features are in-kind, or they do not significantly damage the canal's historic association or its overall design. If in addition to integrity of association, location, and overall design, the historical setting and feeling of a canal are maintained, then the likelihood is even higher that an altered canal could remain eligible. On the other hand, if an entire canal is piped, it would no longer convey any of its original design, workmanship, materials, or historical association and would not be contributing. Conversely, partial piping of a significant canal may not preclude eligibility if a majority of a canal is still open and intact.[108]

Appurtenant Canal Features

Although appurtenant canal features are all operationally and thematically related to canals, each feature type serves a specific purpose. These features can be divided into five categories of structures: conveyance, regulating, protective, water measurement, and bridges. The first four of these types were built to function as part of the canal, while the bridges were built to function independently of the canal.[109]

1. *Conveyance Structures*

Conveyance structures are features such as inverted siphons, drops, chutes, flumes, tunnels, and pipelines that are used to safely transport water from one location to another traversing various existing natural and manmade topographic features along the way. There are two types of pipelines, those that carry water below ground and those that transport water above ground.[110]

2. *Regulating Structures*

Regulating structures are used to raise, lower, or control the release and volume of the water flow. Regulating structures that are located at the source of the water supply include headworks and turnouts. Headworks control the release of water into the canal, and are often located downstream from a major diversion or storage facility. Regulating structures located along the course of a canal include turnouts, checks, check-drops, radial gates, reservoirs, and diversion structures. The smaller regulating structures like checks and turnouts are basic components of an irrigation system.[111]

3. *Protective Structures*

Protective structures protect the canal system and adjacent property from damage which would result from uncontrolled storm runoff or drainage water, or an uncontrolled excess of flow within the canal. Several different types of structures perform this function, including overchutes, drainage inlets, siphon spillways, and wasteways.[112]

4. *Water Measurement Structures and Objects*

Water measurement structures are used to gauge water flow and ensure its equitable distribution. Many different types of water measurement structures are used in irrigation systems. The type most commonly used in Reclamation's systems are Parshall flumes, weirs, open-flow meters, and constant head orifices.[113]

5. *Miscellaneous Structures*

a. Bridges

Bridges crossing CVP canals range from single lane bridges, multi-lane highway bridges, farm bridges, pedestrian bridges, and maintenance bridges. Most of the bridges constructed within the period of significance were built by Reclamation

[108] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 108-109.
[109] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 109.
[110] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 109.
[111] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 109-110.
[112] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 110.
[113] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 111.

according to standard designs. Ownership of the bridges were turned over upon their completion to other entities, including city, county, or state transportation agencies. There are also many bridges not constructed by Reclamation that have been added over CVP canals and were built outside the period of significance for this historic context. Additionally, some original bridges built by Reclamation have been replaced.[114]

b. Gauging or Recording Stations

Several types of small structures were built in association with gauging or recording stations to measure canal flows. The most common are small circular plan, sheet metal structures called "tin whistles" or "silver bullets" that provide enclosure for recording devices. A second type of shelter is small reinforced concrete "houses." When gauging or recording stations are located over the canal, simple wooden footbridges with wood handrails were constructed to permit the taking of measurements. In some cases, the original bridges have been replaced with concrete or metal ones, which are easier to maintain. Many of the gauging or recording structures are built on concrete pads, adjacent to the canal, on the canal berm.[115]

Significance

Secondary to the canals in distributing water are the thousands of appurtenant features. With the exception of bridges, these appurtenant features are important to the overall operation of the main canals, yet are too small in size and repetitive in design to merit individual eligibility.

Even though bridges cross canals and can be physically tied to the canal prism, bridges have no connection to the operation of the CVP and therefore merit separate evaluation from other appurtenant features. In addition, most of the bridges were either constructed by Reclamation and ownership was turned over to a different entity or they were constructed by a different entity. Because of these reasons, bridges would rarely be individually eligible for the National Register in association with this historic context.[116]

Registration Requirements

The period of significance for historic appurtenant canal features begins in 1937 with the initial construction of the first CVP canal, the Contra Costa Canal, and ends in 1951 with the completion of the Friant-Kern, Delta-Mendota, and Delta Cross Channel canals. CVP appurtenant canal features can be eligible for the National Register for the following reasons:[117]

Criterion A: They are directly associated with important events that occurred along canals;

Criterion B: not applicable;

Criterion C: They are among the best or a rare surviving example of a distinctive type of appurtenant canal feature; they represent the evolving technology in the design of appurtenant canal features; they represent a unique design solution developed in response to a difficult engineering challenge; they were identified during the construction period as an individually significant feature;

Criterion D: They have the ability to yield information important to understanding the history of the CVP.[118]

[114] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 111.
[115] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 111.
[116] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 112.
[117] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 112.
[118] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 112-113.

Integrity

As with canals, many appurtenant features are upgraded, altered, or even replaced over time due to the constant ongoing maintenance needs. Integrity of a structure's historic materials, workmanship and design is essential for National Register eligibility under any criterion. Because location is of primary importance under Criterion A, a structure will rarely qualify under this criterion if it does not remain on its historic site along its associated canal. Location can also have importance under Criterion C, but this association is less vital.[119]

Evaluation

The following evaluates Delta-Mendota Canal for individual eligibility for listing in the NRHP and CRHR under the theme presented in the draft CVP MPL.

Portions of Delta-Mendota Canal and some of its appurtenant features have been subject to previous NRHP evaluations. In 2009, Reclamation historian Jim Bailey prepared a draft NRHP nomination form that concluded that Delta-Mendota Canal meets NRHP Criterion A with a period of significance from 1946-1951. Bailey also evaluated Tracy Pumping Plant in 2009, concluding that it meets NRHP Criterion A and C with a period of significance of 1951. Other appurtenant features of the canal that have been previously evaluated are listed in Table 9 below with the updated status codes provided by this evaluation.[120]

Table 9: Previously evaluated segments and appurtenant features of Delta-Mendota Canal.

Primary String	Resource Name	Status Code – Previous	Status Code – Updated by this evaluation	County
P-10-005165	Delta-Mendota Canal Bridge	3D	6Z	Fresno
P-10-006215	Sierra Avenue Bridge (42C0281); Sierra Avenue Bridge over Delta-Mendota Canal	3D	6Z	Fresno
P-10-006649	Bridge 42C0074; Nees Avenue Bridge over Delta-Mendota Canal	3D	6Z	Fresno
P-24-001703	Delta Mendota Canal	2S2	2S2	Merced
P-24-001848	San Luis Wasteway (part of Delta-Mendota Canal)	2S2	2S2	Merced
P-39-000089	Delta Mendota Canal	3D	2S2	San Joaquin
P-50-001904	Delta Mendota Canal	2S2	2S2	Stanislaus

[119] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 113.
[120] California Historical Resource Status Codes.
2S2: Individual Property determined eligible determined eligible for NR by a consensus through Section 106 process. Listed in the CR.
3D: Appears eligible for NR as a contributor to a NR eligible district through survey evaluation.
3S: Appears eligible for NR as an individual property through survey evaluation.
6Z: Found ineligible for NR, CR, or Local designation through survey evaluation.

Primary String	Resource Name	Status Code – Previous	Status Code – Updated by this evaluation	County
P-01-010442	Tracy Pumping Station (No. 11a)	3S	2S2	Alameda
P-07-002983	Tracy Fish Collection Facility	6Z	6Z	Contra Costa

The following presents the evaluation of Delta-Mendota Canal for individual eligibility for listing in the NRHP and CRHR under the theme presented in the draft CVP MPL.

Criteria A and 1

The CVP fundamentally altered California's landscape and economy by moving water over a long distance from basin to basin and providing more reliable irrigation water to regions previously prone to scarcity of both surface water and groundwater. Delta-Mendota Canal, an integral component of the Delta Division of the CVP, allowed continued delivery of water to irrigators on the San Joaquin River so that water could be diverted further south to areas with a lower water supply. While its benefits to agriculture cannot be overstated, Delta-Mendota Canal is also at the center of the controversy over replacing impounded and re-routed San Joaquin River water that no longer flows through historic salmon and steelhead spawning grounds.

Whether viewed as beneficial or harmful, Delta-Mendota Canal is an instrumental component in accomplishing the objective of the CVP, bringing irrigation water from the wetter northern state to the arid regions of the San Joaquin Valley. At 116 miles long, stretching from C.W. Bill Jones Pumping Plant (Tracy Pumping Plant) in the Delta to Mendota Pool on the San Joaquin River, Delta-Mendota Canal demonstrates the purpose of the CVP, and the scale of the transformation it generated. The canal has had a lasting legacy on California agriculture, providing a reliable water source to support immensely successful agricultural enterprises. Delta-Mendota Canal meets NRHP Criterion A and CRHR Criterion 1 at the state level because of its primary role in accomplishing the visionary goals of the CVP to transfer a substantial portion of the San Joaquin River water supply from its historical route to the arid lands of the southern San Joaquin Valley. Delivery of San Joaquin River water away from its historical water users was not a tenable proposition without the provision for replacement water delivered by Delta-Mendota Canal. The period of significance under these criteria is from the awarding of the first construction contract in 1946 to 1951 when water was first turned down the canal to provide a replacement supply of water.

Criteria B and 2

The CVP was the result of the efforts of many individuals and agencies over many years and no one person or group of people rises in the historical record as playing a direct role in its implementation in a way that would be best demonstrated by Delta-Mendota Canal; therefore, Delta-Mendota Canal is not individually eligible for listing in the NRHP under Criterion B or in the CRHR under Criterion 2.

Criteria C and 3

Delta-Mendota is individually eligible for listing in the NRHP and CRHR under Criterion C and Criterion 3 because its size, scale, and purpose demonstrate the magnitude of the CVP's engineering and construction accomplishment. The largesse of the vision required an outsized engineering effort and no other component part of the CVP better demonstrates the vision than Delta-Mendota Canal, designed to provide water to replace the flow of the San Joaquin River. Construction of any long-distance linear infrastructure requires extensive planning and engineering, large-scale construction, and coordination among jurisdictions and agencies. As one contemporary observer noted, the "quantity of earth moved is equivalent in mass to more than three times that of Grand Coulee Dam – world's largest concrete structure – and the quantity [*sic.*] of concrete placed for the 97-mi. concrete-lined portion of the canal is more than sufficient to build a sidewalk 3 ft. wide and 4in. thick between San

Francisco and New York City."[121] The scale of the project and the sheer number of obstacles present along the 116-mile alignment made its design and construction a monumental undertaking. The canal's significance, however, is not tied to the engineering or construction of any of its individual components or appurtenant parts, but rather to its ability to demonstrate the scale of the project by the long-distance conveyance of water for the purpose of transferring water between watersheds. Delta-Mendota Canal is individually eligible at the state level under NRHP Criterion C and CRHR Criterion 3 because it demonstrates the visionary engineering achievement that redistributed the flows of major rivers between basins in California. The period of significance under these criteria is the period of construction of Delta-Mendota Canal, 1945-1951.

Morrison-Knudsen Company, Inc., who won four construction contracts for Delta-Mendota Canal in partnership with M.H. Hasler Construction Company, built the largest share of the canal. Morrison-Knudsen should be considered a master builder for their large body of work and extensive experience with large infrastructural construction projects both in the United States and worldwide since the 1930s that included among other civil and military works, very large dam projects like Hoover Dam on the Colorado River. While construction of Delta-Mendota Canal was a large undertaking for the company, it does not best represent their body of work. They were most known during the pre- and post-World War II period for construction of military installations, bridges, and large dams. Delta-Mendota Canal would not best represent the work of any of the other contractors who won contracts for the canal because their contributions to the project were only to a small fraction of the overall project.

Delta-Mendota Canal also meets NRHP Criterion C and CRHR Criterion 3 because of its direct association with the contributions of renowned Reclamation engineer Oscar Boden who headed the investigation, planning, and siting of the Delta Division of the CVP, including Delta-Mendota Canal. Delta-Mendota Canal, a principal element of the CVP, is an historically important example of this master engineer's work. The period of significance for this canal is its period of construction, 1946-1951.

Criteria D and 4

Delta-Mendota Canal is not eligible under NRHP Criterion D or CRHR Criterion 4 for information potential because it was designed and built according to well-documented practices, and the project is well documented through drawings, textual records, and photographs.

In general, the character-defining features of Delta-Mendota Canal are its location, its relationship to C.W. Bill Jones Pumping Plant (Tracy Pumping Plant), the size, shape, and dimensions of the canal prism, its lining material (approximately 95 miles of concrete and 18 earthen miles), and the direction of water flow from C.W. Bill Jones Pumping Plant downstream to Mendota Pool. Individual elements that contribute to the significance of Delta-Mendota Canal along its 116.4 miles are those structures that are directly related to its significance under NRHP Criterion A / CRHR Criterion 1 and NRHP Criterion C / CRHR Criterion 3, i.e., structures that directly relate to the conveyance of CVP water from the pumping plant to Mendota Pool. Structures like C.W. Bill Jones Pumping Plant, check structures and siphons that convey and control the water's southerly flow from the pumping plant, and structures like turnouts that direct the water to users along its route and wasteways the control excess flows all relate directly to the canal's significance and purpose and therefore contribute to the significance of the historic property. Structures that accommodate pre-existing uses or conditions like pipe crossings, siphon undercrossings, culverts, drains, overchutes, and most bridges do not contribute to the historic significance of this linear historic property because they are not directly related to the conveyance of CVP water, and instead serve ancillary purposes. Similarly, ancillary features like gauging stations or salinity stations do not relate to the historic significance and are not character defining. Operating bridges that are used specifically for the operation of the canal, as opposed to farm bridges or county road bridges that simply cross the canal and have no relationship to its functioning as a CVP water conveyance, have potential to contribute to Delta-Mendota Canal's significance; however, none of this category of bridges crossing Delta-Mendota Canal retain historic integrity. See **Table 5** below and **Appendix C** for contributing status of component elements of Delta-Mendota Canal.

[121] "Concrete Lining Complete for Delta-Mendota Canal," *Western Construction* 25, n. 12 (Dec. 1950), 81.

Table 10: Contributing Status of Component Parts of Delta-Mendota Canal.

Structure Type	Contributing Status
Farm Bridges	Non-Contributing
Railroad Bridge	Non-Contributing
Pipe Crossings	Non-Contributing
County Highway Bridges	Non-Contributing
Overchutes	Non-Contributing
Inlet Drains	Non-Contributing
Road Drains	Non-Contributing
Culverts	Non-Contributing
Cattle Guards	Non-Contributing
Pumps	Non-Contributing
Ladders	Non-Contributing
Gauging Stations	Non-Contributing
Gates	Non-Contributing
Check Structures	All are Contributing
Siphons	All are Contributing
Wasteways	4 are Contributing, 1 is not – see Master Table in **App. D**
CVP Signs	All are Contributing
Lining / Prism	Lining to original specifications is Contributing
O&M Roads	Contributing (roads on canal embankments)
Operating Bridges	Non-contributing; integrity loss
Turnouts	Some are contributing – see Master Table in **App. D**
Pumping Plants	C.W. Bill Jones Pumping Plant is Contributing

The character-defining features and integrity of contributing elements are discussed below, followed by a discussion of the overall integrity of Delta-Mendota Canal. See **Appendix C** for the contributing status of individual components of the historic property.

Canal Prism, Embankments, Maintenance Roads

The character-defining features of Delta-Mendota Canal prism are its original material composition, and original design. Specifically, this includes: its concrete- and earth-lined construction; its original dimensions – height, width, and shape, side slopes, embankments, and O&M roads; and its alignment (**Figure 20**- **Figure 23**).

Those sections of Delta-Mendota Canal prism that have a high degree of integrity and, therefore, contribute to the significance of the historic property are those that retain all or most of their character-defining features. While some concrete-lined stretches of the canal have been altered by the raising of the lining, this modification only constitutes a minor loss of integrity of design, as the work included appropriate materials (concrete) and the elevated extensions were clearly differentiated from the original by a concrete seam above the original lining. As such, these alterations were made in accordance with standards set forth by the *Secretary of the Interior's Standards for the Treatment of Historic Properties* and do not disqualify those sections with raised concrete lining from contributing to the significance of Delta-Mendota Canal.[122] Similarly, those originally earth-lined

[122] Kay D. Weeks and Anne E. Grimmer, *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings*, revised by Anne E. Grimmer (Washington D.C.: USDI, National Park Service, Technical Preservation Services, 2017).

sections that have been altered by the addition of rip-rap only suffer slightly diminished loss of integrity of designs or materials; however, the rip-rap itself is considered a non-contributing element.[123] While the majority of the surrounding setting remains rural in nature as it was at the time of Delta-Mendota Canal's period of significance, 1946-1951, suburban development radiating out from Mountain House, Tracy, and Patterson have started to alter the characteristic setting. The canal itself in these areas retains its other character-defining features and thus contributes to the significance of Delta-Mendota Canal as a whole. As Delta-Mendota Canal has remained in its original alignment, it retains a high degree of integrity of location throughout the entirety of its alignment.



Figure 20: View of concrete-lined section of canal from approximately M.P. 91.36; camera facing upstream from left bank, June 14, 2022.

[123] The *Secretary of the Interior's Standards for the Treatment of Historic Properties* favor protecting historic properties with temporary materials while planning for repairs that meet the standards.



Figure 21: View of earth-lined section of canal from approximately M.P. 104.22; camera facing downstream from left bank, June 14, 2022.



Figure 22: View of embankment and concrete-lined section of canal; camera facing downstream from left bank, June 14, 2022.



Figure 23: View of embankment and maintenance road along earth-lined section; camera facing downstream from left bank, June 15, 2022.

C.W. Bill Jones Pumping Plant (Tracy Pumping Plant)

The Tracy Pumping Plant complex is made up of the Delta-Mendota Intake Canal (M.P. 0.0-2.52), the Tracy Pumping Plant facility (now called "C.W. Bill Jones Pumping Station") (M.P. 2.53), three (3) 15-foot (inside) diameter, 4,822-foot long concrete discharge pipes, a concrete-block siphon breaker house with a flat, overhanging roof at the end of the discharge lines (M.P. 3.49), and a concrete inlet structure that releases the water from the Plant into the concrete-lined section of the DMC, at M.P. 3.50. Each of these features is character defining of the Tracy Pumping Plant.

The Delta-Mendota Intake Canal contains fish collection facilities (M.P. 0.09) and a three-barrel siphon under Byron-Bethany Road and a single track for Union Pacific Railroad (formerly Southern Pacific Railroad) (M.P. 1.36/ M.P. 1.41). The character-defining features of the Intake Canal include: the fish collection facilities; the three-barrel siphon; and its loose-earth construction.

The Pumping Plant is a semi-outdoor facility. The building has a two-story rectangular plan, made of concrete, with a flat, parapet roof with inset handrails. The treatment of the concrete walls creates a rectangular pattern on the north, south, and east façades and the windows and doors of the north and south façades are symmetrically arranged and centered on their respective sides. The character-defining features of the Pumping Plant include: the aforementioned form and massing; concrete construction; the windows on the north façade; the accordion doors on the south façade; the inset handrails on the roof and north façade; the six circular, removable hatches on the roof; the six vertical-shaft pumping units symmetrically arranged in pairs within the three eastern sections of the building; and the inlet transition walls.



Figure 24: Tracy Pumping Plant; camera facing southwest, May 9, 2022.



Figure 25: Tracy Pumping Plant; camera facing east, May 9, 2022.

Siphons

The population of Delta-Mendota Canal siphons comprises 13 concrete structures (see **Appendix C** for a listing of all appurtenant DMC structures). Siphons are defined by their concrete construction, with sloped-to-vertical transitional wingwalls, concrete box inlets and outlets, and one-, two-, three, or four-barrel underground concrete channels that transport Delta-Mendota flows beneath waterways, railroads, highways, and an irrigation canal.

The Delta-Mendota Canal siphons retain historic integrity to their period of significance, 1946-1951, and therefore appear eligible for inclusion in the NRHP and CRHR as contributing features of Delta-Mendota Canal. In terms of integrity of design and setting, the Delta-Mendota Canal siphons all remain in their original locations—at the sites of waterways, roadways, railroad crossings, and an irrigation canal. These locations and settings appear largely unaltered. In terms of design, materials, and workmanship, research did not reveal that any substantial modifications have been made to any of the character-defining features of the siphons that would reduce their integrity. The siphons all retain their basic concrete construction, single- and multiple-barrel conveyance structure, and transitional wingwalls, and they all continue to transport Delta-Mendota Canal flows beneath major appurtenant crossings.



Figure 26: Three-barrel siphon inlet headwall at M.P. 13.67; camera facing downstream from left bank, May 10, 2022.



Figure 27: Four-barrel siphon outlet headwall at M.P. 16.34; camera facing upstream from left bank, May, 10, 2022.

Check Structures

The population of Delta-Mendota Canal check structures consists of 21 concrete structures composed of two types (see **Table 1** in DMC DPR 523 form in **Appendix B** for list of DMC check structures, and **Appendix C** for listing for all appurtenant DMC structures). Check structures are characterized by their predominately poured-in-place concrete construction, with sloped transitional wingwalls that contract and expand as Delta-Mendota Canal leads into and away from the check. All checks feature narrow equipment platforms with mechanical gate-hoisting equipment in metal encasements; the concrete platforms are framed with metal pipe railing and most have metal lampposts with umbrella shades. Concrete block check structure houses are later additions after the period of significance and are not character defining of the historic-era canal.

The character-defining features of the Delta-Mendota Canal check structure population retain historic integrity to their period of significance, 1946-1951, and therefore appear eligible for inclusion in the NRHP and CRHR as contributing features of Delta-Mendota Canal. In terms of integrity of design and setting, the Delta-Mendota Canal check structures all remain in their original locations in a setting characterized by adjacent San Joaquin Valley farmlands. Moreover, those check structures constructed near siphon inlets and wasteway turnouts retain their spatial relationships with other components of the canal. In terms of design, materials, and workmanship, research and field observations did not reveal that substantial modifications have been made to any of the character-defining features that would reduce the integrity of these structures. The later addition of the concrete block check houses does not constitute a loss of historic integrity because the structures are small and unobtrusive into the setting of the canal. Moreover, the historic-period population of Delta-Mendota Canal check structures continues to regulate Delta-Mendota Canal flows throughout the span of the canal.



Figure 28: Check No. 16 at M.P. 85.09; camera facing downstream from left bank, June 14, 2022.



Figure 29: Check No. 11 at M.P. 58.28; camera facing downstream from left bank, June 13, 2022.

Wasteways

Wasteways function as escape structures to protect the canal system by diverting water out of the canal and preventing it from overtopping the banks of the canal, minimize the damage resulting from a break in the canal, or by preventing additional damage from a washout or failure of the canal. This class of structures requires an accompanying waste channel from the canal to a point of discharge into a natural drainage channel. The wasteway channels are not in the APE for this project; however, the turnouts into the wasteways are integrated into Delta-Mendota Canal and are within the APE.

There are four primary wasteways and associated wasteway turnout structures along Delta-Mendota Canal and one overspill apron wasteway on the right bank of the canal (see **Appendix C** of report citied in *P11. for a listing of all appurtenant DMC structures). Wasteways turnouts are defined by poured-in-place concrete construction, two rectangular gate sections, two equally sized radial gates, and narrow equipment platforms with mechanical gate-hoisting equipment in metal encasements. The size of the gates is dictated by the capacity of the canal at the turnout. The concrete platforms are framed with metal pipe railing and feature metal lampposts with umbrella shades, though some umbrella shades are missing.

The four wasteway channels – Westley, Newman, Volta, and Firebaugh – are defined by their locations, size and shape of the excavation, concrete and earth lining, and outfalls into the San Joaquin River channel. Culverts and bridges along the wasteway are not directly related to the historical significance of Delta-Mendota Canal and are not character-defining features.

The Delta-Mendota Canal wasteway turnouts and turnout channels retain a good degree of historic integrity of design, materials, workmanship, setting, location, association, and feeling.

The character-defining features of the Delta-Mendota Canal wasteway turnouts and wasteway channels retain historic integrity to their period of significance, 1946-1951, and therefore are contributing features of Delta-Mendota Canal. In terms of integrity of design and setting, the Delta-Mendota Canal wasteways all remain in their original locations, the setting of which remains defined by adjacent San Joaquin Valley farmlands. Moreover, all wasteway turnouts retain their spatial relationships with other components of the canal, which include the canal lining, and the wasteway channels. In terms of design, materials, and workmanship, research and field observations did not reveal that any substantial modifications have been made to the character-defining features that would reduce the integrity of these structures. The population of Delta-Mendota Canal wasteways continues to function as it did historically to regulate Delta-Mendota Canal flows into natural waterways.



Figure 30: Radial gates at Firebaugh Wasteway's inlet structure; camera facing upstream from wasteway's right bank, June 14, 2022.



Figure 31: View of Newman Wasteway; camera facing upstream from right bank, June 13, 2022.

Turnouts

Turnouts function to deliver water into the local distribution systems of water users along the canal and those that have a high degree of integrity and, therefore, contribute to the significance of Delta-Mendota Canal are those that retain all or most of their character-defining features (**Figure 32**). Minor alterations to some of these turnouts such as conveyor-type debris screens across the channel openings, replacement gear mechanisms, and modern railing or fencing do not prevent the turnouts from conveying significance and they contribute to the canal's historical significance. Those turnouts added to the DMC after the initial period of construction that were designed in accordance with Reclamation's original design specifics and possess those character-defining features enumerated above may also be considered contributors to the DMC's significance. However, those turnouts that have been so heavily altered from their original design that they no longer have sufficient integrity to convey their significance are those that have had the original pedestal and geared hoist mechanism removed and replaced, or the concrete equipment decks raised or entirely replaced. These substantial alterations have diminished the integrity of design, materials, workmanship, and feeling to such a degree that these structures no longer convey the significance of the canal. Additionally, those turnouts that have been added that were designed divergently from Reclamation's original design specifications—such as steel-pipe turnouts and turnouts with automated electronic gate-hoisting equipment—are likewise not considered contributors to the DMC's significance (**Figure 33**).

The character-defining features of the turnouts are those materials, equipment, and design aspects that are part of the original construction of these structures, built according to the original design specifications. Specifically, this includes the concrete construction of the structure; shape and size of the water channels or barrels; metal grate debris screens over the openings; original gate hoisting mechanism; gates; concrete deck, railing, and steps; and the position of the turnout deck just above the canal lining.



Figure 32: Turnout at M.P. 45.35; camera facing downstream from left bank, May 12, 2022.



Figure 33: Two turnouts at M.P. 38.14; camera facing downstream from left bank, May 12, 2022.

Because the vast majority of the contributing elements of Delta-Mendota Canal retain historic integrity of the character-defining features, overall Delta-Mendota Canal retains integrity to its period of significance, 1946-1951, and is eligible for listing in the NRHP and CRHR under Criteria A / C and 1 / 3. The boundary of the historic property is from outside toe to outside toe from the inlet canal at M.P. 0.09 to the outlet at Mendota Pool at M.P. 116.61 because this encompasses all of the features of Delta-Mendota Canal that contribute to its significance.

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Lawton

***Date**: May 9-10, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-1

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 1 spans 11.25 miles between canal mileposts 0.09 and 11.34, from the Tracy Fish Collection Facility to a point just upstream of Check No. 1. This segment traverses the western edge of the San Joaquin Valley in Contra Costa, Alameda, and San Joaquin counties and the western edge of the city of Tracy. See **Sketch Map** and **Location Map** on Continuation Sheets.

UTM: Zone 10S, 626724.65mE / 4186399.55mN (north endpoint); 631965.67mE / 4174954mN (south endpoint)

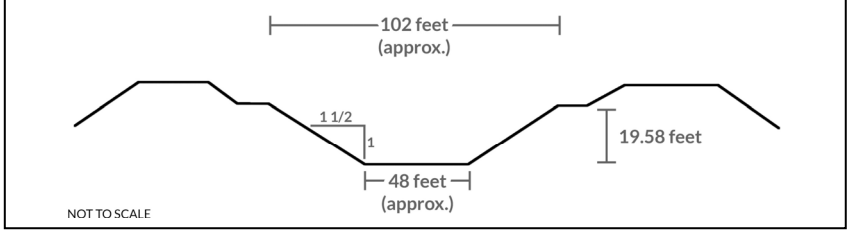
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 1 is a trapezoidal shaped canal with the first approximately 2.5-mile section between the Tracy Fish Collection Facility and the C.W. Bill Jones Pumping Station (known as the Delta-Mendota Intake Canal) being a loose earth channel, while the remainder is concrete lined (**Photograph 107** and **Photograph 131**) (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 102.24 feet (original)
b. **Bottom Width**: 100 feet - 48 feet
c. **Height or Depth**: 14.25 feet – 19.58 feet
d. **Length of Segment**: 11.25 miles

L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L4e. Sketch of Cross-Section (not to scale) **Facing:** Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This segment of the DMC passes through flat farmland, foothills, and an industrial area on the western edge of Tracy.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of a stilling well, pumphouse, and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 107: View of Segment 1 showing beginning of Intake Canal (left) along the right abutment wall of the fish collection facilities (center), with Tracy Fish Collection Facility (right); camera facing north, May 9, 2022 (A00165).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Abigail Lawton
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 1, the trapezoidal DMC is made of compacted-earth from M.P. 0.09 to 2.52, then lined with concrete from M.P. 3.50 to 11.34. The concrete lining was raised by 18 inches in 1965 (**Photograph 13**).[124] Flanking both sides of the canal are gravel maintenance roads approximately 20 feet wide. Another gravel maintenance road about 15 feet wide runs above the 4,822-foot long C.W. Bill Jones Pumping Station discharge pipes. For a detailed discussion of canal cross sections, see the typology discussion in Section P3a.

The major structures on this section of the DMC are the Tracy Fish Collection Facility, C.W. Bill Jones Pumping Station and discharge pipes, and the Mountain House Siphon.

The Bureau of Reclamation's Tracy Fish Collection Facility is located at 6525 Lindemann Road, adjacent to the right bank abutment of the DMC at M.P. 0.90 (**Photograph 107**). Fish collecting facilities were constructed at the head of the Delta-Mendota Intake Canal on Old River in 1947-51. Their purpose is to collect young fish in spring and summer and transport them further down the San Joaquin River. These facilities consist of a row of vertical louver vanes set one (1) inch apart and directed at right angles to the flow in a structure which extends about 340 feet diagonally across a concrete channel 83.5 feet wide and about 25 feet deep. As the fish approach the louvers they swim to one side to avoid the disturbing eddies and vibrations created by the louvers, and readily enter by-passes placed at intervals in the louvered barrier. The bypasses carry the fish to holding tanks. From the holding tanks the fish are transported by trucks 40 miles to the Suisun Bay area where they can swim safely to the ocean.[125]

Water from the Sacramento River flows through the Delta Cross Channel into Old River slough, where it is diverted through the Delta-Mendota Intake Canal, about 2.3 miles long, to C.W. Bill Jones Pumping Station (**Photograph 109**). The Pumping Station (originally known as the "Tracy Pumping Plant") was constructed in 1947-51 and is an original and integral feature of the DMC (ref Historic Photo – **Photograph 109**). It contains six vertical-shaft pumping units. The pumping plant is of the semioutdoor type. The architectural style is Brutalist with Streamline Moderne details (**Photograph 110 – Photograph 117**). The superstructure has a rectangular plan with a flat, parapet roof inset with handrails. The building measures about 360 feet long, 60 feet wide, and 50 feet high. Expansion joints divide the north and south façades into four sections. Horizontal grooves in the board-formed concrete intersect with vertical control and expansion joints to create a rectangular pattern on the façade. Two rows of small steel windows on the intake (north) side are evenly spaced and centered on the building (**Photograph 110**). On the discharge (south) side, instead of windows, there are evenly spaced large accordion doors, which provide gantry crane access to the pumps (**Photograph 116**). There is a 100-ton movable gantry crane affixed to the roof. The roof is also outfitted with large removable hatches that allow the crane access to handle pumping-plant equipment. The three eastern sections of the building house the six pumping units, spaced symmetrically in pairs. The fourth section, at the west end, houses the service bay. A small portion of the east section contains public facilities, stairs, and two offices. Each pumping unit has a rate capacity of 767 second-feet under a head of 197 feet. Each pump is driven by a 22,500-horsepower motor above the pump. The pumps lift a maximum of 4,600 second-feet of water up 197 feet and then through three 15-foot (inside) diameter, concrete discharge pipes for 4,822 feet to a concrete outlet structure that releases the water into the concrete-lined section of the DMC, at M.P. 3.50 (**Photograph 117**).[126]

Three irrigation canals cross the alignment of the discharge pipes. These laterals generally cross the DMC in an east-west orientation. The first, at M.P. 2.68, runs through a siphon under the DMC discharge pipes (**Photograph 120**). The second and third, at M.P. 2.92 and M.P. 3.33, cross over the discharge pipes and under the O&M road, which is carried over them by short concrete bridges with timber decks (**Photograph 121** and **Photograph 122**). Neither of these bridges possess handrails. They are not included within the general DMC bridge population and not part of the total count of extant bridges.

[124] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[125] USDI, Reclamation, *Tracy Pumping Plant and Intake Canal and Discharge Lines: Technical Record of Design and Construction*, May 1959: 14-17.
[126] USDI, Reclamation, *Tracy Pumping Plant and Intake Canal and Discharge Lines: Technical Record of Design and Construction*, May 1959: 1-4, 23, 28.

Near the siphon outlet, at M.P. 3.49, is a siphon breaker house and two 64-gallon water storage tanks. The breaker house is a square-plan, concrete block building with a flat, overhanging roof, single metal personnel door, and eight screen-covered, rectangular windows (**Photograph 123**). There is a metal ladder on the east side, giving access to the roof. The water storage tanks are large steel cylinders with slightly pitched roofs (**Photograph 124**). These tanks hold water for the SLDMWA, USBR, and WAPA compound.

The siphon at Mountain House Road is unique among the DMC siphon population. Located at M.P. 4.41/4.63, it extends a distance of 1,200 feet (**Photograph 126**). This single-barrel siphon is a monolithic concrete structure with an inside diameter of 24 feet 3 inches, and a shell thickness of 24 inches. Mountain House Road runs across the siphon at M.P. 4.46 and a blowoff box is located at M.P. 4.49 (**Photograph 127**). The one other siphon in Segment 1 is located at M.P. 1.36/1.41, along the intake canal section, conveying the DMC under Byron-Bethany Road and a single track for Southern Pacific Railroad. It is a three-barrel siphon of standard design, as described above in Section P3a.

At M.P. 7.20 there is a large, modern side-gable pumphouse with metal roof on the right bank constructed in 2011 which is not recorded in the *DMC Structures List* (2020). On the canal bank is an eight-barrel, concrete turnout structure covered by a metal debris screen (**Photograph 128**). On the opposite side of the building are four large pipes that appear to be metal. Adjacent to the pumphouse is a small electrical substation to power the pumps (**Photograph 129**). The pumphouse conveys water to the nearby California Aqueduct.

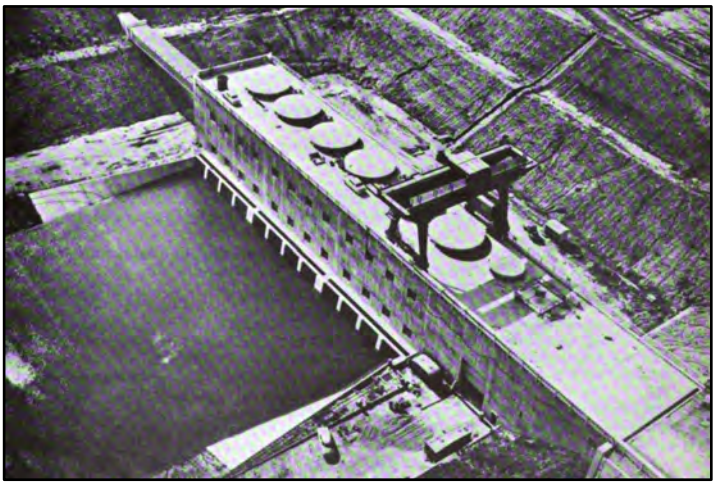
In addition to the major structures along DMC Segment 1 described above, this segment contains nine (9) bridges, 16 turnouts, one pump-in pipe (**Photograph 125**), one recorder house, two wash overchutes, 6 culverts, one stilling well, inlet and shoulder drains, safety ladders, cattle guards, and two Delta-Mendota Canal signs.

The Gage House salinity recorder is located at M.P. 3.65. This standing-seam metal building has a rectangular plan, measuring roughly 9 feet x 10 feet, with a metal door and low-pitched front-gable roof (**Photograph 130**). It is accessed by a set of concrete steps with a metal pipe handrail (**Photograph 131**).

The nine (9) bridges in this segment include: one County Highway Bridge, two State Highway Bridges, three non-original (post-1958) replacement bridges, and four Timber Farm Bridges. The County Highway Bridge at M.P. 0.33 along Lindemann Road is unique within the DMC bridge population. It has a concrete deck measuring 28 feet wide, supported by timber bents (**Photograph 64**). It is the only bridge along the DMC which retains a timber support structure. The three non-original bridges—at M.P. 9.29 along International Parkway / Mountain House Parkway, M.P. 10.28 along W. Schulte Road, and M.P. 10.62 along Hansen Road—are modern, concrete replacements of original County Highway Bridges. All other bridges in the segment are of standard design, although the farm bridge at M.P. 6.95 is barricaded on the right bank (**Photograph 132**) and the farm bridge at M.P. 9.87 has been damaged by fire and is barricaded on both banks (Error! Reference source not found.).

The 16 turnouts along this segment are all of standard design. One is a double-barrel (**Photograph 133**), while the remining 15 are single-barrel box or pipe types. Many of these have modern trash grates covering their inlets. All remaining features on this segment are of standard design. For a detailed discussion of standard repeating types, see the typology discussion in Section P3a.

Photographs (continued):



Photograph 108: Aerial view of Tracy Pumping Plant and inlet transition, April 1951.[127]



Photograph 109: View of water intake (north side) at C.W. Bill Jones Pumping Station; camera facing downstream from left bank, May 9, 2022. (A00106)



Photograph 110: North elevation of Pumping Station; camera facing south, May 9, 2022. (A00144)



Photograph 111: South elevation of Pumping Station; camera facing east, May 9, 2022. (A00095)

[127] [photograph], DM-1536-CV, in USDI, Reclamation, *Tracy Pumping Plant and Intake Canal and Discharge Lines: Technical Record of Design and Construction*, May 1959: 21.



Photograph 112: Suspended walkway on east side of Pumping Station; camera facing north, May 9, 2022. (A00099)



Photograph 113: East elevation of Pumping Station; camera facing west, May 9, 2022. (A00145)



Photograph 114: Roof access to Pumping Station from Road; camera facing northeast, May 9, 2022. (A00082)



Photograph 115: Detail view of removable hatches on roof of Pumping Station with gantry in background (left); camera facing east, May 9, 2022. (A00091)



Photograph 116: View of accordion doors on south façade; camera facing northeast, May 9, 2022. (A00098)



Photograph 117: View of windows on north façade of Pumping Station; camera facing west, May 9, 2022 (A00107).



Photograph 118: Detail view of east elevation and trusses on underside of suspended walkway; camera facing southwest, May 9, 2022. (A00102)



Photograph 119: Detail view of personnel door on east side of Pumping Station; camera facing west, May 9, 2022. (A00104)



Photograph 120: View of irrigation canal at M.P. 2.92; camera facing east, May 9, 2022. (A00176)



Photograph 121: View of bridge crossing over Irrigation Canal 120, around M.P. 3.12; camera facing east, May 9, 2022. (A00181)



Photograph 122: View of Irrigation Canal 155, around M.P. 3.33, with detail view of timber deck of bridge (bottom right); camera facing west, May 9, 2022. (A00188)



Photograph 123: View of concrete-block siphon breaker house at M.P. 3.49; camera facing south, May 9, 2022. (A00194)



Photograph 124: View of 64-gallon water storage tanks at M.P. 3.49; camera facing north, May 9, 2022. (A00192)



Photograph 125: View of BBID pump-in for Tracy Hills at M.P. 3.50, adjacent to discharge pipes inlet headwall (right); camera facing right bank from left bank, May 9, 2022. (A00199)



Photograph 126: View of Mountain House Road siphon inlet at M.P. 4.41; camera facing downstream from left bank, May 9, 2022. (A00216)



Photograph 127: View of blowoff box (M.P. 4.49, center foreground) on top of Mountain House Road siphon (M.P. 4.41/4.63); camera facing southwest, May 9, 2022. (A00219)



Photograph 128: View of pumphouse at M.P. 7.50 with eight-barrel concrete turnout structure covered by metal debris screen; camera facing right bank from left bank, May 9, 2022. (A00252)



Photograph 129: View of electrical substation adjacent to pumphouse at M.P. 7.50; camera facing downstream from left bank, May 9, 2022. (A00250)



Photograph 130: View of Gage House salinity recorder house at M.P. 3.65; camera facing upstream from left bank, May 9, 2022. (A00205)



Photograph 131: View of Gage House salinity recorder house and access stairs at M.P. 3.65 and concrete canal lining; camera facing downstream from left bank, May 9, 2022. (A00206)



Photograph 132: Detail view of barricade on right bank entrance to Farm Bridge at M.P. 6.95; camera facing downstream from left bank, May 9, 2022. (A00246)



Photograph 133: View of original double-barrel turnout at M.P. 3.54; camera facing right bank from left bank, May 9, 2022. (A00203)

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Lawton

***Date**: May 10, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-2

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 2 spans 4.83 miles between canal mileposts 11.35 and 16.18, from the Check No. 1 to a point just upstream of Check No. 2. This segment traverses the western edge of the San Joaquin Valley in San Joaquin County. See **Sketch Map** and **Location Map** on Continuation Sheets.

UTM: Zone 10S, 631988.99mE / 4174947.30mN (north endpoint); 637996.38mE / 4171388.27mN (south endpoint)

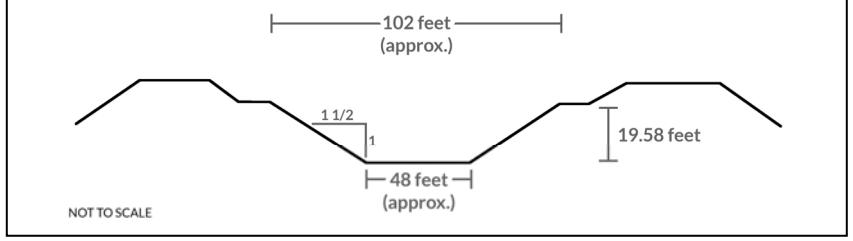
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
Beginning at Check No. 1 (**Photograph 134**), this segment of the DMC ends just upstream of Check No. 2 (**Photograph 146**) (see Continuation Sheet). This segment is concrete-lined with a trapezoidal cross section.

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 102 (original)
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 19.58 feet – 19.37 feet
d. **Length of Segment**: 4.83 miles

L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This segment of DMC traversed flat agricultural lands, orchards, hilly grasslands, and skirts an industrial area on the western edge of Tracy.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 134: Beginning of Segment 2, showing Check No. 1; camera facing upstream from left bank, May 10, 2022 (A00335).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Abigail Lawton
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 2, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[128] The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 135 - Photograph 136**).

The upstream end of DMC Segment 2 begins at Check No. 1, the site of which contains the check structure and check building (**Photograph 134**). Check No. 1, located at M.P. 11.35, is a concrete structure with a total length of 137 feet (**Photograph 137**), a width of approximately 102 feet at the upstream end, 123 feet at the check gates, and then narrowing again to about 102 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 138**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 11.35 on the left bank, is a concrete block structure, measuring approximately 9 feet by 7 feet. A stilling well is located just below Check No. 1, at M.P. 11.38, while a second stilling well is located just above Check No. 2 at M.P. 16.15. Both stilling wells are located on the left bank and are the typical cylindrical concrete type.[129]

In addition to the structures located at Check No. 1, DMC Segment 2 contains 15 turnouts, five (5) bridges, one wash overchute, two siphons, culverts, inlet drains, and cattle guards. The two siphons convey the DMC below single tracks for the Southern Pacific Railroad, at M.P. 11.49/11.51 (**Photograph 140** and **Photograph 141**), and Western Pacific Railroad, at M.P. 13.66/13.69 (**Photograph 142** and **Error! Reference source not found.**). Of the 15 Turnouts, 14 are concrete pipe types and one, at M.P. 15.95, is an overlining type for the City of Tracy and located adjacent to the Tracy Water Treatment Plant (**Photograph 144** and **Photograph 145**). This multi-component structure appears to have been modified (possibly enlarged) between 2005-2006.[130] All remaining turnouts are of standard design. Of the five (5) bridges, there are three Timber Farm Bridges, and two concrete County Highway Bridges, all of standard design, though the farm bridge at M.P. 15.10 is the only bridge with a timber deck measuring 12 feet wide and supported by four concrete piers, rather than the typical three piers (**Photograph 97**). All other features in this segment are of standard design. For a detailed discussion of standard repeating types, see the typology discussion in Section P3a.

[128] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[129] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*: 59, 62, 93, 97-99.
[130] USDI, Reclamation, *Milepost at Structure Sites: Delta-Mendota Canal*, December 1985: 17; USDI, Reclamation, *Delta-Mendota Canal Structures List*, May 2020: 8; Google Earth, historic views: 1985-2020

Photographs (continued):



Photograph 135: Downstream view from the top deck of Check No. 1 at M.P. 11.35; camera facing downstream from left bank; May 10, 2022 (A00337).



Photograph 136: Downstream view of deep excavation cuts at approximately M.P. 15.50; camera facing downstream from left bank, May 10, 2022 (A00431).



Photograph 137: Upstream view of Check No.1; camera facing upstream from left bank; May 10, 2022 (A00344).



Photograph 138: Top deck of Check No. 1; camera facing right bank, May 10, 2022 (A00342).



Photograph 139: *C*heck building on left bank at Check No. 1; camera facing northwest, May 10, 2022 (A00343).



Photograph 140: South Pacific Railroad Siphon inlet headwall at M.P. 11.49; camera facing downstream from left bank, May 10, 2022 (A00351).



Photograph 141: South Pacific Railroad Siphon outlet headwall at M.P. 11.51; camera facing upstream from left bank, May 10, 2022 (A00353).



Photograph 142: Western Pacific Railroad Siphon inlet headwall at M.P. 13.67; camera facing downstream from left bank, May 10, 2022 (A00392).



Photograph 143: Western Pacific Railroad Siphon outlet headwall at M.P. 13.69; camera facing upstream from left bank, May 10, 2022 (A00394).



Photograph 144: View of overlining type turnout at M.P. 15.95, for the City of Tracy; camera facing right bank from the left bank, May 10, 2022 (A00435).



Photograph 145: View of overlining type turnout at M.P. 15.95, for the City of Tracy, Tracy Water Treatment Plant visible in background (upper right corner); camera facing upstream from left bank, May 10, 2022 (A00436).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Lawton

***Date**: May 10, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-3

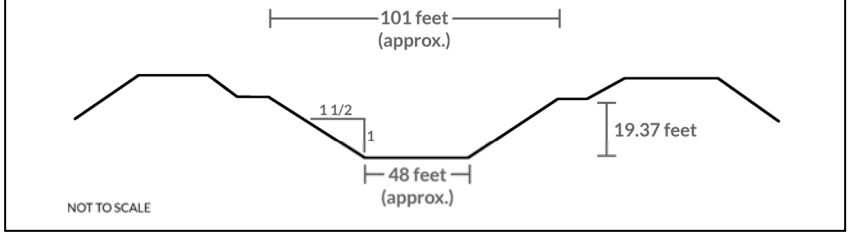
***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 3 spans 4.43 miles between mileposts 16.19 and 20.62 of the Delta-Mendota Canal, from Check No. 2 complex to just upstream of Check No. 3. This segment traverses the western edge of the San Joaquin Valley in San Joaquin County. See **Sketch Map** and **Location Map** on Continuation Sheets.
UTM: Zone 10S, 638014.15mE / 4171373.00mN (north endpoint); 643252.37mE / 4167485.02mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
Beginning at Check No. 2 (**Photograph 146**), this segment of the DMC traverses the grass-covered hillsides and flat agricultural lands of the western San Joaquin Valley to a downstream point located just upstream of Check No. 3. (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 101.6 feet (original)
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 19.37 feet
d. **Length of Segment**: 4.43 miles

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This segment of the DMC is located primarily in the flat agricultural lands of the San Joaquin Valley in southwestern San Joaquin County. Hillside vegetation to the east largely consists of tall grasses, while the surrounding agricultural lands are principally planted with orchards. Four public roadways cross this segment – S. Tracy Boulevard, Durham Ferry Road, McArthur Road, and Chrisman Road.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, patches to the canal lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 146: Beginning of Segment 3, showing Check No. 2; camera facing downstream from left bank, May 10, 2022 (A00446).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Abigail Lawton
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 3, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[131] Deterioration, cracking, and erosion are evident along some stretches of the canal lining (**Photograph 156**). Sandbags line the top of the canal wall in multiple locations (**Photograph 157 - Photograph 160**). The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 147** and **Photograph 148**). For a detailed discussion of DMC cross sections, see typology discussion in P3a. Description on Continuation Sheets.

The upstream end of DMC Segment 3 begins at Check No. 2, the site of which contains the check structure and check building; a siphon at M.P. 16.20/16.25 that carries the DMC under Tracy Blvd.; a short, narrow span of canal that runs from M.P. 16.25 to 16.31, approximately 310 feet long, with a non-transitioned siphon outlet and inlet; and a second siphon at M.P. 16.31/16.34 that conveys the DMC under a culvert that diverts Corral Hollow Creek across the canal (**Photograph 146, Photograph 150, - Photograph 153**). The outlet of this siphon, at M.P. 16.34, transitions back to the full-width canal (**Photograph 154**). Both siphons have four barrels and are of standard design, apart from their non-transitioned outlet/inlet, respectively.

Check No. 2 at M.P. 16.19 is a concrete structure with a total length of approximately 70 feet from its canal transition to the beginning of the siphon inlet (**Photograph 149**). It is approximately 101 feet wide at the widest upstream point where it meets the canal, then tapers as it transitions downstream to its narrowest point of approximately 62 feet wide. The walls of the check/inlet siphon structure transition from sloped, where it meets the canal, to vertical at the control gates. The canal narrows further between the check structure and the siphon inlet headwall, from approximately 62 feet to 50 feet (**Photograph 151**). The check structure is rectangular in cross section and divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. No provision was made for an overflow section. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 149**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. One metal lamp post with an umbrella-shaped shade is also present on the deck. The transitional concrete siphon outlet at M.P. 16.34 is approximately 70 feet long and 50 feet wide at the upstream end where it connects with the below-grade siphon (**Photograph 154**). The outlet walls are vertical at this point and flare out downstream as the outlet transitions to the canal, at which point the structure is 101 feet wide where it meets the canal. A stilling well is located just below this transition, at M.P. 16.39, while a second stilling well is located just above Check No. 3 at M.P. 20.60. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[132]

In addition to the canal features described above, DMC Segment 3 contains other major appurtenant structures in its span, including one wash overchute, four bridges, and 17 turnouts. The wash overchute at M.P. 18.59 is the typical reinforced concrete box type and carries the Corral Hollow Creek across the DMC. The four bridge crossings in this span, consist of: one Timber Operating Bridge and three Concrete County Highway Bridges, all of standard design. There are three types of turnouts in this segment: one overlining, one concrete box, and the rest are the typical concrete pipe type.

DMC Segment 3 also contains numerous minor appurtenant structures, including ladders, well discharges, and inlet and shoulder drains, virtually all constructed of metal and PVC pipes. The drain inlets consist of three types: concrete box, metal or PVC pipes, and pipes with a flap gate cover. For a detailed discussion of repeating major and minor appurtenant structures along the DMC, including siphon, overchute, bridge, turnout, culvert, inlet drain, stilling well, and check building types, see typology discussion in P3a. Description on Continuation Sheets.

[131] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[132] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*: 59-61, 93, 98-99; *2020 Structures List*: 8.

Photographs (continued):



Photograph 147: Downstream view from approximately M.P. 16.39; camera facing downstream from left bank; May 10, 2022 (B00003).



Photograph 148: Downstream view from approximately M.P. 20.37, with Check No. 3 in the distance; camera facing downstream from left bank, May 10, 2022 (B00076).



Photograph 149: View of Check No. 2, showing its transition into the Tracy Boulevard Siphon; camera facing downstream from left bank; May 10, 2022 (A00448).



Photograph 150: Check building at Check No. 2; camera facing northeast, May 10, 2022 (A00451).



Photograph 151: Transition between Check No. 2 and Tracy Boulevard Siphon, showing the siphon's inlet headwall; camera facing right bank from left bank, May 10, 2022 (A00452).



Photograph 152: Tracy Boulevard Siphon outlet headwall at M.P. 16.25; camera facing upstream from left bank, May 10, 2022 (A00454).



Photograph 153: Corral Hollow Creek Siphon inlet headwall at M.P. 16.31; camera facing right bank from left bank, May 10, 2022 (A00455).



Photograph 154: Corral Hollow Creek Siphon outlet headwall at M.P. 16.34; camera facing upstream from left bank, May 10, 2022 (B0002).



Photograph 155: Upstream view of Corral Hollow Creek where it crosses over the Corral Hollow Creek Siphon; camera facing southwest, May 10, 2022 (B00001).



Photograph 156: New cracking at a repair to the canal lining at M.P.; camera facing right bank from left bank, May 10, 2022. (B00029)



Photograph 157: View of sandbags lining the top of the canal wall at a turnout at M.P. 19.59; camera facing right bank from left bank, May 10, 2022. (B00069)



Photograph 158: View of sandbags lining the top of the canal wall at turnout site at M.P. 19.85; camera facing right bank from left bank, May 10, 2022. (B00070)



Photograph 159: View of sandbags lining the top of the canal wall at a turnout on the left bank at M.P. 20.42; camera facing right bank from left bank, May 10, 2022. (B00079)



Photograph 160: View of sandbags lining the top of the canal wall at a turnout on the left bank at M.P. 20.59; camera facing right bank from left bank, May 10, 2022. (B00085)

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Lawton

***Date**: May 10-11, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-4

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 4 spans 3.79 miles between mileposts 20.63 and 24.42 of the Delta-Mendota Canal, from just above the Check No. 3 to just above Check No. 4 in San Joaquin County along the western edge of the San Joaquin Valley. See **Sketch Map** and **Location Map** on Continuation Sheets.

UTM: Zone 10S, 643262.92mE / 4167471.29mN (north endpoint); 647820.49mE / 4164770.17mN (south endpoint)

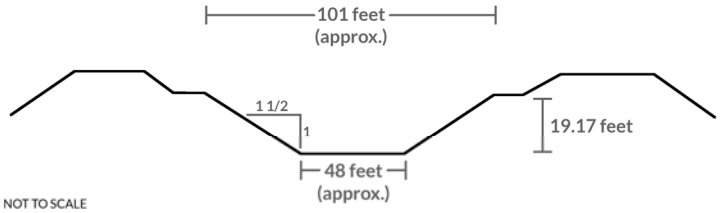
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)

Beginning immediately upstream of the Check No. 3 (**Photograph 161**), this segment of the DMC traverses the flat agricultural lands of the western San Joaquin Valley to a downstream point located just north of Check No. 4 (**Photograph 174**) (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 101 feet (original)
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 19.17 feet
d. **Length of Segment**: 3.79 miles

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)

This segment of the DMC is located primarily in the flat agricultural lands of the San Joaquin Valley in southwestern San Joaquin County. Surrounding agricultural lands are principally planted with orchards. Four public roadways cross the segment – S. Bird Road, Highway 132, Interstate 5, and Blewett Road.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, patches to the canal lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 161: Beginning of Segment 4, showing Check No. 3 and check building with a turnout and stilling well in the foreground; camera facing downstream from left bank, May 10, 2022 (B00084).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Abigail Lawton
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 4, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[133] Repairs and new cracking are evident along some stretches in this segment (**Photograph 171** and **Photograph 172**). Sandbags have been placed along the top of the canal lining in some areas (**Photograph 173**). The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 162** and **Photograph 163**). For a detailed discussion of DMC cross sections, see P3a. Description on Continuation Sheets.

The upstream end of DMC Segment 4 begins at Check No. 3, which includes the check structure and check building (**Photograph 161**). Check No. 3, at M.P. 20.63, is a concrete structure with a total length of 137 feet. It is approximately 101 feet wide at the upstream end, widens to about 123 feet at the check gates, and then narrows again to 101 feet where it rejoins the canal walls on the downstream side (**Photograph 164** and **Photograph 165**). The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 166**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. One metal lamp post with an umbrella-shaped shade is also present on the deck. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 20.63 on the left bank, is a rusticated concrete block structure, measuring approximately 9 feet by 7 feet. A stilling well is located just below Check No. 3, at M.P. 20.69, while a second stilling well is located just above Check No. 4 at M.P. 24.40 (**Photograph 167**). Both stilling wells are located on the left bank and are standard design.[134]

In addition to the canal features located at Check No. 3, DMC Segment 4 contains other major appurtenant structures in its span, including nine (9) bridges, twelve turnouts, one wash overchute, one CVP sign, and one siphon. The nine bridge crossings in this span consist of five non-original (post-1958) State Highway bridges, two timber Farm Bridges, and one concrete County Highway bridge, and one County Road crossing a siphon. Blewett Road crosses over the DMC siphon at M.P. 23.95/24.01 and is included in the bridge population of this inventory because it is categorized as a Bridge in the *DMC Structures List* (**Photograph 168** and **Photograph 169**). This siphon is a three-barrel type, of standard design. Of the segment's twelve turnouts, one is a steel pipe turnout (**Photograph 170**), while the rest are the typical concrete pipe type all with modern trash racks. The wash overchute at M.P. 21.91 is a reinforced concrete box type, carrying Lone Tree Creek north across the DMC.

DMC Segment 4 contains numerous minor appurtenant structures, including pipe crossings, inlet and shoulder drains, and ladders.

For a detailed discussion of DMC siphon, bridge, turnout, culvert, pipe crossings, inlet drain, CVP signs, stilling well, and check building types, see typology description in P3a. Description on Continuation Sheets.

[133] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[134] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*: 59, 62, 93, 97-99.

Photographs (continued):



Photograph 162: Upstream view from approximately M.P. 21.65; camera facing camera facing upstream from left bank, with a turnout in the foreground; May 10, 2022 (B00124).



Photograph 163: Downstream view from approximately M.P. 23.41; camera facing camera facing downstream from left bank, May 10, 2022 (A00459).



Photograph 164: Check No. 3; camera facing camera facing downstream from left bank, May 10, 2022 (B00092).



Photograph 165: Check No. 3; camera facing upstream from left bank, May 10, 2022 (B00091).



Photograph 166: Deck of Check No. 3; camera facing right bank from left bank, May 10, 2022 (B00090).



Photograph 167: View of stilling well, M.P. 20.69, and Check No. 3 outlet transition; camera facing upstream from left bank, May 10, 2020 (B00096.)



Photograph 168: Blewett Road Siphon inlet headwall; camera facing downstream from left bank; May 11, 2022 (A00471).



Photograph 169: Blewett Road Siphon outlet headwall; camera facing upstream from left bank; May 11, 2022 (A00475).



Photograph 170: The one steel pipe turnout in this segment at M.P. 20.97; camera facing right bank from left bank, May 10, 2022 (B00104).



Photograph 171: Cracking in canal lining at right abutment of BRIDGE at M.P.; camera facing downstream from left bank, May 10, 2022 (B00116).



Photograph 172: View of repair to concrete lining around M.P 22.90., with sandbags on top of wall downstream; camera facing right bank from left bank, May 10, 2022 (B00180).



Photograph 173: Sandbags lining the concrete wall above the turnout at M.P.; camera facing right bank from left bank, May 10, 2022 (B00097

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Lawton

***Date**: May 11, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-5

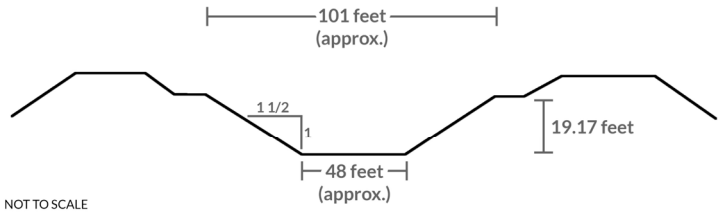
***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) FKC Segment 5 spans 5.38 miles between mileposts 24.43 and 29.81 of the Delta-Mendota Canal, from just above Check No. 4 in San Joaquin County to just above Check No. 5 in Stanislaus County along the western edge of the San Joaquin Valley. See **Sketch Map** and **Location Map** on Continuation Sheets.
UTM: Zone 10S, 647821.03mE / 4164752.13mN (north endpoint); 652704.37mE / 4158413.08mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
Beginning immediately upstream of Check No. 4 (**Photograph 174**), this segment of the DMC traverses the grass-covered hillsides and flat agricultural lands of the western San Joaquin Valley to a downstream point located just upstream of Check No. 5 (**Photograph 181**) (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 101 feet (original)
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 19.17 feet
d. **Length of Segment**: 5.83 miles

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This segment of the DMC is located primarily in the flat agricultural lands of the San Joaquin Valley in southwestern San Joaquin County and northwestern Stanislaus County. The surrounding agricultural lands are principally planted with orchards. The canal is traversed by four public roadways – Koster Road, Gaffery Road, Welty Road, and Hamilton Road.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, patches to the canal lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 174: Beginning of Segment 5, showing Check No. 4 and recorder house; camera facing downstream from left bank, May 11, 2022 (A00484).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Abigail Lawton
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: July 2022

L3. Description (continued):

In Segment 5, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[135] Cracking is evident along some stretches in this segment (**Photograph 180**). The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 175** and **Photograph 176**). For a detailed discussion of DMC cross sections, see P3a. Description on Continuation Sheets.

The upstream end of DMC Segment 5 begins immediately above Check No. 4, the site of which contains the check structure and building (**Photograph 174**). Check No. 4, at M.P. 24.42, is a concrete structure with a total length of 137 feet (**Photograph 177**). It is approximately 101 feet wide at the upstream end, widens to about 123 feet at the check gates, and then narrows again to 101 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 178**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. One metal lamp post with an umbrella-shaped shade is also present on the deck. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 24.42 on the left bank, is a rusticated concrete block structure, measuring approximately 9 feet by 7 feet. A stilling well is located just below Check No. 4, at M.P. 24.48, while a second stilling well is located just above Check No. 5 at M.P. 29.79. Both stilling wells are located on the left bank and are of standard design.[136]

In addition to the canal features located at the Check No. 4 site, DMC Segment 5 contains other major appurtenant structures in its span, including 19 turnouts, five (5) bridges, and two wash overchutes. There are 18 active turnouts, of which 16 are the typical concrete pipe type, and 2 are steel pipes. There is an additional concrete pipe turnout listed in the Structures List at M.P. 25.61, but this appears to have been deactivated and its pump removed (**Photograph 179**). There are five bridge crossings, consisting of four concrete County Highway bridges and one Timber Farm bridge, all of standard type. Both overchutes are the reinforced concrete box type. The overchute at M.P. 25.20 carries Hospital Creek across the DMC and the overchute at M.P. 25.62 conveys Little Hospital Creek.

DMC Segment 5 contains numerous minor appurtenant structures, including ladders, and inlet and shoulder drains, virtually all of which are made of metal or PVC.

For a detailed discussion of DMC bridge, turnout, siphon undercrossing, inlet drain, and recorder house types, see typology discussion in P3a. Description on Continuation Sheets.

[135] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[136] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*: 59, 62, 93, 97-99.

Photographs (continued):



Photograph 175: Downstream view from approximately M.P. 24.89; camera facing downstream from left bank, May 11, 2022 (A00498).



Photograph 176: Downstream view from approximately M.P. 27.22; camera facing downstream from left bank, May 11, 2022 (A00548).



Photograph 177: Check No. 4; camera facing downstream from left bank, May 11, 2022 (A00485).



Photograph 178: Check No. 4; camera facing right bank from left bank, May 11, 2022 (A00489).



Photograph 179: Site where a concrete pipe turnout listed at M.P. 25.61, appears to have been deactivated and its pump removed; camera facing downstream from left bank, May 11, 2022 (A00515).



Photograph 180: Cracking on concrete lining around turnout at M.P. 26.69; camera facing right bank from left bank, May 11, 2022 (A00535).

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Lawton

***Date**: May 11, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-6

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 6 spans 4.59 miles between canal mileposts 29.82 and 34.41, from Check No. 5 to just above Check No. 6 along the western edge of the San Joaquin Valley in Stanislaus County. See **Sketch Map** and **Location Map** on Continuation Sheets.

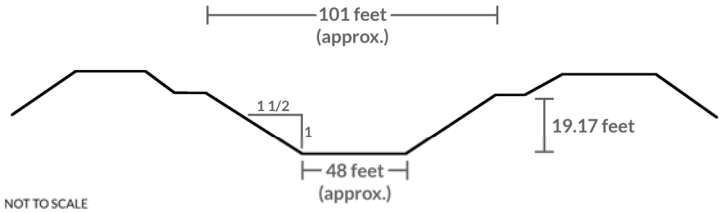
UTM: Zone 10S, 652727.27mE / 4158408.47mN (north endpoint); 657414.47mE / 4154272.19mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
Beginning at Check No. 5 (**Photograph 181)**, this segment of the DMC is 4.59 miles long and ends just upstream of Check No. 6 (**Photograph 182**). This segment of the DMC is concrete-lined and has the same trapezoidal cross section as elsewhere on the canal. Along both sides of the conduit are gravel maintenance roads approximately 12 to 20 feet wide (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 101 feet (original)
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 19.17 feet
d. **Length of Segment**: 4.59 miles

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This segment of DMC passes through flat agricultural lands planted principally with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 181: Beginning of Segment 6, showing the Check No. 5 and recorder house with a stilling well in the foreground; camera facing downstream from left bank, May 11, 2022 (A00602).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Abigail Lawton
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 6, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[137] Deterioration, cracking, and erosion are evident along some stretches in this segment and sandbags line the top of the canal wall in some locations (**Photograph 198 - Photograph 203**). The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 182 - Photograph 184**). For a detailed discussion of DMC cross sections, see P3a. Description on Continuation Sheets.

The upstream end of DMC Segment 6 begins immediately above Check No. 5, the site of which contains the check structure and building (**Photograph 181**). Check No. 5 at M.P. 29.81 is a concrete structure with a total length of 137 feet. It is approximately 101 feet wide at the upstream end, widens to about 123 feet at the check gates, and then narrows again to 101 feet where it rejoins the canal walls on the downstream side (**Photograph 185** and **Photograph 186**). The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 185**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. One metal lamp post with an umbrella-shaped shade is also present on the deck. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 29.81 on the left bank, is a rusticated concrete block structure, measuring approximately 9 feet by 7 feet. A stilling well is located just below Check No. 5, at M.P. 29.88, while a second stilling well is located just above Check No. 6 at M.P. 34.39. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[138]

Downstream of Check No. 5 is the Westley Wasteway on the east side of the canal at M.P. 34.32 (**Photograph 187**). The wasteway allows water to flow from the canal northeast about 3.9 miles to the San Joaquin River. The wasteway begins with a concrete inlet structure on the left bank of the canal consisting of two waterways, each with a steel radial gate—measuring 20 feet wide and 17 feet tall—controlling the water flow (**Photograph 188** and **Photograph 189**). Both radial gates each have two gate arms, each measuring 19 feet, 9.5 inches long, with the pivot points bolted to a concrete headwall. The gates' arms all have truss designs, and the arched gate faces are all reinforced by a grid pattern of steel beams. The gates are raised and lowered by a row of electric motors, hoists, pulleys, and a manual handle mounted on a concrete platform on top of the structure. This top deck includes a service walkway with pipe railing along the edge, and it also features a metal electrical box.[139]

Water passing through the wasteway control structure flows into a concrete chute on the east side of the canal levee (**Photograph 190** and **Photograph 191**). About 3.8 miles of the wasteway are concrete-lined and of trapezoidal chute section with vertical top walls, and 0.1 mile is unlined earth (**Photograph 192 - Photograph 195**). The concrete sidewalls quickly narrow from about 47 feet wide where the water emerges from the control structure to about 23 feet wide where the water is siphoned into the main chute of the wasteway, which quickly expands to a width of about 42 feet. After the concrete transitions to earth the wasteway continues for approximately 0.1 miles until it terminates at an inlet to the San Joaquin River

[137] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[138] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*: 59, 62, 93, 97-99.
[139] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*, "Table 1.—Design data for gates and hoists installed at structures on Delta-Mendota Canal," 99; USDI, Reclamation, Central Valley Project – California (CVP), "Delta Mendota Canal-Sta.625+00-Check, Radial Gate and Hoist Installation" dwg. no. 214-D-13893, ca. 1947.

(**Photograph 196**). The only Railroad Bridge associated with the DMC crosses over the Westley Wasteway at M.P. 2.06 (station 108+85.20). It is a single-span bridge originally provided for the Southern Pacific Railroad. It has a concrete deck supported on steel stringer, with metal pipe railings (**Photograph 193**). It was designed for a single track, but abutments were designed to accommodate two tracks. It was designed for an E-72 loading in accordance with "Specifications for Steel Railway Bridges" of the American Railway Engineering Association, 1946 edition.[140]

In addition to the canal features located at or near the Check No. 5 site and Westley Wasteway, DMC Segment 6 contains other major appurtenant structures in its span, including 16 turnouts and eight (8) bridges. The 16 turnouts consist of 15 of the concrete pipe type, and one concrete box type (**Photograph 197**). The eight bridge crossings include: two Timber Farm bridges, one concrete County Highway bridge, one County Highway Wasteway Crossing bridge, one Timber Operating bridge, and three non-original bridges built post-1958. The three non-original bridges consist of two concrete county road bridges that were rebuilt in 1965, at M.P. 29.93 along McCracken Road and at M.P. 34.39 along Needham Road, and one timber operating bridge at M.P. 33.29 that was replaced in 1998. All other bridges are of standard design. There are also three siphon undercrossings that convey irrigation laterals under the DMC at M.P. 31.65, 33.72, and 34.1

DMC Segment 6 contains numerous minor appurtenant structures, including ladders, and inlet and shoulder drains, virtually all of which are made of metal or PVC. These all follow the standard design type.

For a detailed discussion of DMC bridge, turnout, siphon undercrossing, inlet drain, stilling well and check building types, see typology discussion in P3a. Description on Continuation Sheets.

[140] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*: 13, 88.

Photographs (continued):



Photograph 182: Upstream view from approximately M.P. 30.33; camera facing upstream from left bank, May 11, 2022 (A00615).



Photograph 183: Downstream view from approximately M.P. 30.33; camera facing downstream from left bank, May 11, 2022 (A00614).



Photograph 184: Downstream view from approximately M.P. 32.38; camera facing downstream from left bank, May 11, 2022 (A00666).



Photograph 185: Detail view of Check No. 5 deck, camera facing right bank from left bank, May 11, 2022 (A00606).



Photograph 186: Upstream view of Check No. 5; camera facing upstream from left bank, May 11, 2022 (A00607).



Photograph 187: Downstream view of inlet to Westley Wasteway at M.P. 34.32, including wasteway bridge; camera facing downstream from left bank from left bank, May 11, 2022 (A00709).



Photograph 188: Detail view of Westley Wasteway's inlet structure's top deck and gate-hoisting equipment; camera facing upstream from left bank, May 11, 2022 (A00713).



Photograph 189: Detail view of the radial gates in Westley Wasteway's inlet structure; camera facing west, May 11, 2022 (A00712).



Photograph 190: View of beginning of concrete-lined chute of Westley Wasteway from inlet at M.P. 34.32; camera facing east from left bank, May 11, 2022 (A00710).



Photograph 191: View of Westley Wasteway inlet from approximately M.P. 34.32; camera facing upstream from left bank of the Westley Wasteway, May 11, 2022 (A00728).



Photograph 192: View of wasteway concrete chute and missing bridge around M.P. 0.35 on the Westley Wasteway; camera facing downstream from right bank, May 11, 2022 (A00730).



Photograph 193: View of Railroad Bridge at M.P. 2.06 on the Westley Wasteway; camera facing upstream from right bank, May 11, 2022 (A00756).



Photograph 194: "Drop" structure at the end of concrete lined section of Westley Wasteway at wasteway M.P. 3.84; camera facing upstream from wasteway's right bank, May 11, 2022 (A00775).



Photograph 195: Upstream view of earth section of Westley Wasteway around wasteway M.P. 3.85; camera facing upstream from wasteway's right bank, May 11, 2022 (A00778).



Photograph 196: End of earth section of Westley Wasteway where it natural water feature connected to the San Joaquin River at wasteway M.P. 4.01; camera facing downstream from wasteway's right bank, May 11, 2022 (A00785).



Photograph 197: Concrete box turnout at M.P. 31.31; camera facing downstream from left bank, May 11, 2022 (A00645).



Photograph 198: View of a new crack on a repair to the canal wall near M.P. 30.63; camera facing right bank from left bank, May 11, 2022 (A00634).



Photograph 199: View of sandbags lining the top of the concrete wall around turnout at M.P. 33.53; camera facing right bank from left bank, May 11, 2022 (A00690).



Photograph 200: View of large patch on right embankment above concrete lining at approximately M.P. 33.71; camera facing downstream from left bank, May 11, 2022 (A00693).



Photograph 201: View of sandbags lining the top of the concrete wall around features at M.P. 33.71; camera facing downstream from left bank, May 11, 2022 (A00694)



Photograph 202: View of patch to canal wall transitioning to bags laid on top of the concrete lining at approximately M.P. 33.71; camera facing right bank from left bank, May 11, 2022 (A00697).



Photograph 203: View of sandbags lining the top of the concrete wall around features on both side of the canal at M.P. 33.90; camera facing upstream from left bank, May 11, 2022 (A00703).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby, A. Lawton & A. Young

***Date**: May 11-12, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-7

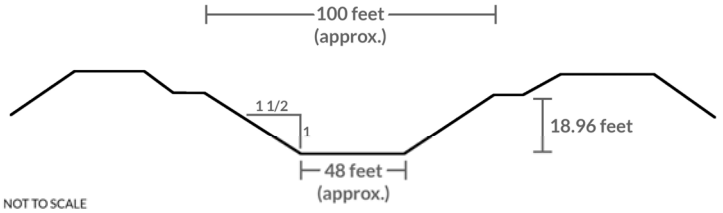
***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 7 spans 4.25 miles between canal mileposts 34.42 and 38.67, from just above Check No. 6 to just above Check No. 7. See **Sketch Map** and **Location Map** on Continuation Sheets.
UTM: Zone 10S, 657420.14mE / 4154251.96mN (north endpoint); 660474.74mE / 419242.05mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
This segment begins at a point just upstream of Check No. 6 and continues to a point just upstream of Check No. 7 (**Photograph 204**) (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100.38 feet (original)
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 18.96 feet
d. **Length of Segment**: 4.25 miles

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
The setting of Segment 7 is the flat agricultural lands of the western San Joaquin Valley surrounded largely by orchards. This segment terminates at the northwest corner of the City of Patterson.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 204: Beginning of Segment 7, showing the Check No. 6 and check building; camera facing downstream from left bank, May 11, 2022 (A00720).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Abigail Lawton
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 7, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[141] The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 206 and Photograph 207**).

The upstream end of DMC Segment 7 begins at Check No. 6, the site of which contains the check structure and building (**Photograph 204**). Check No. 6, at M.P. 34.42, is a concrete structure with a total length of 137 feet (**Photograph 208** and **Photograph 209**). It is approximately 100 feet wide at the upstream end, widens to about 123 feet at the check gates, and then narrows again to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 208**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. One metal lamp post with an umbrella-shaped shade is also present on the deck. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 34.42 on the left bank, is a rusticated concrete block structure, measuring approximately 9 feet by 7 feet. A stilling well is located just below Check No. 6, at M.P. 34.47, while a second stilling well is located just above Check No. 7 at M.P. 38.64. Both stilling wells are located on the left bank and are of standard design.

In addition to the canal features located at Check No. 6 and described above, DMC Segment 7 contains other major appurtenant structures in its span, including 13 turnouts, five (5) bridges, two siphon undercrossing, one siphon, one pump-in structure, and one "underdrain." Of the 13 turnouts, 12 are the typical concrete pipe type, and one is a fiberglass pipe. The five bridges in this segment include: two timber Operating Bridges, two Timber Farm Bridges, and one concrete Operating Bridge (**Photograph 205**). Most of these bridges are of the standard type, except for the concrete Operating Bridge at M.P. 37.28, adjacent to the Del Puerto Creek siphon. This is the only operating bridge with a concrete deck on concrete bents (**Photograph 210** and **Photograph 211**). Its deck measures 16 feet wide and has modern steel guard-rails. The date of construction of this bridge is unknown. Original design drawings show that, initially, all DMC operating bridges were of timber construction, therefore it is likely that this concrete bridge replaced an original timber bridge at or near this location, at a date unknown. The siphon under Del Puerto Creek, at M.P. 37.24/37.31, is a three-barrel siphon of standard design (**Photograph 213** and **Photograph 214**). The two siphon undercrossings carry irrigation lines under the DMC at M.P. 34.64 and 35.05. The Modesto Irrigation District pump-in is included in the DMC Structures List at M.P. 37.33, however it was observed as being slightly further downstream (**Photograph 215** and **Photograph 216**).

DMC Segment 7 contains numerous minor appurtenant structures, including ladders, and inlet and shoulder drains, virtually all comprised of metal and PVC pipes. This segment also contains one stairway for fishing at M.P. 38.11. This structure is a four-step concrete stairway on the canal bank with a metal pipe railing and a short metal pipe railing at the canal edge to stand along (**Photograph 212**).

For a detailed discussion of repeating major and minor appurtenant structures along the DMC, including bridge, turnout, culvert, inlet drain, stilling well, and check building types, see typology discussion in P3a. Description on Continuation Sheets.

[141] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.

Photographs (continued):



Photograph 205: Upstream view of Segment 7, showing farm bridge at M.P. 35. 39 with a tractor crossing it; camera facing upstream from left bank, May 12, 2022 (A00834).



Photograph 206: Downstream view of Segment 7 from approximately M.P. 35.10, showing a well discharge (left bank) and inlet drain (right bank); camera facing downstream from left bank, May 12, 2022 (A00815).



Photograph 207: View from the deck of a farm bridge a M.P. 38.14; camera facing upstream, May 12, 2022.



Photograph 208: View of Check No. 6; camera facing downstream from left bank, May 11, 2022 (A00722).



Photograph 209: Upstream view of Check No. 6; camera facing upstream from left bank, May 11, 2022 (A00723).



Photograph 210: View of concrete deck on Operating Bridge at M.P. 37.28; camera facing right bank from left bank, May 12, 2022 (B00255).



Photograph 211: Detail view of concrete bents on Operating Bridge at M.P. 37.28; camera facing northwest, May 12, 2022 (B00256).



Photograph 212: Fishing stairs at M.P. 38.11; camera facing downstream from left bank, May 12, 2022 (B00266).



Photograph 213: Downstream view of siphon inlet headwall at M.P. 37.31; camera facing downstream from left bank, May 12, 2022 (B00234).



Photograph 214: Upstream view of siphon outlet headwall at M.P. 37.31; camera facing upstream from right bank, May 12, 2022 (B00252).



Photograph 215: Modesto Irrigation District pump-in near M.P. 37.33, camera facing upstream from right bank, May 12, 2022 (B00245).



Photograph 216: Modesto Irrigation District pump-in, reportedly at M.P. 37.33, but here shown upstream of an inlet drain marked at M.P. 37.34, camera facing upstream from right bank, May 12, 2022 (B00245).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Lawton

***Date**: May 12, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-8

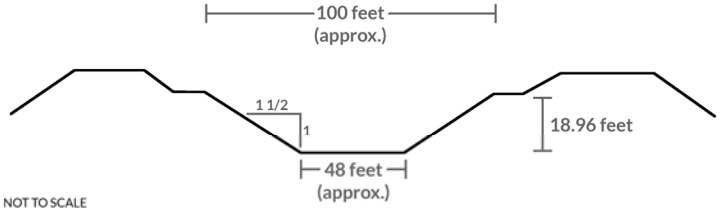
***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) FKC Segment 8 spans 5.57 miles between canal mileposts 38.68 and 44.25, from just above Check No. 7 to just above Check No. 8 along the western edge of the San Joaquin Valley in Stanislaus County. See **Sketch Map** and **Location Map** on Continuation Sheets.
UTM: Zone 10S, 660487.43mE / 4149239.14mN (north endpoint); 665394.03mE / 4143148.06mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
Beginning at Check No. 7 (**Photograph 217**), this segment of the DMC ends just upstream of Check No. 8 (**Photograph 240**) (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100.38 feet (original)
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 18.96 feet
d. **Length of Segment**: 5.57 miles

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This segment of DMC is located in the flat agricultural lands of the San Joaquin Valley principally planted with orchards. The canal skirts the commercial zones at the western edge of the City of Patterson.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, patches to the canal lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 217: Beginning of Segment 8, showing Check No. 7, check building, and stilling well; camera facing downstream from left bank, May 12, 2022 (B00297).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Abigail Lawton
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 8, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[142] Heavy deterioration, cracking, erosion, and subsidence are evident along some stretches in this segment (**Photograph 233 - Photograph 239**). The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 218 - Photograph 220**).

The upstream end of DMC Segment 8 begins at Check No. 7, the site of which contains the check structure and building (**Photograph 217**). Check No. 7, at M.P. 38.68, is a concrete structure with a total length of 137 feet (**Photograph 221 - Photograph 223**). It is approximately 100 feet wide at the upstream end, widens to about 123 feet at the check gates, and then narrows again to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 222**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. One metal lamp post with an umbrella-shaped shade is also present on the deck. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 36.68 on the left bank, is a rusticated concrete block structure, measuring approximately 9 feet by 7 feet. A stilling well is located just below Check No. 7, at M.P. 38.74, while a second stilling well is located just above Check No. 8 at M.P. 44.24. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[143]

In addition to the canal features located at Check No. 7, DMC Segment 8 contains other major appurtenant structures in its span, including one wasteway, one culvert, one overchute, one overflow inlet structure, one set of fishing stairs, seven (7) bridges, and 18 turnouts. This segment also includes the Patterson O&M storage yard on the east side of the O&M road, at M.P. 40.00, which consists of a fenced in yard containing two single-story standing-seam metal buildings of rectangular plan, with low-pitched gable roofs. (**Photograph 224** and **Photograph 225**). The prefabricated metal construction of these buildings was common and ubiquitous throughout the CVP. They are no longer in use and have suffered heavy deterioration, such as missing roofing and siding panels and many missing doors and windows. Remaining metal siding and roofing has been subject to heaving rusting.

The wasteway is a concrete overspill apron, the only one of its type on DMC, located at M.P. 39.32/39.42 on the right bank (**Photograph 226** and **Photograph 227**). Just downstream of this, at M.P. 39.46, is the culvert crossing that carries Black Gulch under the DMC. The overchute, at M.P. 41.93, is the typical reinforced concrete box type and carries Salado Creek across the DMC. Just downstream of the overchute is the City of Patterson's overflow inlet structure for Salado Creek. This structure consists of three 60-inch concrete pipes at M.P. 41.94 (**Photograph 228** and **Photograph 229**). Fishing stairs were observed around M.P. 38.75, although they are not included in the DMC Structures List (2020) (**Photograph 230**). They consist of a set of four concrete steps, with a metal pipe handrail, leading from the road to the canal with another short span of metal pipe railing along the top of the canal wall. The seven bridge crossings in this segment include: three concrete County Highway bridges, two Timber Farm bridges, one Timber Operating bridge, and one non-original (post-1958) county highway bridge. The non-original county highway bridge at M.P. 39.81 carries Sperry Road/Hwy 130 across the DMC. It is a concrete bridge, deck measuring 30 feet wide, that stretches between two large abutments with no support piers (**Photograph 231** and **Photograph 232**). The footings of the original bridge are still evident underneath the current bridge. All other bridges in this

[142] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[143] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*, 59, 62, 93, 97-99.

segment are of standard designs. Of the 18 turnouts in this span, 15 are the typical concrete pipe type, two are the concrete box type, and one is a steel pipe.

DMC Segment 8 contains numerous minor appurtenant structures, including ladders, well discharges, and inlet and shoulder drains, virtually all constructed of metal and PVC pipes.

For a detailed discussion of repeating major and minor appurtenant structures along the DMC, including bridge, turnout, overchute, culvert, inlet drain, stilling well, and check building types, see typology discussion in P3a. Description on Continuation Sheets.

Photographs (continued):



Photograph 218: Downstream view from the deck of Check No. 7; camera facing downstream, May 12, 2022 (B00318).



Photograph 219: Downstream view from approximately M.P. 38.74; camera facing downstream from left bank, May 12, 2022 (B00321).



Photograph 220: Downstream view from approximately M.P. 43.73; camera facing downstream from left bank, May 12, 2022 (B00449).



Photograph 221: Downstream view of Check No. 7; camera facing downstream from left bank, May 12, 2022 (B00298).



Photograph 222: Detail view of Check No. 7's deck and gate-hoisting equipment; camera facing right bank from left bank, May 12, 2022 (B00300).



Photograph 223: View of downstream side of Check No. 7; camera facing upstream from left bank, May 12, 2022 (B00320).



Photograph 224: Patterson O&M storage yard on the east side of the O&M road, at M.P. 40.00 containing two deteriorated and unused buildings; camera facing southeast, May 12, 2022 (B00364).



Photograph 225: Patterson O&M storage yard at M.P. 40.00 where buildings are no longer in use and have suffered heavy deterioration; camera facing southwest, May 12, 2022 (B00368).



Photograph 226: Concrete overspill apron wasteway at M.P. 39.32/39.42 on the right bank is the only one of its type on the DMC; camera facing downstream from left bank; May 12, 2022 (B00338).



Photograph 227: Concrete overspill apron wasteway at M.P. 39.32/39.42 on the right bank, the only one of its type on the DMC; camera facing upstream from left bank; May 12, 2022 (B00342).



Photograph 228: City of Patterson's overflow inlet structure for Salado Creek at M.P. 41.94, just below overchute; camera facing upstream from left bank, May 12, 2022 (B00412).



Photograph 229: City of Patterson's overflow inlet structure for Salado Creek at M.P. 41.94, consists of three 60-inch concrete pipes; camera facing right bank from left bank, May 12, 2022 (B00413).



Photograph 230: Fishing stairs around M.P. 38.75; camera facing southwest from left bank, May 12, 2022 (B00323).



Photograph 231: Non-original replacement county highway bridge at M.P. 39.81 along Sperry Road/Hwy 130, concrete deck measuring 30 feet wide, that stretches between two large abutments with no support piers; camera facing downstream from left bank, May 12, 2022 (B00343).



Photograph 232: Non-original replacement county highway bridge at M.P. 39.81 along Sperry Road/Hwy 130, with footings of the original bridge still evident underneath the current bridge; camera facing upstream from left bank, May 12, 2022 (B00350).



Photograph 233: Subsidence on right bank around M.P. 42.30; camera facing right bank from left bank, May 12, 2022 (B00417).



Photograph 234: Repair to the right bank canal lining around M.P. 42.3; camera facing right bank from left bank, May 12, 2022 (B00417).



Photograph 235: Repairs to the right bank canal lining around M.P. 42.53; camera facing right bank from left bank, May 12, 2022 (B00426).



Photograph 236: Patches to right bank canal lining with fresh cracks visible around turnout at M.P. 43.08; camera facing right bank from left bank, May 12, 2022 (B00434).



Photograph 237: Patches to right bank canal wall and subsidence just above Marshall Road bridge at M.P. 43.24; camera facing right bank from left bank, May 12, 2022 (B00442).



Photograph 238: Large repair to right bank canal wall between Marshall Road bridge and inlet drain at M.P. 43.24; camera facing right bank from left bank, May 12, 2022 (B00447).



Photograph 239: Cracking in right bank canal lining between a large repair to canal wall just below Marshall Road bridge at M.P. 43.24 and drain inlet with flap gate on right bank at M.P. 43.26; camera facing right bank from left bank, May 12, 2022 (B00448).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Lawton

***Date**: May 12-13, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-9

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 9 spans 4.35 miles between canal mileposts 44.26 and 48.61, from just above Check No. 8 to just above Check No. 9 along the western edge of the San Joaquin Valley in Stanislaus County. See **Sketch Map** and **Location Map** on Continuation Sheets.
UTM: Zone 10S, 665395.16mE / 4143126.94mN (north endpoint); 667851.60mE / 4137214.23mN (south endpoint)

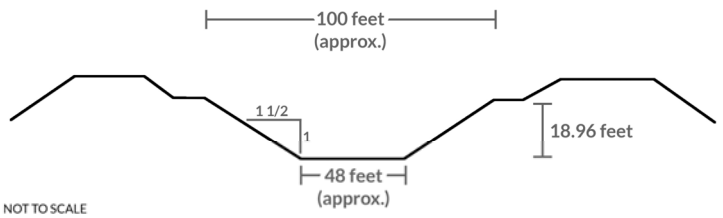
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
This segment begins at a point just upstream of Check No. 8 and continues to a point just upstream of Check No. 9 (**Photograph 240**). The canal has a trapezoidal cross-section and is lined with concrete (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100.38 feet (original)
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 18.96 feet
d. **Length of Segment**: 4.35 miles

L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This segment of DMC passes through the flat agricultural lands of the western San Joaquin Valley. Surrounding agricultural lands are principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 240: Beginning of Segment 9, showing Check No. 8 and check building; camera facing downstream from left bank, May 12, 2022 (B00456)

L9. Remarks:

L10. Form prepared by:
H. Norby & A. Lawton
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 9, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[144] Subsidence and cracking are evident along some stretches of this segment and sandbags line the top of the canal wall in some locations (**Photograph 243** and **Photograph 244**). The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 241**). For a detailed discussion of DMC cross sections, see typology discussion in P3a. Description on Continuation Sheets.

DMC Segment 9 begins at Check No. 8 at M.P. 44.26, the site of which contains the check structure and building (**Photograph 240**). The check is a concrete structure with a total length of 137 feet (**Photograph 242**). It is approximately 100 feet wide at the upstream end, widens to 123 feet at the check gates, and then narrows again to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge. On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. One metal lamp post with an umbrella-shaped shade is also present on the deck. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 44.26 on the left bank, and is of standard design. A stilling well is located just below Check No. 8, at M.P. 44.32, while a second stilling well is located just above Check No. 9 at M.P. 48.59. Both stilling wells are located on the left bank and are of standard design.[145]

In addition to the structures located at Check No. 8, DMC Segment 9 contains one overchute, one culvert, one pipe crossing, six (6) bridges, and 14 turnouts. The Crow Creek overchute at M.P. 48.43 and the Little Salado Creek culvert crossing at M.P. 45.75 are of standard design. The six bridge crossings in this span include: three concrete County Highway bridges and three timber Farm Bridges, all of standard design. Additionally, the concrete abutments from a no longer extant farm bridge are still evident at M.P. 46.36 (**Photograph 244**).

DMC Segment 9 also contains numerous minor appurtenant structures, including ladders, well discharges, and inlet and shoulder drains, virtually all constructed of metal and PVC pipes.

For a detailed discussion of repeating major and minor appurtenant structures along the DMC, including bridge, turnout, overchute, culvert, inlet drain, stilling well, and check building types, see typology discussion in P3a. Description on Continuation Sheets.

[144] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[145] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*, 59, 62, 93, 97-99.

Photographs (continued):



Photograph 241: Downstream view from the deck of the farm bridge at M.P. 47.38; camera facing downstream, May 13, 2022 (A00862).



Photograph 242: Upstream view of Check No. 8; camera facing upstream from left bank, May 13, 2022 (B00457).



Photograph 243: Downstream view of DMC from approximately M.P. 46.02 showing sandbags lining the top of the canal wall; camera facing downstream from left bank, May 13, 2022 (A00838).



Photograph 244: Right abutment from a no longer extant farm bridge at M.P. 46.36, with cracking visible along the canal lining; camera facing right bank from left bank, May 13, 2022 (A00848).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

*Resource Name or # (Assigned by recorder): Delta-Mendota Canal

*Recorded by: H. Norby, A. Lawton, & A. Young

*Date: May 13 & June 13, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation:** DMC-10

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 10 spans 5.78 miles between canal mileposts 48.62 and 54.40, from Check No. 9 to just above Check No. 10 along the western edge of the San Joaquin Valley in Stanislaus County. See **Sketch Map** and **Location Map** on Continuation Sheets.

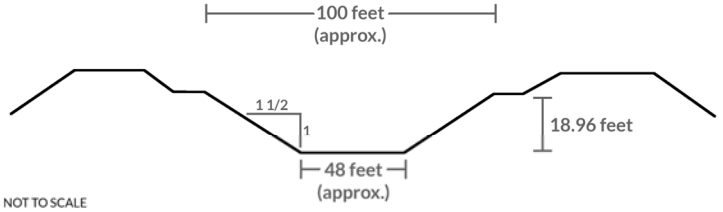
UTM: Zone 10S, 667851.77mE / 4137192.11mN (north endpoint); 669484.97mE / 4128831.84mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
Segment 10 begins at a point just upstream of Check No. 9 and continues to a point just upstream of Check No. 10 (**Photograph 245)**. (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width:** 100.38 feet (original)
b. **Bottom Width:** 48 feet
c. **Height or Depth:** 18.96 feet
d. **Length of Segment:** 5.78 miles

L4e. Sketch of Cross-Section (not to scale) **Facing:** Northeast



L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This segment of DMC is located primarily in the flat agricultural lands of the San Joaquin Valley in southwestern Stanislaus County. Surrounding agricultural lands are principally planted with orchards. This segment is crossed by four public roadways – Bell Road, Stuhr Road, Orestimba Road, and Shiells Road.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 245: Downstream view of Segment 10's northern end, showing Check No. 9 and check building with a stilling well in the foreground; camera facing downstream from left bank, May 13, 2022 (A00885).

L9. Remarks:

L10. Form prepared by:
Heather Norby, Abigail Lawton, & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 10, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[146] The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 246 - Photograph 248**). For a detailed discussion of DMC cross sections, see typology discussion in P3a. Description on Continuation Sheets.

The upstream end of DMC Segment 10 begins at Check No. 9, the site of which contains the check structure and building (**Photograph 245**). Check No. 9, at M.P. 48.62, is a concrete structure with a total length of 137 feet (**Photograph 249 - Photograph 251**). It is approximately 100 feet wide at the upstream end, widens to about 123 feet at the check gates, and then narrows again to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 250**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. One metal lamp post with an umbrella-shaped shade is also present on the deck. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 48.62 on the left bank and is of standard design. A stilling well is located just below Check No. 9, at M.P. 48.69, while a second stilling well is located just above Check No. 10 at M.P. 54.39. Both stilling wells are located on the left bank and are of standard design.[147]

In addition to the canal features located at Check No. 9, DMC Segment 10 contains other major appurtenant structures in its span, including the Newman Wasteway, one siphon, two culverts, six (6) bridges, and 13 turnouts.

The Orestimba Creek siphon at M.P. 51.18/51.27 is a four-barrel siphon conveying the DMC 330 feet under Bell Road, at M.P. 51.21, and the Orestimba Creek culvert, at M.P. 51.31, which provides an outlet for the Orestimba Water District (**Photograph 252 - Photograph 255**). A retaining wall on the east side of the Orestimba Creek siphon was repaired in 1995 after experiencing severe storm damage. Damaged steel sheet piles were removed or cut off and new Government supplied AZ 18 sheet piles were installed (**Photograph 254**).[148]

The second culvert in this segment crosses below the DMC at M.P. 50.49 to facilitate drainage. The six bridge crossings in this span include: three concrete County Highway bridges, one County Highway Wasteway Crossing bridge, and two timber Farm bridges, all of standard design. All 13 turnouts are the concrete pipe type and are of standard design.

The Newman Wasteway is on the left bank (east side) of the canal at M.P. 54.38 (**Photograph 256 - Photograph 263**). The wasteway extends generally northeast about 8.2 miles to the San Joaquin River. The wasteway begins with a concrete inlet structure on the left bank of the canal consisting of two waterways, each with a steel radial gate—measuring 20 feet wide and 17 feet tall—controlling the water flow. Both radial gates each have two gate arms, each measuring 19 feet, 9.5 inches long, with the pivot points bolted to a concrete headwall (**Photograph 258**). The gates' arms all have truss designs, and the arched gate faces are all reinforced by a grid pattern of steel beams. The gates are raised and lowered by a row of electric motors, hoists, pulleys, and a manual handle mounted on a concrete platform on top of the structure. This top deck includes a service

[146] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[147] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*, 59, 62, 93, 97-99.
[148] Welsh, Richard A., USDI, Reclamation, *Technical Report of Construction: Orestimba Creek Siphon Repairs*, September 28, 2001: 1-8, Appendix B, Central Valley Project – California (CVP), "Delta-Mendota Canal, Orestimba Creek Siphon Repair, Sheet Pile Drop and Impact Basin Plan", dwg. no. 214-D-22675, 1995.

walkway with pipe railing along the edge, and it also features a metal electrical box. Water passing through the wasteway control structure is channeled into a concrete-line trapezoidal chute with vertical top walls (**Photograph 259** and **Photograph 260**). This concrete-lined section of the wasteway extends about 1.5 miles and the remaining 6.7 miles are earth-line (**Photograph 261** and **Photograph 262**).[149]

DMC Segment 10 also contains numerous minor appurtenant structures, including ladders, well discharges, cattle guards, and inlet and shoulder drains, virtually all constructed of metal and PVC pipes. In this segment, some inlet drains were observed at locations not included in the *2020 DMC Structures List*, while other inlet drains included in that document were not observed at the specified locations. There were also three large pipes observed at approximately M.P. 54.39 on the right bank, however they did not appear to be connected/operable (**Photograph 264**). A review of archival photographs on Google Earth showed the pipes present at this location beginning in 2015. No photographs appear to show them operational.

For a detailed discussion of repeating major and minor appurtenant structures along the DMC, including bridge, turnout, culvert, inlet drain, stilling well, cattle guards, and check building types, see typology discussion in P3a. Description on Continuation Sheets.

[149] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*, 53.

Photographs (continued):



Photograph 246: Downstream view from the deck of a farm bridge at M.P. 49.55; camera facing downstream, May 13, 2022 (A00909).



Photograph 247: View of deep excavations on the right bank of the DMC from approximately M.P. 50.00; camera facing downstream from left bank, May 13, 2022 (C20400).



Photograph 248: Downstream view of DMC from approximately M.P. 53.15, Shiells Road bridge visible in distance (left background); camera facing downstream from left bank, May 13, 2022 (A00973).



Photograph 249: Detail view of Check No. 9 from the deck of Diehl Road Bridge; camera facing downstream from left bank, May 13, 2022 (A00883).



Photograph 250: Detail view of Check No. 9, showing its top deck and a pipe crossing mounted atop its support piers; camera facing right bank from left bank, May 13, 2022 (A00889).



Photograph 251: View of downstream side of Check No. 9; camera facing upstream from left bank, May 13, 2022 (A00893).



Photograph 252: Inlet headwall for Orestimba Creek siphon at M.P. 51.18; camera facing downstream from left bank, May 13, 2022 (A00940).



Photograph 253: Bell Road crossing over the 330-foot long Orestimba Creek siphon at M.P. 51.21; camera facing southeast, May 13, 2022 (A00941).



Photograph 254: Retaining wall around siphon and culvert that was repaired in 1995 after sheet piles were damaged in severe storm, fence around siphon outlet visible on elevated embankment in background (top center); camera facing south, May 13, 2022 (A00946).



Photograph 255: Outlet headwall of Orestimba Creek siphon, at M.P. 51.27, repaired retaining wall visible in background (far right); camera facing upstream from left bank, May 13, 2022 (A00948).



Photograph 256: View of Newman Wasteway inlet structure, looking upstream; camera facing downstream from left bank, May 13, 2022 (A00994).



Photograph 257: Newman Wasteway inlet structure, showing automatic-siphon spillways; camera facing downstream from left bank, May 13, 2022 (A00990).



Photograph 258: Detail view of Newman Wasteway inlet structure, showing the top deck, gate-hoisting equipment, and a radial gate's backside; camera facing right bank from left bank, May 13, 2022 (A00992).



Photograph 259: Downstream view of Newman Wasteway showing the start of the concrete-lined section at M.P. 54.38; camera facing east from left bank, May 13, 2022 (A00993).



Photograph 260: Upstream view of Newman Wasteway, showing concrete-lined section; camera facing upstream from wasteway's right bank, June 13, 2022 (C10778).



Photograph 261: Upstream view of Newman Wasteway, showing earth-lined section; camera facing upstream from wasteway's right bank, June 13, 2022 (C10778).



Photograph 262: Upstream view of Newman Wasteway from approximately M.P. 8.15, showing earth-lined section; camera facing upstream from wasteway's right bank, June 13, 2022 (C0025).



Photograph 263: Downstream view of Newman Wasteway's terminus where it joins the San Joaquin River; camera facing dowstream from wasteway's right bank, June 13, 2022 (C0026).



Photograph 264: Three (uninstalled) large pipes just above Check No. 10 at M.P. 54.41 on the right bank; camera facing downstream from left bank, May 13, 2022 (A00989).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Lawton

***Date**: May 13, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-11

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) Segment 11 spans 3.86 miles between canal mileposts 54.41 and 58.27, from Check No. 10 in southwestern Stanislaus County to the just above Check No. 11 in northwestern Merced County. See **Sketch Map** and **Location Map** on Continuation Sheets.

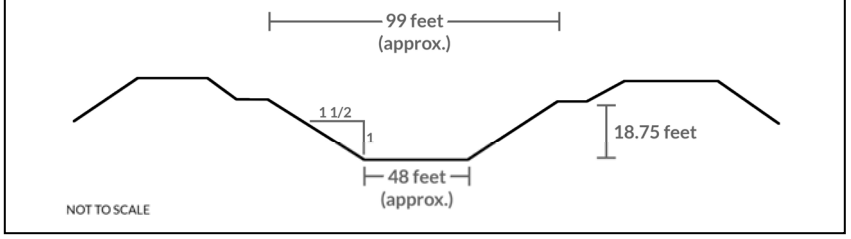
UTM: Zone 10S, 669490.56mE / 412888.06mN (north endpoint); 670531.47mE / 4123389.25mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
This segment begins at a point just upstream of Check No. 10 and continues to a point just upstream of Check No. 11 (**Photograph 265**). (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 99.75 feet (original)
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 18.75 feet
d. **Length of Segment**: 3.86 miles

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 11 skirts along the junction of the low-hilled grasslands and flat agricultural lands of the western San Joaquin Valley. The agricultural lands are principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 265: Beginning of Segment 11, showing Check No. 10 (center right), check building (left), and a stilling well (bottom right); camera facing downstream from left bank, May 13, 2022. (A00995)

L9. Remarks:

L10. Form prepared by:
Heather Norby, Abigail Lawton, & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 11, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[150] The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 266** and **Photograph 267**). For a detailed discussion of DMC cross sections, see typology discussion in P3a. Description on Continuation Sheets.

DMC Segment 11 begins at Check No. 10, the site of which contains the check structure and building (**Photograph 265**). Check No. 10, located at M.P. 54.4is a concrete structure with a total length of 137 feet. Its width is approximately 100 feet wide at the upstream end, widens to about 123 feet at the check gates, and then narrows back to 100 feet where it rejoins the canal walls on the downstream side (**Photograph 268** and **Photograph 269**). The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 268**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 54.41 on the left bank, is of standard design. A stilling well is located just below Check No. 10, at M.P. 54.49, while a second stilling well is located just above Check No. 11 at M.P. 58.25. Both stilling wells are located on the left bank and are of standard design.[151]

In addition to the structures located at Check No. 10 and described above, DMC Segment 11 contains three culverts, three (3) bridges, and 13 turnouts. The three bridge crossings in this segment include: two concrete County Highway bridges and one timber Operating Bridge, however this operating bridge, at M.P. 56.02, is currently barricaded at both ends and shows evidence of fire damage (**Photograph 270**). The two concrete County Highway bridges are of standard design, though the bridge at M.P. 56.60 along Pete Miller Road has parapet concrete walls, rather than the typical steel guard-rails (**Photograph 271**). Of the 13 turnouts, eleven are the typical concrete pipe type while two are the concrete box type. All of these are of standard design. The three drainage culverts are all of standard design.

DMC Segment 11 also contains numerous minor appurtenant structures, including ladders and inlet and shoulder drains, virtually all constructed of metal and PVC pipes.

For a detailed discussion of repeating major and minor appurtenant structures along the DMC, including bridge, turnout, culvert, inlet drain, stilling well, cattle guards, and check building types, see typology discussion in P3a. Description on Continuation Sheets.

[150] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[151] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*, 59, 62, 93, 97-99.

Photographs (continued):



Photograph 266: Downstream view of DMC from approximately M.P. 55.07, with spoil piles flanking both banks; camera facing downstream from left bank, May 13, 2022 (A01010).



Photograph 267: Upstream view of DMC from approximately M.P. 56.18; camera facing upstream from left bank, May 13, 2022 (A01012).



Photograph 268: Check No. 10; camera facing downstream from left bank, May 13, 2022 (A00997).



Photograph 269: Check No. 10; camera facing right bank from left bank, May 13, 2022 (A00998).



Photograph 270: Detail view of fire damaged deck of Operating Bridge at M.P. 56.02; right bank from left bank, May 13, 2022 (A01020)



Photograph 271: View of concrete County Highway bridge at M.P. 56.60 along Pete Miller Road with parapet concrete walls, rather than the typical steel guard-rails; downstream from left bank, May 13, 2022 (A01027).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 13, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-12

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) Segment 12 of the canal spans 5.70 miles between canal mileposts 58.28 and 63.98, from Check No. 11 to a point just above Check No. 12 in northwestern Merced County. See **Sketch Map** and **Location Map** on Continuation Sheets.

UTM: Zone 10S, 670530.32mE / 4123386.32mN (north endpoint); 673476.73mE / 4115507.16mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 12 begins at Check No. 11 (**Photograph 272**) and ends at a point just upstream of Check No. 12 (

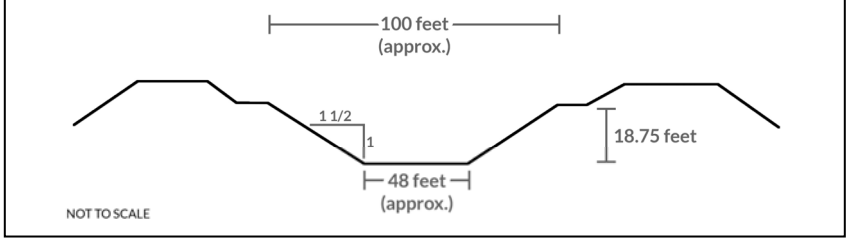
Photograph 273). It has the same concrete lining and trapezoidal cross section as elsewhere along the canal, and it is flanked with unpaved maintenance roads on both banks that are approximately 12 to 20 feet wide. (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100 feet
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 18.75 feet
d. **Length of Segment**: 5.70 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 12 skirts along the junction of the low-hilled grasslands and flat agricultural lands of the western San Joaquin Valley. The agricultural lands are principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by raising the concrete lining, alterations to bridges and turnouts, and the addition of stilling wells, well discharges, and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 272: Beginning of Segment 12 showing Check No. 11 and check building (left) with a turnout and stilling well (foreground); camera facing downstream from the left bank, June 13, 2022 (C0080).

L9. Remarks:

L10. Form prepared by:
Heather Norby and Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

Segment 12 of the canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 273** - **Photograph 275**). The width of the roads seems to vary based on topography.

Segment 12 begins at Check No. 11, located at M.P. 58.28. The check is a concrete structure with a total length of approximately 100 feet. Its width approximately is 100 feet at the upstream end, narrows to 60 feet at the check gates, and then narrows again to 40 feet where it transitions into the inlet of Garzas Creek Siphon (**Photograph 276**). The check structure is rectangular in cross section and divided into three bays of equal size, each with a radial gate for regulation and closure. The banks of the canal transition from sloped to vertical at the control structure. Spanning the top of the structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 277**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The check building, at M.P. 58.28 on the left bank, is of concrete block construction, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 11 at M.P. 58.25 while a second stilling well is located just below the siphon's outlet at M.P.58.40. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[152]

The Garzas Creek Siphon begins immediately downstream from Check No. 11 (**Photograph 278**). The concrete structure consists of inlet and outlet headwalls that are connected by four 12-by-16-feet barrels. The inlet headwall at M.P. 58.29 is 51 feet wide and approximately 23.75 feet tall. The outlet headwall at M.P. 58.35 is 48 feet wide and approximately 22.5 feet tall (**Photograph 279**). The barrels are 225 feet long and buried beneath Garzas Creek (**Photograph 280**). A concrete weir (**Photograph 281**) sits in the Garzas Creek streambed approximately in line with the canal's left bank.[153]

The four bridge spans in this segment include: three concrete county highway bridges and one timber-deck county highway bridge, at M.P. 62.09. All these bridges are of standard design.

In addition to the structures discussed above, DMC Segment 12 contains one pipe crossing, twelve turnouts, and inlet drains. All the other structures are of standard design or have standard alterations as discussed in the above typology discussion in Section P3a.

[152] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 62, 93, 97-99.

[153] "Garzas Creek Check and Siphon: Profile and Siphon Details," on file at the Bureau of Reclamation Design Construction Library; "Garzas Creek Check and Siphon: Details of Check and Siphon Inlet," on file at the Bureau of Reclamation Design Construction Library; Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 64-65.

Photographs (continued)



Photograph 273: View of Segment 12 from approximately M.P. 63.64, with a spoils pile flanking the right bank; camera facing downstream from left bank, June 13, 2022 (C0137).



Photograph 274: View of Segment 12 from approximately M.P. 63.34; camera facing upstream from left bank, June 13, 2022 (C0135).



Photograph 275: View of Segment 12 from the deck of Gravel Pit Road at M.P. 58.46; camera facing downstream, June 13, 2022 (C0094).



Photograph 276: Transition between Check No. 11 and Garzas Creek Siphon; camera facing right upstream from left bank, June 13, 2022 (C0087).



Photograph 277: Detail view of Check No. 11's gate hoisting equipment; camera facing upstream from left bank, June 13, 2022 (C0088).



Photograph 278: Garzas Creek Siphon's inlet headwall; camera facing downstream from left bank, June 13, 2022 (C0085).



Photograph 279: Garzas Creek Siphon's outlet headwall from the deck of Gravel Pit Road bridge at M.P. 58.46; camera facing upstream, June 13, 2022 (C0080).



Photograph 280: View across the Garzas Creek Siphon, with its outlet in the background; camera facing downstream, June 13, 2022 (C0086).



Photograph 281: Upstream view of Garzas Creek, showing the weir that sits approximately adjacent to the DMC centerline; camera facing west, June 13, 2022 (C0090).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 13, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-13

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 13 of the canal spans 6.01 miles between canal mileposts 63.99 and 70.00, from Check No. 12 to a point just upstream from Check No. 13.
UTM: Zone 10S, 673489.44mE / 4115478.07mN (north endpoint); 674434.29mE / 4106749.78mN (south endpoint)

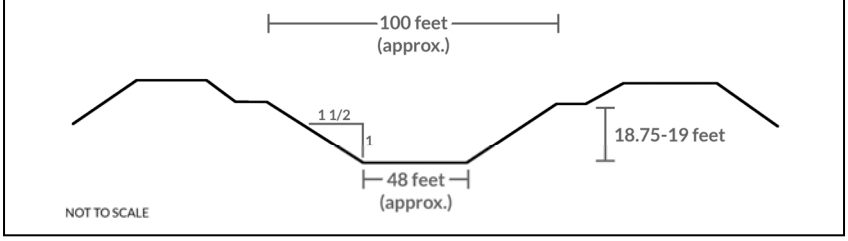
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 13 begins at Check No. 12 (**Photograph 282**) and ends at a point just upstream of Check No. 13. It has the same concrete lining and trapezoidal cross section as elsewhere along the canal, and it is flanked with unpaved maintenance roads on both banks that are approximately 12 to 20 feet wide.

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100 feet
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 18.75 feet – 19.00 feet
d. **Length of Segment**: 6.01 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 13 skirts along the junction of the low-hilled grasslands and flat agricultural lands of the western San Joaquin Valley. The agricultural lands are principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by raising the concrete lining, alterations to bridges, turnouts and inlet drains, and the addition of stilling wells, pipe crossings, and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 282: Beginning of Segment 13 showing Check No. 12 and check building (left), with a turnout and stilling well (foreground); camera facing south, June 13, 2022 (C0140)

L9. Remarks:

L10. Form prepared by:
Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

(west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 283** - **Photograph 284**). The width of the roads seems to vary based on topography.

Segment 13 begins at Check No. 12 located at M.P. 63.99 (**Photograph 285** - **Photograph 286**). The check is a concrete structure with a total length of 180 feet. Its width approximately is 100 feet wide at the upstream end, widens to 135 feet at the check gates, and then narrows back to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of the structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge. On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 63.99 on the left bank, is a concrete block structure, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 12 at M.P. 63.95 while a second stilling well is located just below it at M.P. 64.06. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[154]

The O'Neill Forebay intake channel extends from the canal's right bank at M.P. 69.30 (**Photograph 287**). It is approximately 125 feet wide and extends approximately one-half mile from the canal to the forebay intake.

The Volta Wasteway extends from the canal's left bank at M.P. 69.98 (**Photograph 288**). It is approximately six miles in total length, ending where it transitions into the San Luis Wasteway. It begins with a concrete inlet structure consisting of two 15-foot-wide channels, each with a steel radial gate to control the flow of water. The arced gate faces are 16.5 feet tall and 15 feet wide and reinforced on the back by a grid of steel members. Each has two steel arms of a truss design that pivot from pins fixed into the central support pier and channel sidewalls. Supported by the pier and sidewalls is a concrete top deck on which electric gate-hoisting equipment and a concrete bridge are mounted. A replacement automatic-siphon spillway passes beneath the south radial gate (**Photograph 289**). Water passing through the inlet structure flows down a chute, into a stilling pool, and then into the wasteway lined with compacted earth (**Photograph 290** - **Photograph 291**). The O'Neill Forebay Wasteway, which passes beneath the DMC through a culvert at M.P. 69.85 (**Photograph 292**), joins the Volta Wasteway approximately 850 feet downstream from the inlet structure (**Photograph 293**).[155]

A Bureau of Reclamation O&M yard is sited on the east side of the canal at approximately M.P. 69.90 and flanked by the Volta and O'Neill wasteways on its northeast and southeast sides (**Photograph 294**). It consists of two Quonset huts sited parallel to each other. The approximately 4,000-square-feet buildings have rectangular footprints, semi-cylindrical forms, and they are clad in metal. Access to each is provided through double garage doors at both ends. Fenestration on the west building includes sliding aluminum windows flanking the garage doors while the east building includes no fenestration.

The five extant bridge crossings in this segment include two concrete county highway bridges, one county highway wasteway crossing bridge, one non-original (post-1958) state highway bridge, and the O'Neill intake channel operating bridge. All county highway bridges are of standard design, although the bridge at M.P. 68.03, along McCabe Road, has concrete parapet walls, instead of the typical steel guard-rails, and is supported by three concrete piers, rather than the typical two piers (**Photograph 295**). The non-original bridge at M.P. 65.89 consists of two spans that carry Interstate 5 north and south. This

[154] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 62, 97-99.
[155] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 65, 70-74.

bridge, constructed in 1965, has paved concrete decks, each measuring 39 feet, 8 inches wide, and supported by steel stringers. The abutments on the right bank sit directly next to the canal and support the stringers, while on the left bank, the stringers terminate monolithic concrete piers, while the decks extend over the O&M road adjacent to the canal and terminate at abutments further up the embankment.[156] The O'Neill intake channel operating bridge has a paved concrete deck supported by a single support pier. Additionally, the abutments of a non-extant farm bridge remain at M.P. 67.15.

In addition to the structures discussed above, DMC Segment 13 contains two overchutes, two culverts, three pipe crossings, 18 turnouts, and inlet drains. All these structures are of standard design or have standard alterations as discussed in the above typology discussion in Section P3a.

[156] USDI, Reclamation, *Designer's Operating Criteria*, 1971: 26.

Photographs (continued):



Photograph 283: View of Segment 13 from approximately M.P. 64.44, with spoils piles along the right bank; camera facing downstream from left bank, June 13, 2022 (C0158).



Photograph 284: View of Segment 13, showing the canal's left bank and a turnout at M.P. 65.89; camera facing downstream from left bank, June 13, 2022 (C0165).



Photograph 285: Check No. 12, with a turnout at M.P. 63.96 visible in the foreground; camera facing downstream from left bank, June 13, 2022 (C0142).



Photograph 286: Check No. 12; camera facing upstream from left bank, June 13, 2022 (C0147).



Photograph 287: The O'Neill Forebay Intake Channel; camera facing right bank from left bank, June 13, 2022 (C0189).



Photograph 288: Volta Wasteway's inlet structure at M.P. 69.98, with Check No. 13 in the background; camera facing downstream from left bank, June 13, 2022 (C0194).



Photograph 289: Automatic-siphon spillway; camera facing northeast from left bank, June 13, 2022 (C0198).



Photograph 290: Upstream view of the Volta Wasteway, with its inlet structure in the background; camera facing upstream from wasteway's left bank, June 13, 2022 (C0219).



Photograph 291: View of Volta Wasteway with a pipe crossing at approximately M.P. 1.5; camera facing upstream from wasteway's left bank, June 13, 2022 (C0225).



Photograph 292: Culvert channeling the O'Neill Forebay Wasteway beneath the DMC at M.P. 69.62; camera facing upstream from wasteway's right bank, June 13, 2022 (C0214).



Photograph 293: View of the O'Neill Forebay Wasteway, showing its junction with the Volta Wasteway in the distance; camera facing downstream from wasteway's right bank, June 13, 2022 (C0215).



Photograph 294: Quonset huts in O&M yard approximately at M.P. 69.90; camera facing northeast, June 13, 2022 (C0223).



Photograph 295: Bridge at M.P. 68.03; camera facing downstream from left bank, June 13, 2022 (C0178).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 13-14, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-14

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 14 of the canal spans 4.38 miles between canal mileposts 70.01 and 74.39, from Check No. 13 to a point just above Check No. 14 in Merced C3ounty.

UTM: Zone 10S, 674462.32mE / 4106744.51mN (north endpoint); 680767.62mE / 4104237.10mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)

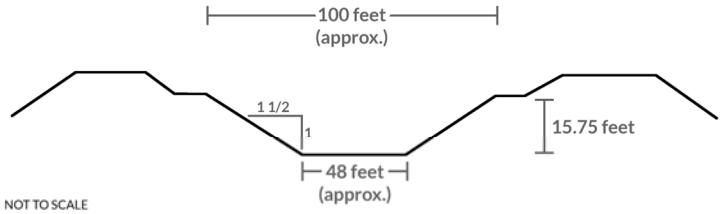
DMC Segment 14 begins at Check No. 13 (**Photograph 296**) and ends at a point just upstream of Check No. 14. It has the same concrete lining and trapezoidal cross section as elsewhere along the canal, and it is flanked with unpaved maintenance roads on both banks that are approximately 12 to 20 feet wide. (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100 feet
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 15.75 feet
d. **Length of Segment**: 4.38 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)

Segment 14 skirts along the junction of the low-hilled grasslands and flat agricultural lands of the western San Joaquin Valley. The agricultural lands are principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by raising the concrete lining, alterations to bridges, turnouts, and inlet drains, and the addition of stilling wells, pipe crossings, and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 296: Beginning of Segment 14 showing Check No. 13 with the Volta Wasteway in the foreground; camera facing downstream from left bank, June 13, 2022 (C0192).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

Segment 14 of the canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 297** - **Photograph 298**). The width of the roads seems to vary based on topography.

Segment 14 begins at Check No. 13 (**Photograph 299**), located at M.P. 70.00. The check is a concrete structure with a total length of 180 feet. Its width approximately is 100 feet at the upstream end, widens to 135 feet at the check gates, and then narrows back to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same sloped angle as the canal. Spanning the top of the structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge. On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 70.00 on the left bank, is of concrete block construction, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 13 at M.P. 69.99 while a second stilling well is located just below it at M.P. 70.04. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[157]

The salinity station building on the right bank at M.P. 70.01 has a 7-by-7-feet, square footprint (**Photograph 300**). Its roof and walls are covered in corrugated metal. A metal door provides access on its northwest side.

The three bridge crossings in this segment include one state highway bridge, one timber county highway bridge, and one non-original (post-1958) state highway bridge. The state highway bridge at M.P. 71.31 along Jenson Road/State Route 207 and the timber county highway bridge at M.P. 72.33 along Hilldale Avenue are of standard design. The non-original bridge at M.P. 72.80 consists of two spans that carry Interstate 5's north and south bound lanes. This bridge, constructed in 1965, has paved concrete decks, each measuring 39 feet, 8 inches wide, and supported by steel stringers. The abutments of this bridge sit right next to the canal lining and the stringers are strung directly between the abutments (**Photograph 301**).[158]

In addition to the canal structures discussed above, Segment 14 contains two siphon undercrossings, two culverts, five pipe crossings, two siphon undercrossings, ten turnouts, and inlet drains. Of the eight turnouts, all are concrete pipe types. All these structures are of standard design or have standard alterations as discussed in the above typology discussion in Section P3a.

[157] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 62, 93, 97-99.
[158] USDI, Reclamation, *Designer's Operating Criteria*, 1971: 26.

Photographs (continued)



Photograph 297: View of Segment 14 from approximately M.P. 74.20, with Check No. 14 visible in the distance; camera facing downstream from left bank, June 14, 2022 (D2214).



Photograph 298: View of Segment 14 from approximately M.P. 73.87; camera facing upstream from left bank, June 14, 2022 (D2211).



Photograph 299: Check No. 13; camera facing upstream from left bank, June 13, 2022 (D0203).



Photograph 300: Salinity station building along the right bank at M.P. 70.01; camera facing right bank from left bank, June 13, 2022 (D0201).



Photograph 301: Bridge at M.P. 72.80; camera facing upstream from left bank, June 14, 2022 (D0206).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 14, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-15

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 15 spans 5.23 miles between canal mileposts 74.40 and 79.63, from Check No. 14 to a point just above Check No. 15.
UTM: Zone 10S, 680778.56mE / 4104215.13mN (north endpoint); 686746.73mE / 4099027.25mN (south endpoint)

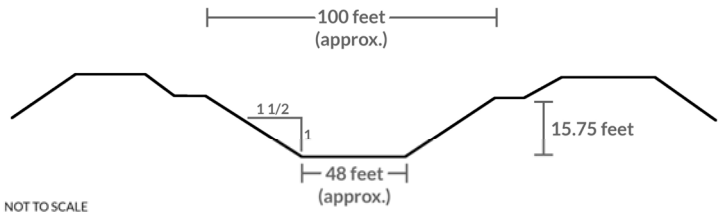
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 15 begins at Check No. 14 (**Photograph 302**) and ends at a point just upstream of Check No. 15. It has the same concrete lining and trapezoidal cross section as elsewhere along the canal, and it is flanked with unpaved maintenance roads on both banks that are approximately 12 to 20 feet wide. (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100 feet
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 15.75 feet
d. **Length of Segment**: 5.23 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 15 skirts the junction of the low-hilled grasslands and flat agricultural lands of the western San Joaquin Valley. The agricultural lands are principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by raising the concrete lining, alterations to bridges, turnouts, and inlet drains, and the addition of stilling wells, pipe crossings, and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 302: Beginning of Segment 15's northern end showing Check No. 14, check building (left), and a stilling well (foreground); camera facing downstream from left bank, June 14, 2022 (D2215).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

Segment 15 of the canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 303 - Photograph 304**). The width of the roads seems to vary based on topography.

Segment 15 begins at Check No. 14 (**Photograph 305**), located at M.P. 74.44. The check is a concrete structure with a total length of approximately 135 feet. Its width approximately is 100 feet wide at the upstream end, widens to 135 feet at the check gates, and then narrows back to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of the structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 306**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below (**Photograph 307**). The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 74.40 on the left bank, is of concrete block construction, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 14 at M.P. 74.36 while a second stilling well is located just below it at M.P. 74.45. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[159]

The Wolfsen Bypass extends from the canal's left bank at M.P. 76.04 (**Photograph 308**). It begins at a concrete inlet structure that consists of two four-by-five-feet turnouts that are the box barrel type (**Photograph 309**), and it extends approximately 900 feet until it transitions into another canal that runs alongside and generally parallel to DMC Segment 15 (**Photograph 310**).

The Los Banos Creek inlet, located along the right bank at M.P. 79.63, consists of a 10-by-6-foot concrete double-box-barrel with lift gates (**Photograph 311**). Manual gate hoisting equipment raises and lowers the gates.

The five bridge crossings in this segment include three concrete county highway bridges, one timber county highway bridge, and one state highway bridge. Most of these bridges are of standard design, however the deck of the county highway bridge at M.P. 77.20 appears different from the typical concrete decks (**Photograph 312**). It does not possess any curbs and an examination report from 1971 notes: "Many timber bridges have been replaced or repaired. Most of the replacements have used a treated-timber superstructure; however, the bridge at Mile 77.20 was replaced using prestressed precast slabs. This bridge looks very good."[160]

In addition to the canal structures discussed above, Segment 15 contains two overchutes, five pipe crossings, twelve turnouts, and inlet drains. All these structures are of standard design or have standard alterations as discussed in the above typology discussion in Section P3a.

[159] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 62, 93, 97-99.
[160] USDI, Reclamation, *Condition of Major Irrigation Structures and Facilities, Region 2*, 1970: 6.

Photographs (continued)



Photograph 303: View of Segment 15 approximately from M.P. 76.64; camera facing upstream from left bank, June 14, 2022 (C0254).



Photograph 304: View of Segment 15, showing a well discharge and remnants of a deleted pipe crossing at M.P. 78.31; camera facing downstream from left bank, June 14, 2022 (C0267).



Photograph 305: Check No. 14; camera facing downstream from left bank, June 14, 2022 (D2216).



Photograph 306: Check No. 14, with a pipe crossing mounted on its piers; camera facing upstream from left bank, June 14, 2022 (D2218).



Photograph 307: Detail view of Check No. 14's top deck; camera facing right bank from left bank, June 14, 2022 (D2217).



Photograph 308: Wolfsen Bypass inlet structure along left bank at M.P. 76.04; camera facing downstream from left bank, June 14, 2022 (C0250).



Photograph 309: Detail view of Wolfsen Bypass inlet structure along left bank at M.P. 76.04, showing the gates for each box-barrel-type turnout; camera facing east, June 14, 2022 (C0251).



Photograph 310: Downstream view of Wolfsen Bypass at M.P. 76.04; camera facing northwest from left bank of DMC, June 14, 2022 (C0252).



Photograph 311: Los Banos Creek inlet at M.P. 79.63; camera facing right bank from left bank, June 14, 2022 (C0282).



Photograph 312: Bridge at M.P. 77.20; camera facing downstream from left bank, June 14, 2022 (C0259).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 14, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-16

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 16 of the canal spans 5.44 miles between canal mileposts 79.64 and 85.08, from Check No. 15 to a point just above Check No. 16 in Merced County.
UTM: Zone 10S, 686757.91mE / 4099011.75mN (norther endpoint); 693000.31mE / 4093641.06mN (south endpoint)

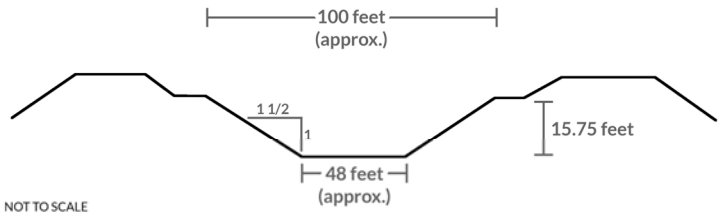
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 16 begins at Check No. 15 (**Photograph 313**) and ends at a point just upstream of Check No. 16. It has the same concrete lining and trapezoidal cross section as elsewhere along the canal, and it is flanked with unpaved maintenance roads on both banks that are approximately 12 to 20 feet wide. (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100 feet
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 15.75 feet
d. **Length of Segment**: 5.44 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 16 traverses through the flat agricultural lands of the western San Joaquin Valley principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by raising the concrete lining, alterations to bridges, turnouts, and inlet drains, and the addition of stilling wells, pipe crossings, and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 313: Beginning of Segment 16 showing Check No. 15, check building (left), turnout (right), and well discharge (foreground); camera facing downstream from left bank, June 14, 2022 (C0279).

L9. Remarks:

L10. Form prepared by:

Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

Segment 16 of the canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 314 - Photograph 316**). The width of the roads seems to vary based on topography.

Segment 16 begins at Check No. 15 (**Photograph 317**), located at M.P. 79.64. The check is a concrete structure with a total length of approximately 100 feet. Its width approximately is 100 feet wide at the upstream end, narrows to 60 feet at the check gates, and then narrows again to 40 feet where it transitions into the Los Banos Creek Siphon. The banks of the canal transition from sloped to vertical at the control structure. Spanning the top of the structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 318**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is rectangular in cross section and divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The check building, at M.P. 79.64 on the left bank, is of concrete block construction, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 15 at M.P. 79.63 while a second stilling well is located just below the Los Banos Siphon's outlet at M.P. 80.01. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[161]

The Los Banos Creek Siphon begins immediately downstream of Check No. 15. The concrete structure consists of inlet and outlet headwalls that are connected by three 12-feet by 16-feet barrels. The barrels are 250 feet long and buried beneath Los Banos Creek. The inlet headwall at M.P. 79.64 is 41 feet wide and approximately 25 feet tall. The outlet headwall at M.P. 79.72 is 41.5 feet wide and approximately 23 feet tall (**Photograph 319**). The barrels are 250 feet long and buried beneath Los Banos Creek. A bridge extends across Los Banos Creek along the DMC centerline, and a modern check+ structure sits in Los Banos Creek directly upstream from the bridge (**Photograph 320 - Photograph 321**).[162]

The San Luis and Delta-Mendota Water Authority Field Office is sited on the west side of the canal at M.P. 80.00 (**Photograph 322**). It consists of a generally triangular-shaped lot containing a modern office building, two original garages, one modern garage, and several outbuildings. As originally developed, the two original garages likely functioned as Bureau of Reclamation O&M buildings. The approximately 2,700-square-feet, modern office building is sited toward the lot's southeast corner (**Photograph 323**). It has a rectangular footprint, side gable roof of crimped metal, and walls clad in metal. The main entrance is located on its north side and consists of double metal doors sheltered beneath a metal canopy. An additional entrance is comprised of a metal door on the east side. Fenestration includes sliding windows. Two approximately 2,500-square-feet, five-bay garages are sited in the lot's southwest corner next to each other facing north (**Photograph 324**). Both have rectangular footprints and side-gable metal roofs. The west garage is original and of a prefabricated metal construction that was common and ubiquitous throughout the CVP. Of its five bays, four are open while the bay at its west end has been enclosed by the addition of a metal roll-up garage door. The east garage is modern but of a similar prefabricated metal construction. Of its five bays, the two at its east end are open while the rest are enclosed and accessed by metal roll-up garage doors, and the bay at its west sits above grade, atop a concrete foundation. An additional entryway to the above-grade bay is provided by a metal door accessed by a metal staircase on the garage's east side. The second original garage is sited in the middle of the lot's west edge. It is approximately 4,700-square-feet, has a rectangular footprint, and walls clad in metal. An addition was constructed onto the original section's east side. Primary and secondary side-gable metal roofs cover both sections, with the secondary roof over the addition sitting slightly higher than the primary. Both sections are accessed by metal roll-up garage doors.[163]

The nine bridge crossings in this segment include six concrete county highway bridges, two timber farm bridges, and one operating bridge, which consists of a road with steel guard-rails along the Los Banos Creek siphon. This structure replaced the

[161] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59-61, 93, 97-99.
[162] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59-61, 64-65.
[163] Cartwright and Co., Flight ABF-1957, Frame 11T-90, 1:20,000 (April 9, 1957) flown for USDA; USGS, Flight NAPP, Frame 462-23, 1:40,000 (June 17, 1987) flown for USGS.

original timber operating bridge at this location and is included in the bridge inventory because it possesses a Caltrans bridge number. All other bridges in this segment are of standard design.

In addition to the canal structures discussed above, Segment 16 contains two overchutes, 14 pipe crossings, 13 turnouts, and inlet drains. All these structures are of standard design or have standard alterations as discussed in the above typology discussion in Section P3a.

Photographs (continued)



Photograph 314: View of Segment 16 from approximately M.P. 82.17; camera facing upstream from left bank, June 14, 2022 (C0312).



Photograph 315: View of Segment 16 from approximately M.P. 82.17; camera facing downstream from left bank, June 14, 2022 (C0313).



Photograph 316: View of Segment 16 from at M.P. 84.65, showing a pipe crossing; camera facing right bank from left bank, June 14, 2022 (C0330).



Photograph 317: Check No. 15, showing where it transitions into the Los Banos Creek Siphon inlet; camera facing downstream from left bank, June 14, 2022 (C0280).



Photograph 318: Detail view of Check No. 15's top deck; camera facing right bank from left bank, June 14, 2022 (C0284).



Photograph 319: Los Banos Creek Siphon outlet at M.P. 79.69; camera facing upstream from right bank, June 14, 2022 (C0293).



Photograph 320: Check structure in Los Banos Creek from the deck of the operating bridge at M.P. 79.69; camera facing west, June 14, 2022 (C0288).



Photograph 321: Check structure in Los Banos Creek at the Los Banos Creek Siphon; camera facing southwest, June 14, 2022 (C0287).



Photograph 322: San Luis and Delta-Mendota Water Authority Field Office; camera facing right bank from left bank, June 14, 2022 (C0294).



Photograph 323: Office building at San Luis and Delta-Mendota Water Authority Field Office; camera facing right bank from left bank, June 14, 2022 (C0295).



Photograph 324: Both two 5-bay garages at San Luis and Delta-Mendota Water Authority Field Office; camera facing right bank from left bank, June 14, 2022 (C0296).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 14, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-17

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 17 spans 5.44 miles between canal mileposts 85.09 and 90.53, from Check No. 16 to a point just above Check No. 17 in Merced County.
UTM: Zone 10S, 693007.86mE / 4093625.13mN (north endpoint); 698602.59mE / 4088374.85mN (south endpoint)

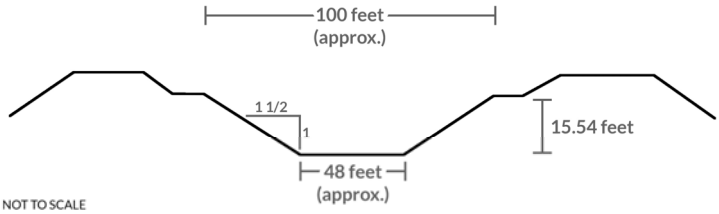
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 17 begins at Check No. 16 (**Photograph 325**) and ends at a point just upstream of Check No. 17.
It has the same concrete lining and trapezoidal cross section as elsewhere along the canal, and it is flanked with unpaved maintenance roads on both banks that are approximately 12 to 20 feet wide. (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100 feet
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 15.54 feet
d. **Length of Segment**: 5.44 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 17 traverses through the flat agricultural lands of the western San Joaquin Valley principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by raising the concrete lining, alterations to bridges, turnouts, and inlet drains, and the addition of stilling wells and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 325: Beginning of Segment 17 showing Check No. 16 and check building (left); camera facing downstream from left bank, June 14, 2022 (C0333).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

Segment 17 of the canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 326 - Photograph 327**). The width of the roads seems to vary based on topography.

Segment 17 begins at Check No. 16 (**Photograph 328 - Photograph 329**), located at M.P. 85.09. The check is a concrete structure with a total length of approximately 145 feet. Its width approximately is 100 feet at the upstream end, widens to 130 feet at the check gates, and then narrows back to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of the structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge. On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 85.07 on the left bank, is of concrete block construction, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 16 at M.P. 85.09 while a second stilling well is located just below the Los Banos Siphon's outlet at M.P. 85.14. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[164]

The four bridge crossings in this segment include two timber farm bridges and two concrete county highway bridges. All are standard design.

In addition to the canal structures located at Check No. 16, Segment 17 contains eight pipe crossings, 15 turnouts, and inlet drains. All these structures are of standard design or have standard alterations as discussed in the above typology discussion in Section P3a.

[164] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 62, 93, 97-99.

Photographs (continued)



Photograph 326: View of Segment 17 approximately from M.P. 90.16, showing two well discharges and an inlet drain; camera facing downstream from left bank, June 14, 2022 (C0363).



Photograph 327: View of Segment 17 approximately from M.P. 86.51; camera facing downstream from left bank, June 14, 2022 (C0344).



Photograph 328: Check No. 16 at M.P. 85.09; camera facing downstream from left bank, June 14, 2022 (C0333).



Photograph 329: Check No. 16 at M.P. 85.09; camera facing downstream from left bank, June 14, 2022 (C0336).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 14, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-18

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 18 of the canal spans 6.26 miles between canal mileposts 90.54 and 96.80, from Check No. 17 in Merced County to a point just above Check No. 18 in Fresno County.
UTM: Zone 10S, 698618.86mE / 4088361.11mN (north endpoint); 707625.65mE / 4085198.89mN (south endpoint)

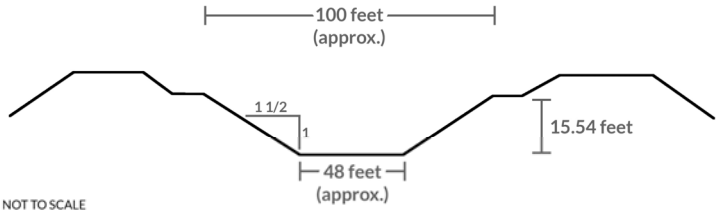
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 18 begins at Check No. 17 (**Photograph 330**) and ends at a point just upstream of Check No. 18 (**Photograph** 297). It has the same concrete lining and trapezoidal cross section as elsewhere along the canal, and it is flanked with unpaved maintenance roads on both banks that are approximately 12 to 20 feet wide. (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100 feet
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 15.54 feet
d. **Length of Segment**: 6.26 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 18 traverses through the flat agricultural lands of the western San Joaquin Valley principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by raising the concrete lining, alterations to bridges, turnouts, and inlet drains, and the addition of stilling wells, well discharges, and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 330: Beginning of Segment 18 showing Check No. 17 and check building (left); camera facing downstream from left bank, June 14, 2022 (E0366).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

Segment 18 of the canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 331 - Photograph 334**). The width of the roads seems to vary based on topography.

Segment 18 begins at Check No. 17 (**Photograph 335**), located at M.P. 90.54. The check is a concrete structure with a total length of approximately 145 feet. Its width approximately is 100 feet at the upstream end, widens to 120 feet at the check gates, and then narrows back to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of the structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge. On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 90.54 on the left bank, is of concrete block construction, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 17 at M.P. 90.53 while a second stilling well is located just it at M.P. 90.61. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[165]

The seven bridge crossings in this segment include five timber farm bridges, one concrete county highway bridge, and one timber operating bridge. All of these bridges are of standard design.

In addition to the canal structures discussed above, Segment 18 contains 7 pipe crossings, one siphon undercrossing, 14 turnouts, well discharges, and inlet drains. All the bridges are of standard design. All these structures are of standard design or have standard alterations as discussed in the above typology discussion in Section P3a.

[165] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 62, 93, 97-99.

Photographs (continued)



Photograph 331: View of Segment 18 from approximately M.P. 91.36, with Check No. 17 in the distance; camera facing upstream from left bank, June 14, 2022 (C0376).



Photograph 332: View of Segment 18 approximately from M.P. 91.77; camera facing upstream from left bank, June 14, 2022 (C0381).



Photograph 333: View of Segment 18 from the deck of a farm bridge at M.P. 95.45; camera facing downstream, June 14, 2022 (C0398).



Photograph 334: View from approximately from M.P. 91.77; camera facing right bank from left bank, June 14, 2022 (C0404).



Photograph 335: Check No. 17, with an operating bridge in the background; camera facing downstream from left bank, June 14, 2022 (C0368).



Photograph 336: View from approximately M.P. 90.57, showing a pipe crossing, operating bridge, and Check No. 17 in the background; camera facing upstream from left bank, June 14, 2022 (C0371).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 14, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-19

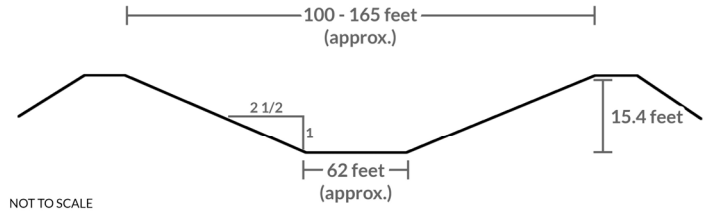
***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 19 of the canal spans 8.24 miles between canal mileposts 96.81 and 105.05, from Check No. 19 to a point just above Check No. 19 in Fresno County.
UTM: Zone 10S, 707647.78mE / 4085198.79mN (north endpoint); 720476.64mE / 4083384.47mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 19 begins at Check No. 18 (**Photograph 337**) and ends at a point just upstream of Check No. 19. It the same trapezoidal cross section as elsewhere along the canal. The northern approximately one-quarter of this segment is concrete-lined while the remainder is lined with compacted earth. On both sides of the canal are unpaved maintenance roads approximately 12 to 20 feet wide. (See Continuation Sheet.)

L4. Dimensions: (in feet for historic features and meters for prehistoric features)
- **a. Top Width**: 100 - approximately 165 feet
- **b. Bottom Width**: 48-84 feet
- **c. Height or Depth**: 15.54 feet – 15.40 feet
- **d. Length of Segment**: 8.24 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 19 traverses through the flat agricultural lands of the western San Joaquin Valley principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by alterations to bridges, turnouts, and inlet drains and the addition of stilling wells, well discharges, and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 337: Beginning of Segment 19's northern end showing Check No. 18 and check building (right); camera facing downstream from left bank, June 14, 2022 (C0409).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

Segment 19 of the canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (Error! Reference source not found. - Error! Reference source not found.). The width of the roads seems to vary based on topography. The canal is lined with concrete from its beginning to M.P. 98.62, after which it is lined with compacted earth **(**Error! Reference source not found. - Error! Reference source not found.).

Segment 19 begins at Check No. 18 (Error! Reference source not found.), located at M.P. 96.81. The check is a concrete structure with a total length of approximately 135 feet. Its width approximately is 100 feet at the upstream end, widens to 130 feet at the check gates, and then narrows back to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of the structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge. On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 96.81 on the left bank, is of concrete block construction, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 18 at M.P. 96.71 while a second stilling well is located just below it at M.P. 96.88. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[166]

The six bridge crossings in this segment include three concrete county highway bridges, two timber farm bridges, and one non-original (post-1958) replacement farm bridge. The farm bridge at M.P. 102.03 was reconstructed in 2014 with a concrete deck, measuring 22 feet wide, supported by five concrete bents, with steel guard-rails (**Photograph 345**). All other bridges are of standard design.

In addition to the canal structures discussed above, Segment 19 contains nine pipe crossings, one siphon undercrossing, ten turnouts, well discharges, and inlet drains. All these structures are of standard design or have standard alterations as discussed in the above typology discussion in Section P3a.

[166] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 62, 93, 97-99.

Photographs (continued)



Photograph 338: View of Segment 19's concrete-lined section from approximately M.P. 98.62; camera facing upstream from left bank, June 14, 2022 (C0419).



Photograph 339: Deteriorated concrete lining along right bank at approximately M.P. 96.82; camera facing right bank from left bank, June 14, 2022 (C0411).



Photograph 340: View of Segment 19 from approximately M.P. 98.62, showing where it transitions from concrete-lined to earth-lined; camera facing downstream from left bank, June 14, 2022 (C0418).



Photograph 341: View of Segment 19's transition from concrete-lined to earth-lined at M.P. 98.74; camera facing upstream, June 14, 2022 (C0423).



Photograph 342: View of Segment 19's earth-lined section from approximately M.P. 104.22; camera facing downstream from left bank, June 14, 2022 (C0449).



Photograph 343: Check No. 18; camera facing right bank from left bank, June 14, 2022 (C0413).



Photograph 344: Check No. 18; camera facing upstream from left bank, June 14, 2022 (C0412).



Photograph 345: Bridge at M.P. 102.03; camera facing downstream from left bank, June 14, 2022 (C0440).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 14, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-20

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 20 of the canal spans 6.19 miles between canal mileposts 105.06 and 111.25, from Check No. 19 to a point just above Check No. 20 in Fresno County.
UTM: Zone 10S, 720497.39mE / 4083377.60mN (north endpoint); 728358.55mE / 4079053.51mN (south endpoint)

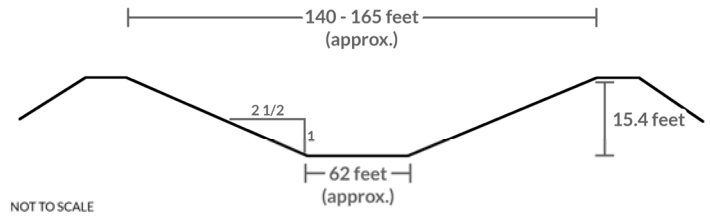
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 20 begins at Check No. 19 (**Photograph 346**) and ends at a point just upstream of Check No. 20. It has the same trapezoidal cross section as elsewhere on the canal and is lined with compacted earth. It is flanked with unpaved maintenance roads on both banks that are approximately 12 to 20 feet wide. (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: Approximately 140-165 feet
b. **Bottom Width**: 60-84 feet
c. **Height or Depth**: 15.40 feet
d. **Length of Segment**: 6.19 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 20 traverses through the flat agricultural lands of the western San Joaquin Valley principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by alterations to bridges and inlet drains and the addition of stilling wells, pipe crossings, well discharges, and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 346: Beginning of Segment 20 showing Check No. 19 and check building (right); camera facing downstream from left bank, June 14, 2022 (C0453).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

Segment 20 of the canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 347 - Photograph 349**). The width of the roads seems to vary based on topography.

Segment 20 begins at Check No. 19 (**Photograph 350**), located at M.P. 105.06. The check is a concrete structure with a total length of approximately 125 feet and a width that approximately is 145 feet at the upstream end, narrows to 125 feet at the check gates, and then widens again to 145 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of the structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge. On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 96.81 on the left bank, is of concrete block construction, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 19 at M.P. 105.05 while a second stilling well is located just below it at M.P. 105.09. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[167]

The Southern Pacific Railroad and State Highway 33 Siphon (**Photograph 351** - **Photograph 352**) begins approximately one quarter mile upstream from Check No. 20. The concrete structure consists of inlet and outlet headwalls that are connected by three 16-by-16-feet barrels. The inlet headwall at M.P. 110.96 is approximately 39 feet wide while the outlet headwall at M.P. 111.02 is approximately 38 feet wide. The barrels are 305 feet long and buried beneath the Southern Pacific Railroad and State Highway 33.[168]

The Firebaugh Wasteway extends from the canal's left bank at M.P. 111.22 (**Photograph 353**). It is approximately 1.1 miles in total length, ending where it flows into the San Joaquin River. It begins with a concrete inlet structure consisting of two 15-foot-wide channels, each with a steel radial gate to control the flow of water. The arced gate faces are 15 feet tall and 13 feet wide and reinforced on the back by a grid of steel members (**Photograph 354**). Each has two steel arms of a truss design that pivot from pins fixed into the central support pier and channel sidewalls. Supported by the pier and sidewalls is a concrete top deck on which electric gate-hoisting equipment is mounted and a concrete bridge. Double automatic-siphon spillways flank the gates (**Photograph 355**). Water passing through the inlet structure flows down a chute, into a stilling pool, and then into the wasteway lined with compacted earth.[169]

A siphon undercrossing at M.P. 111.24 consists of two one-foot pipes that convey the Master Drain beneath the DMC.

The six bridge crossings in this segment include two concrete county highway bridges, one county highway wasteway crossing bridge, one timber farm bridge, one non-original (post-1958) replacement farm bridge, and one crossing over a siphon. The farm bridge at M.P. 106.58 was replaced in 2004 and now has a concrete deck, measuring 20 feet wide, supported by five concrete bents, with steel guard-rails (**Photograph 356**). The crossing at M.P. 110.99 carries State Highway 33 and a single track for the Southern Pacific Railroad across the siphon at M.P. 110.96/111.02 (**Photograph 357**). It is included in the bridge population because it is categorized as a bridge in the DMC Structures List (2020). All other bridges are of standard design.

[167] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 62, 93, 97-99.
[168] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 64-65.
[169] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 53, 65, 72-73.

In addition to the structures discussed above, Segment 20 contains nine pipe crossings, four siphon undercrossings, well discharges, turnouts, and inlet drains. Of the three turnouts, two are overlining types, and one is a concrete pipe type. All these structures are of standard design or have standard alterations as discussed in the above typology discussion in Section P3a.

Photographs (continued)



Photograph 347: View of Segment 20 from the deck of the bridge at M.P. 106.58 Check No. 19; camera facing downstream, June 14, 2022 (C0462).



Photograph 348: View of Segment 20 from approximately M.P. 107.43; camera facing upstream from left bank, June 14, 2022 (C0464).



Photograph 349: View of Segment 20 from approximately M.P. 107.65; camera facing downstream from left bank, June 14, 2022 (C0466).



Photograph 350: Check No. 19; camera facing upstream from left bank, June 14, 2022 (C0456).



Photograph 351: Siphon inlet headwall at M.P. 110.96; camera facing downstream from left bank, June 14, 2022 (C0477).



Photograph 352: Siphon outlet headwall at M.P. 111.02; camera facing upstream from left bank, June 14, 2022 (C0479).



Photograph 353: Firebaugh Wasteway inlet structure at M.P. 111.22, with Check No. 20 visible in the background; camera facing downstream from left bank, June 14, 2022 (C0480).



Photograph 354: Firebaugh Wasteway inlet structure at M.P. 106.58, showing the radial gates (center) and an outlet to one of the automatic-siphon spillways (bottom, right); camera facing upstream from the wasteway's right bank, June 14, 2022 (C0485).



Photograph 355: Detail view of the Firebaugh Wasteway inlet structure at M.P. 111.22; camera facing downstream from left bank, June 14, 2022 (C0482).



Photograph 356: Bridge at M.P. 106.58; camera facing upstream from the wasteway's right bank, June 14, 2022 (C0460).



Photograph 357: Bridge at M.P. 1106.96; camera facing upstream from the left bank, June 14, 2022 (C0479).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 14-15, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-21

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 21 spans 5.22 miles between canal mileposts 111.26 and 116.48, from the Check No. 20 complex to a point just above Check No. 21 in Fresno County, near the city of Mendota.
UTM: Zone 10S, 728376.12mE / 4079046.33mN (north endpoint); 734438.24mE / 4073782.25mN (south endpoint)

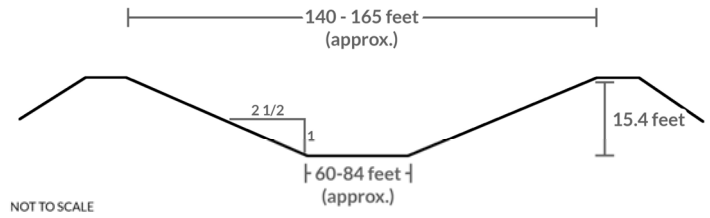
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 21 begins at Check No. 20 (**Photograph 358**) and ends at a point just upstream of Check No. 21. It has the same trapezoidal cross section as elsewhere on the canal and is lined with compacted earth. The canal is flanked by gravel access roads on both banks that are approximately 12 to 20 feet wide. (See Continuation Sheet.)

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: Approximately 140-165 feet
b. **Bottom Width**: 60-84 feet
c. **Height or Depth**: 15.40 feet
d. **Length of Segment**: 5.22 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 21 traverses through the flat agricultural lands of the western San Joaquin Valley principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by alterations to bridges and inlet drains and the addition of stilling wells, well discharges, and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 358: Beginning of Segment 21 showing Check No. 20, the Firebaugh Wasteway inlet structure (foreground), and check building (distance left), camera facing downstream from left bank, June 14, 2022 (C0480).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

Segment 21 of the canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 359** - **Photograph 362**). The width of the roads seems to vary based on topography.

Segment 21 begins at Check No. 20 (**Photograph 363**), located at M.P. 111.26. The check is a concrete structure with a total length of approximately 105 feet and a width that approximately is 145 feet wide at the upstream end, narrows to 125 feet at the check gates, and then widens again to 145 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 364**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 111.26 on the left bank, is of concrete block construction, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 20 at M.P. 111.24 while a second stilling well is located just below it at M.P. 111.28. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[170]

The Miller & Lux Outside Canal Siphon (**Photograph 365**) begins approximately one mile upstream from Check No. 20. The concrete structure consists of inlet and outlet headwalls that are connected by three 16-by-16-feet barrels. The inlet headwall at M.P. 115.57 is approximately 36 feet wide while the outlet headwall at M.P. 115.59 is approximately 38 feet wide. The barrels are 156 feet long and buried beneath the Miller & Lux Outside Canal.[171]

The single extant bridge crossing in this segment is a concrete county highway bridge at M.P. 111.51, along Sierra Avenue, and is of standard design. The bents and abutments of a non-extant operating bridge are still evident at M.P. 115.58 (**Photograph 366**).

In addition to structures discussed above, Segment 21 contains two pipe crossings, one siphon undercrossing, well discharges, and inlet drains. All these structures are of standard design as discussed above in Section P3a.

[170] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 62, 93, 97-99.
[171] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 64-65.

Photographs (continued)



Photograph 359: View of Segment 21 from M.P. 113.72, with a well discharge in the foreground; camera facing upstream from left bank, June 14, 2022 (C0509).



Photograph 360: View of Segment 21 from approximately M.P. 111.55, with the Miller & Lux Outside Canal (left) running parallel to the Delta-Mendota Canal; camera facing downstream from left bank, June 14, 2022 (C0508).



Photograph 361: View of Segment 21 from atop the outlet of the siphon at M.P. 115.59, with two well discharges visible in the background; camera facing downstream, June 15, 2022 (C0566).



Photograph 362: View of Segment 21 from approximately M.P. 116.45 showing the canal bank functioning as a levee; camera facing upstream from left bank, June 15, 2022 (C0558).



Photograph 363: Check No. 20; camera facing downstream from left bank, June 14, 2022 (C0487).



Photograph 364: View of Check No. 20; camera facing upstream from left bank, June 14, 2022 (C0487).



Photograph 365: Miller & Lux Outside Canal Siphon outlet headwall at M.P. 115.59; camera facing upstream from left bank, June 15, 2022 (C0562).



Photograph 366: Remnants of no-longer extant operating bridge that previously spanned the Miller & Lux Outside Canal where it crosses over the DMC at M.P. 115.58; camera facing upstream, June 15, 2022 (C0565).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 15, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-22

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 22 spans 0.13 miles between canal mileposts 116.48 and 116.61, from the Check No. 21 complex to the canal's terminus at the San Joaquin River in Fresno County, near the city of Mendota.
UTM: Zone 10S, 734475.93mE / 4073788.85mN (north endpoint); 734675.53mE / 4073828.97mN (south endpoint)

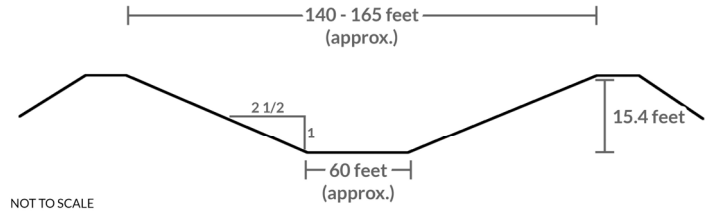
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 22 begins at Check No. 21 (**Photograph 367**) and ends at canal's terminus at the San Joaquin River in Fresno County, near the city of Mendota. It has the same trapezoidal cross section as elsewhere on the canal and is lined with compacted earth. The canal is flanked by gravel access roads on both banks that are approximately 12 to 20 feet wide. (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: Approximately 140-165 feet
b. **Bottom Width**: 60-84 feet
c. **Height or Depth**: 15.40 feet
d. **Length of Segment**: 5.22 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 22 traverses through the flat agricultural lands of the western San Joaquin Valley principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has not been altered in this segment.

L8b. Description of Photo, Map, or Drawing:
Photograph 367: Beginning of Segment 22 showing Check No. 21 and check building (background, center), with a pipe crossing (foreground); camera facing southeast, June 15, 2022 (C0550).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 368** - **Photograph 369**). The width of the roads seems to vary based on topography.

Segment 22 begins at Check No. 21 (**Photograph 370**), located at M.P. 116.48. The check is a concrete structure with a total length of approximately 300 feet and a width that is approximately 150 feet wide at the upstream end, narrows to 60 feet at the check gates, and then widens again to approximately 160 feet where it rejoins the canal walls on the downstream side. The banks of the canal transition from sloped to vertical at the control structure. The check structure is rectangular in cross section and divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 18 feet tall by 18 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. Spanning the top of the structure is a 10-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge. On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates that face downstream. The check building, at M.P. 116.48 on the right bank, is of concrete block construction, measuring approximately 12 feet by 11 feet. A stilling well is located just above Check No. 21 at M.P. 116.45. It is located on the right bank and is the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail. [172]

The single bridge crossing in this segment is a concrete County Highway Bridge at M.P. 116.48, along Bass Avenue and is of standard design (**Photograph 371**).

The Bureau of Reclamation maintenance yard is located at M.P. 116.50, along the right bank (**Photograph 372**). It consists of a generally rectangular lot containing a garage, a storage building, and an intermodal shipping container. The approximately 1,850-square-feet, three-bay garage is sited in the lot's northwest corner and faces east (**Photograph 373** - **Photograph 374**). It has a rectangular footprint, a side-gable roof of crimped metal, and walls clad in metal. The bay at its north end is fully enclosed. It is accessed by a doorway piercing its east side, and its fenestration consists of original divided-light awning windows and a replacement aluminum sliding window. The other two bays are fully open along the garage's east side. The approximately 1,050-square-feet storage building is sited toward the lot's southeast corner (**Photograph 375**). It has a rectangular footprint, a side-gable roof of crimped metal, and walls clad in metal. It is accessed by a metal door its south side, and fenestration consists of a sliding window concealed behind a screen. The intermodal shipping container is sited parallel to the storage building's east side, approximately 40 feet away. Metal chain-link fencing fully encloses the lot's southern half while its northern half is enclosed by metal chain-link fencing that extends onto and along the canal's right bank to enclose the check building at Check No. 21 as well.

[172] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 86-87, 93, 97-99.

Photographs (continued)



Photograph 368: View of Segment 22 from approximately M.P. 116.55, showing the canal's terminus, where it flows into the San Joaquin River; camera facing downstream from right bank, June 15, 2022 (C0537).



Photograph 369: View of Segment 22 from approximately M.P. 116.55, with Check No. 21 in the background; camera facing upstream from right bank, June 15, 2022 (C0538).



Photograph 370: Check No. 21, showing the radial gates fully open; camera facing upstream from left bank, June 15, 2022 (C0555).



Photograph 371: Check No. 21 and Bass Avenue Bridge, showing radial gates' backside; camera facing downstream from left bank, June 15, 2022 (C0551).



Photograph 372: View of maintenance yard at M.P. 116.50 (left), with Check No. 21 visible in the distance (right); camera facing west, June 15, 2022 (C0540).



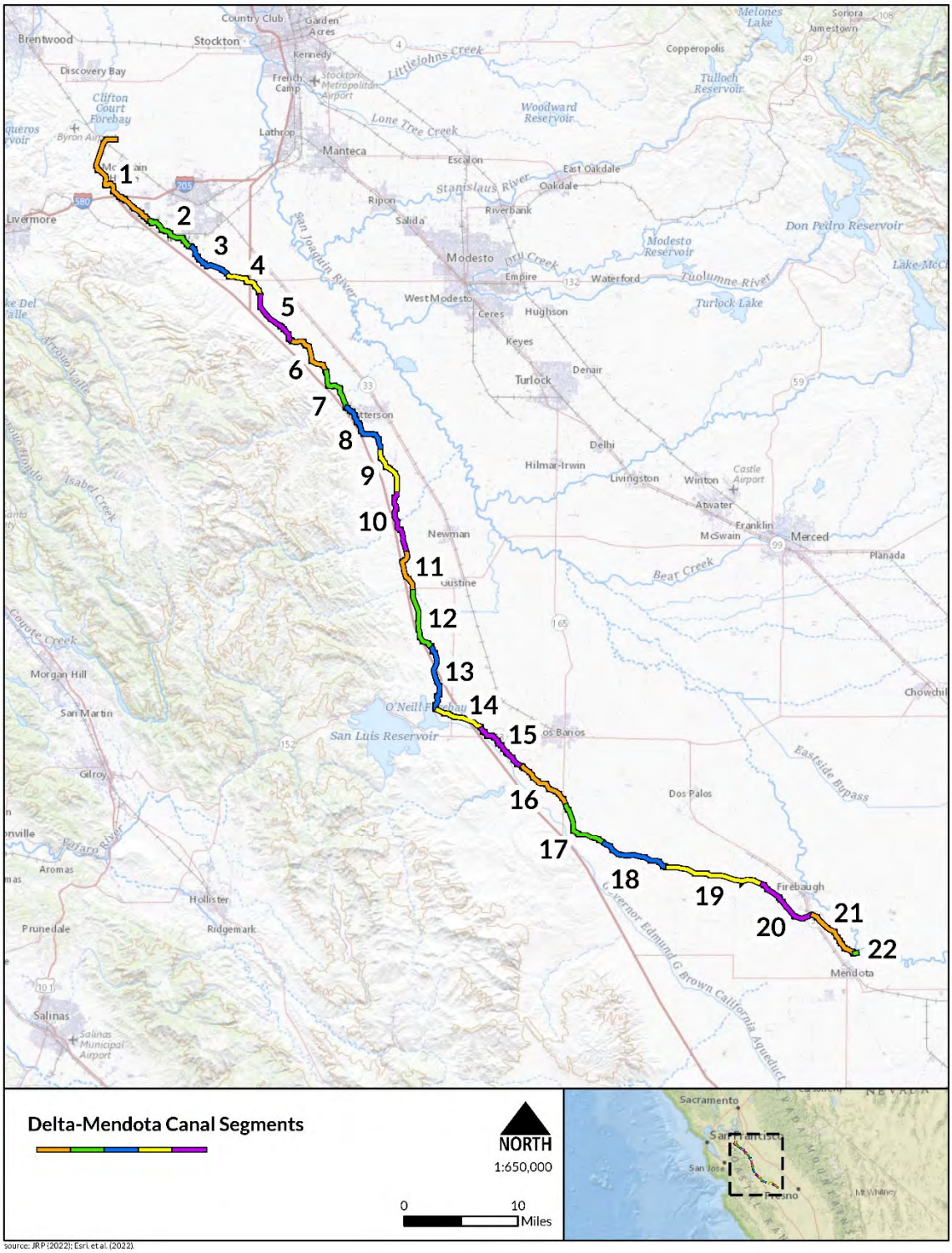
Photograph 373: Front (east) side of three-bay garage; camera facing west, June 15, 2022 (C0542).



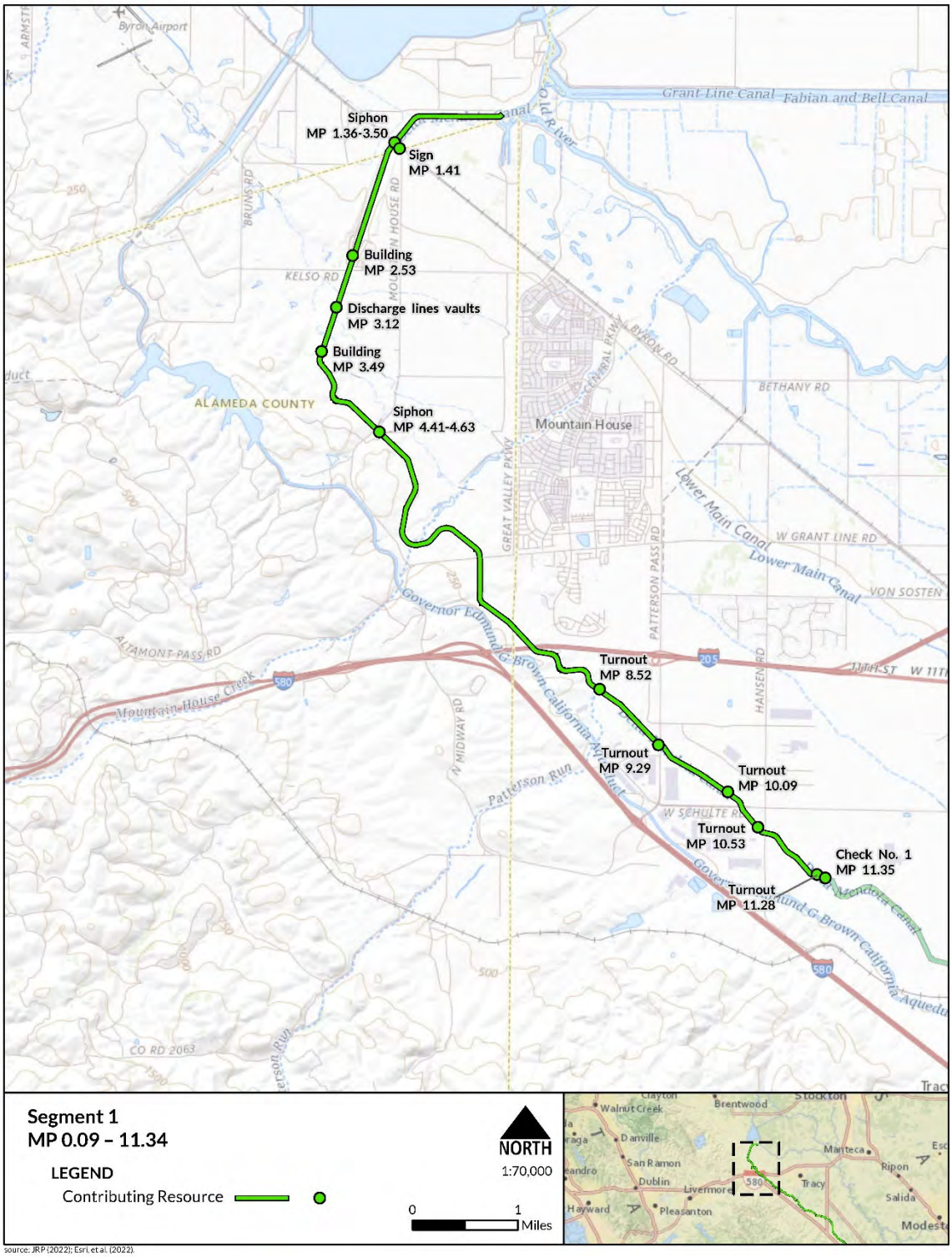
Photograph 374: West and south sides of three-bay garage; camera facing northeast, June 15, 2022 (C0548).



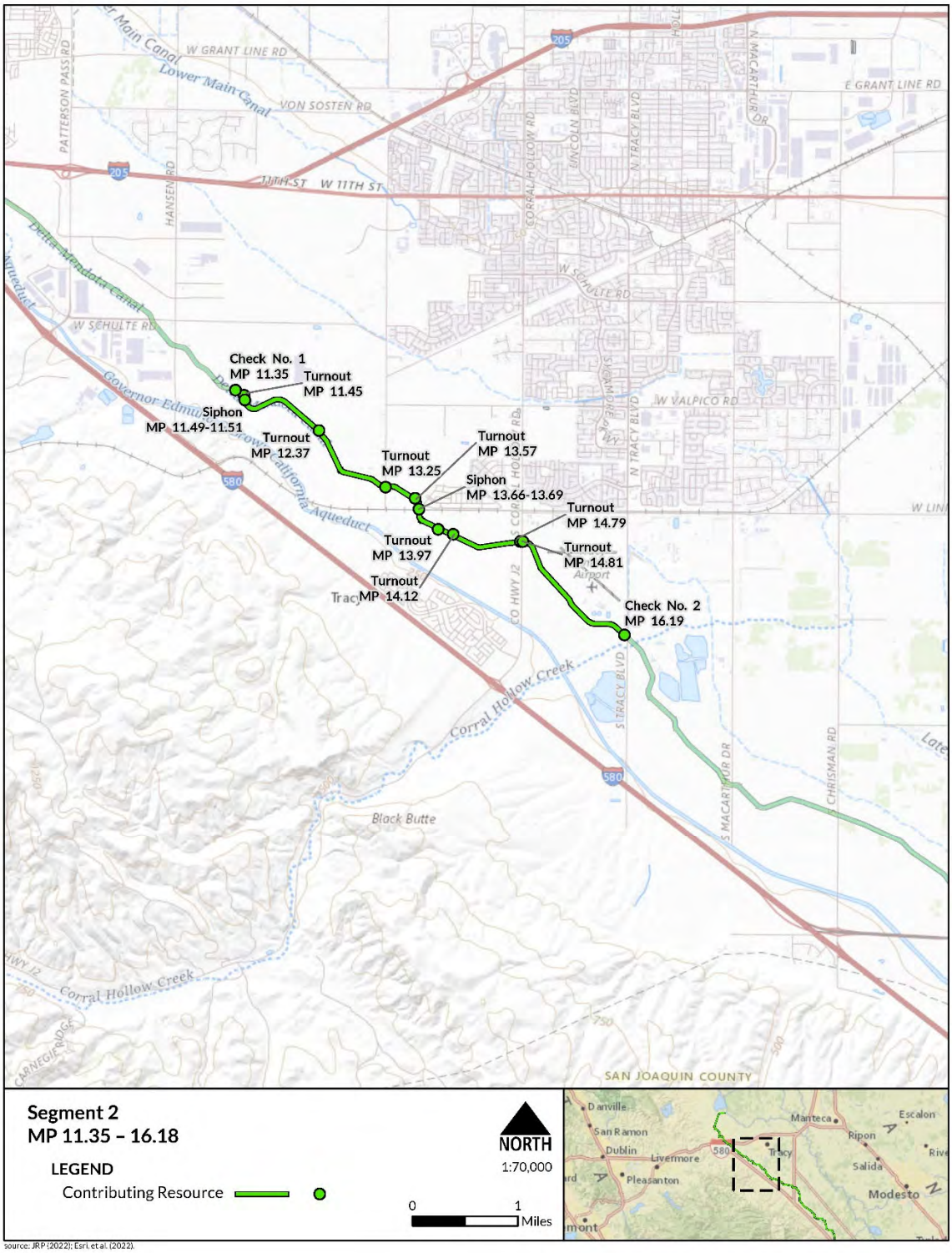
Photograph 375: South and east sides of storage building; camera facing northwest, June 15, 2022 (C0545).

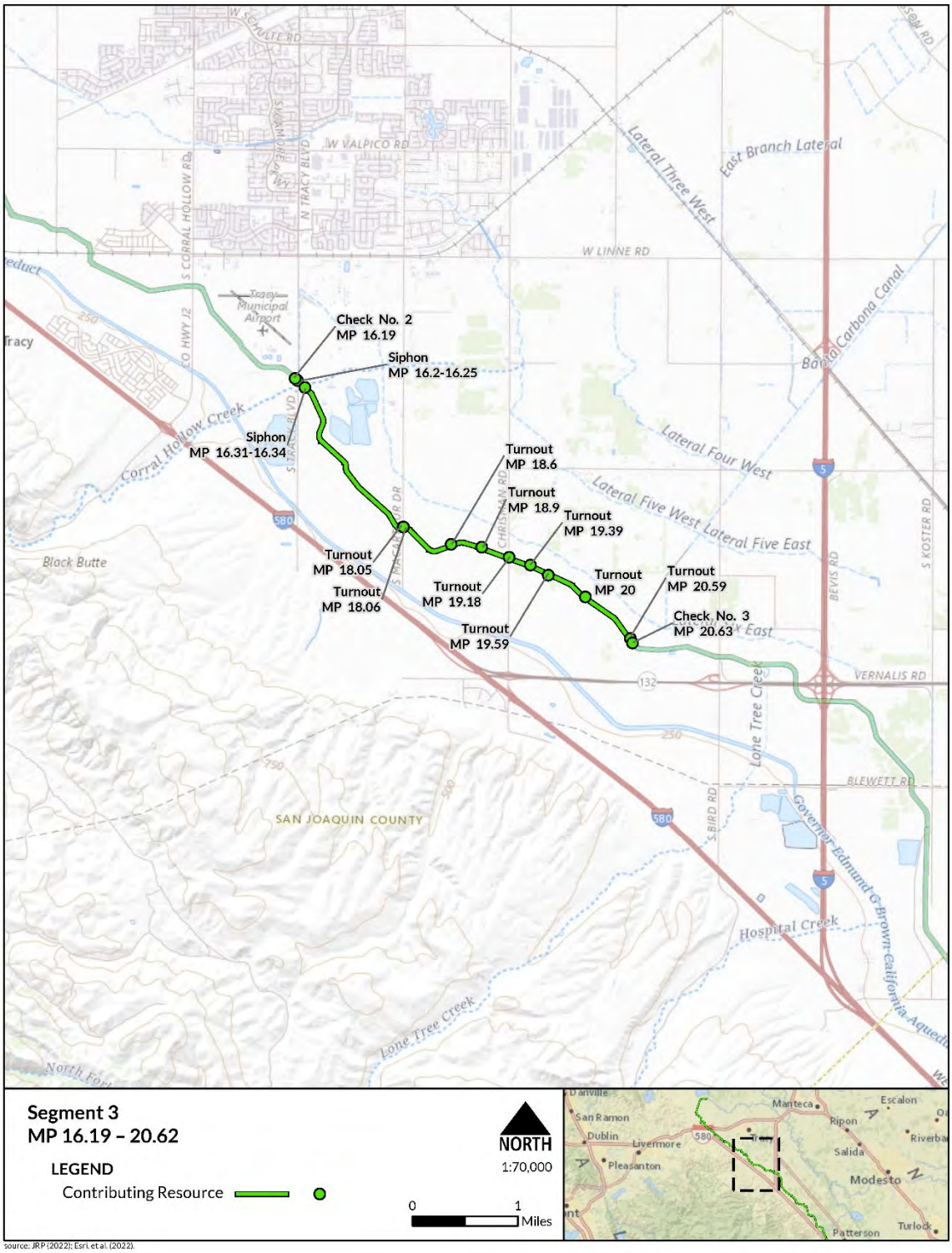


source: JRP (2022); Esri, et al. (2022).

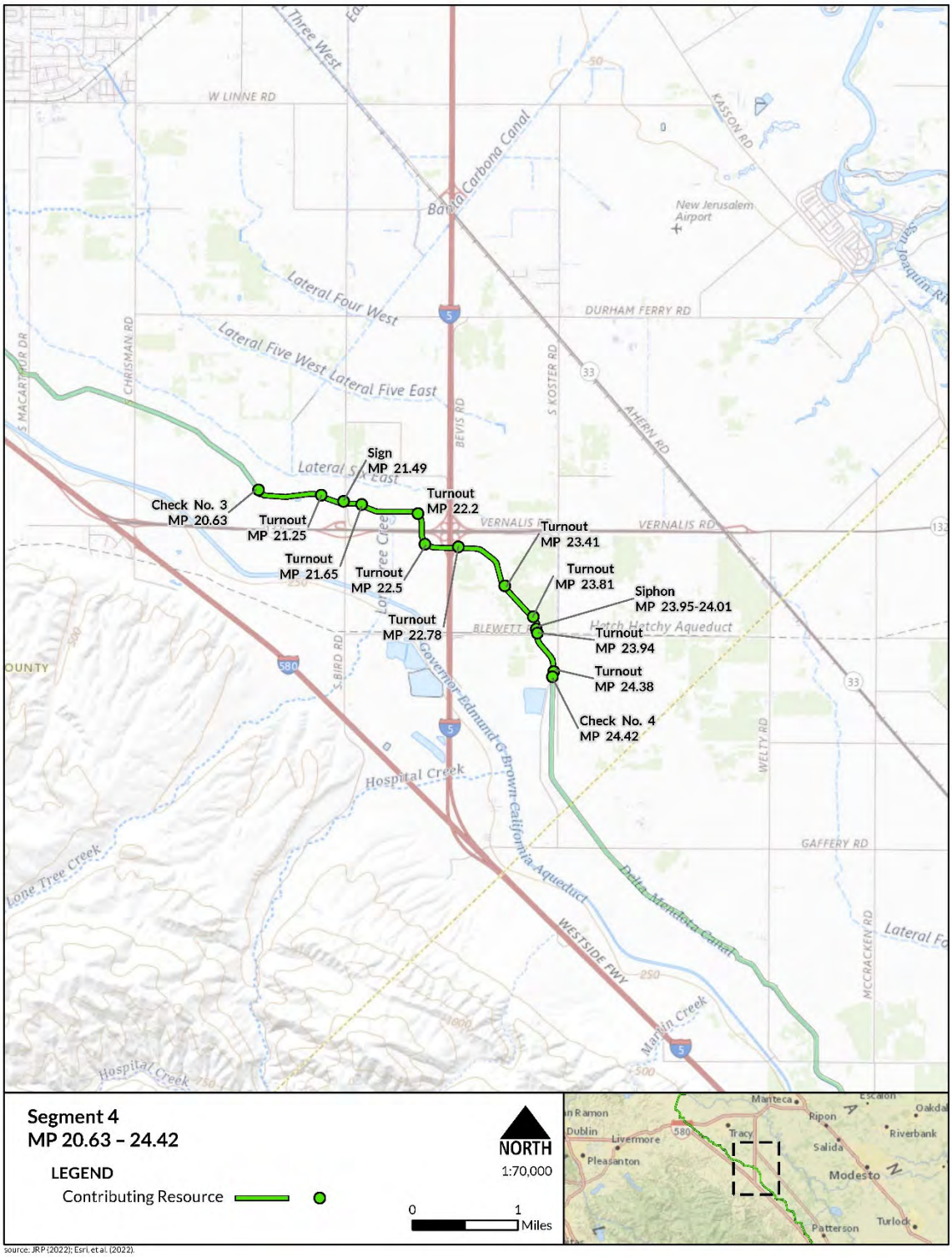


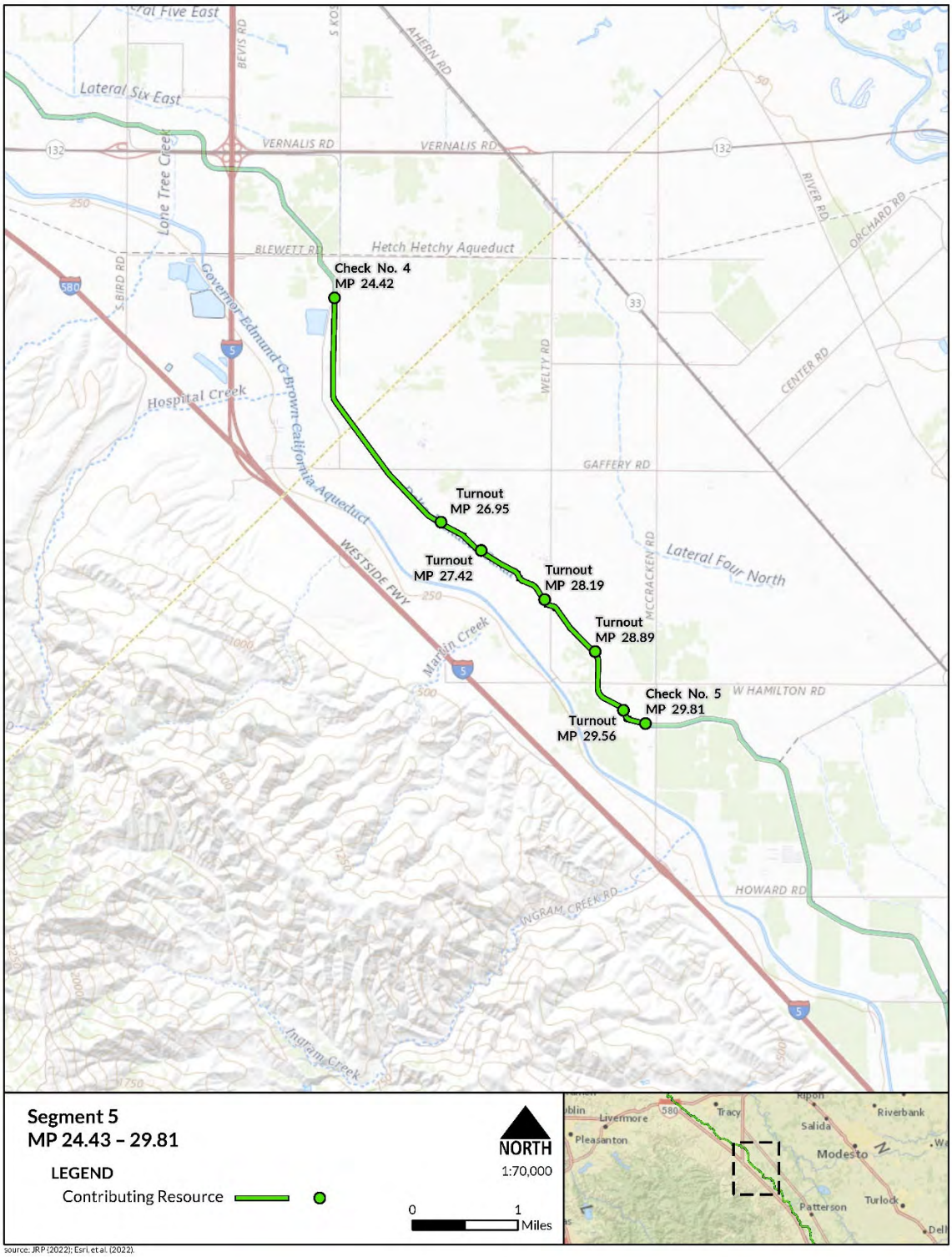
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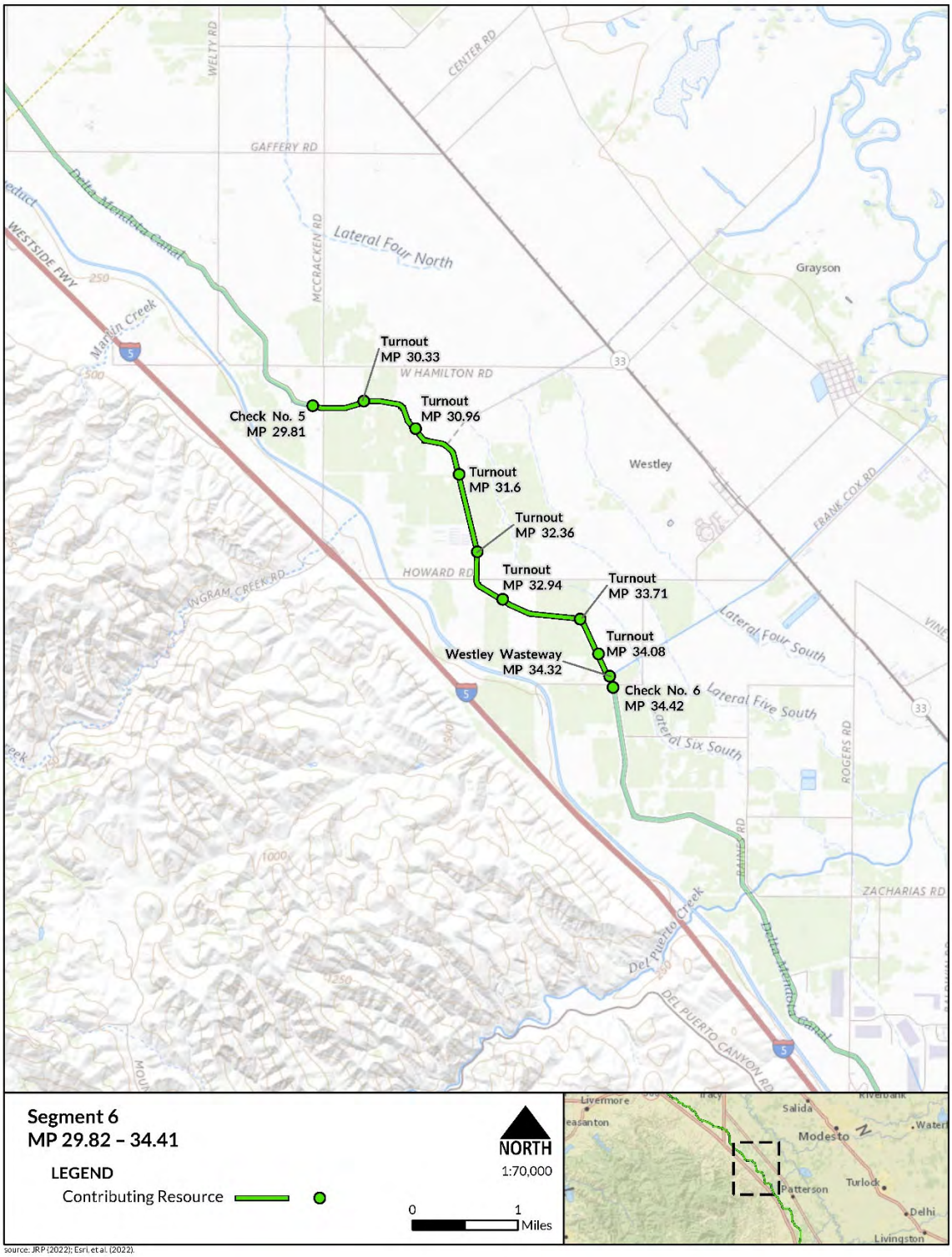

Check No. 1
MP 11.35
Turnout
MP 11.45
Siphon
MP 11.49-11.51
Turnout
MP 12.37
Turnout
MP 13.25
Turnout
MP 13.57
Siphon
MP 13.66-13.69
Turnout
MP 14.79
Turnout
MP 13.97
Turnout
MP 14.81
Turnout
MP 14.12
Check No. 2
MP 16.19
Delta-Mendota Canal
Governor Edmund G. Brown California Aqueduct
Corral Hollow Creek
Black Butte
SAN JOAQUIN COUNTY
Segment 2
MP 11.35 – 16.18
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
source: JRP (2022); Esri, et al. (2022).

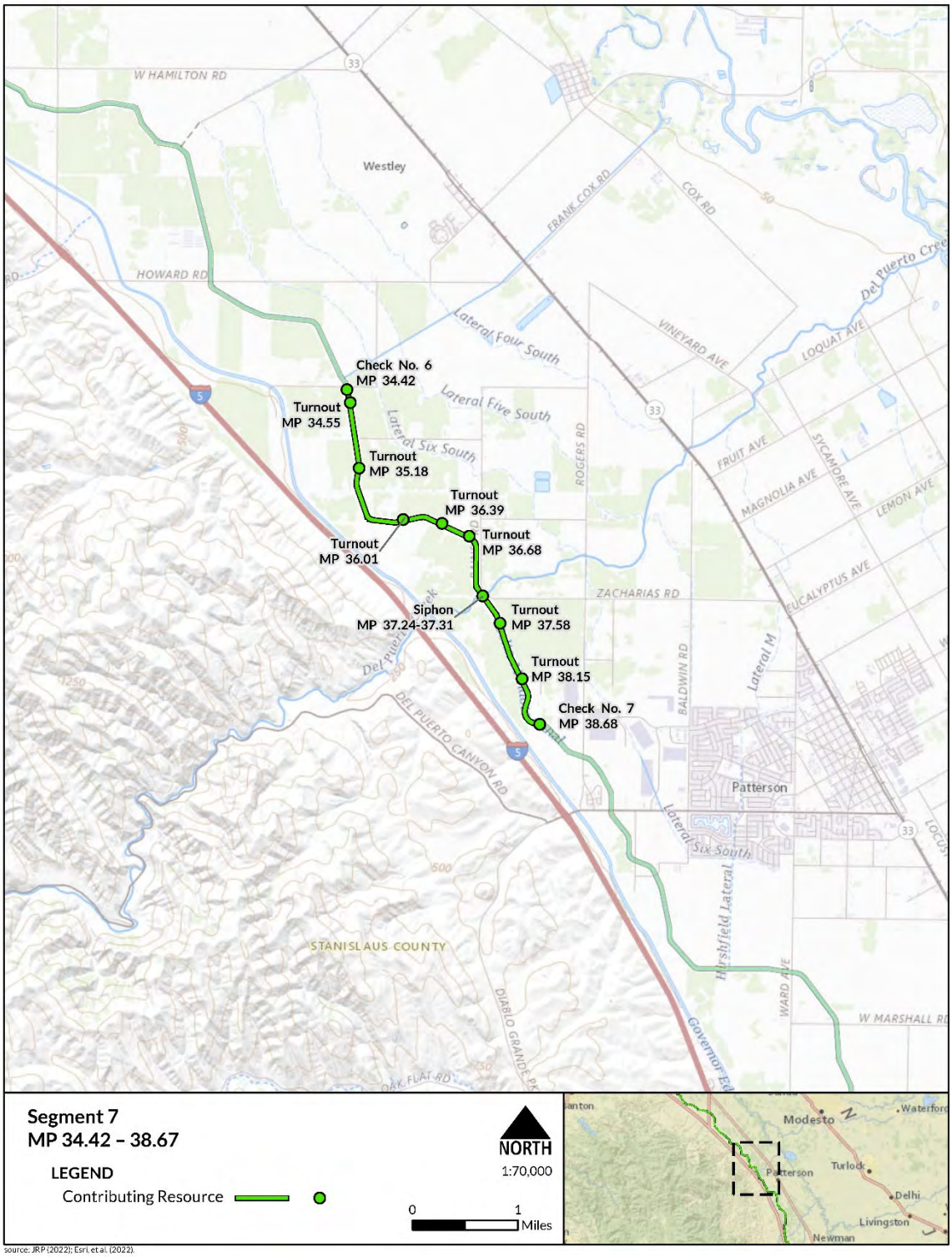


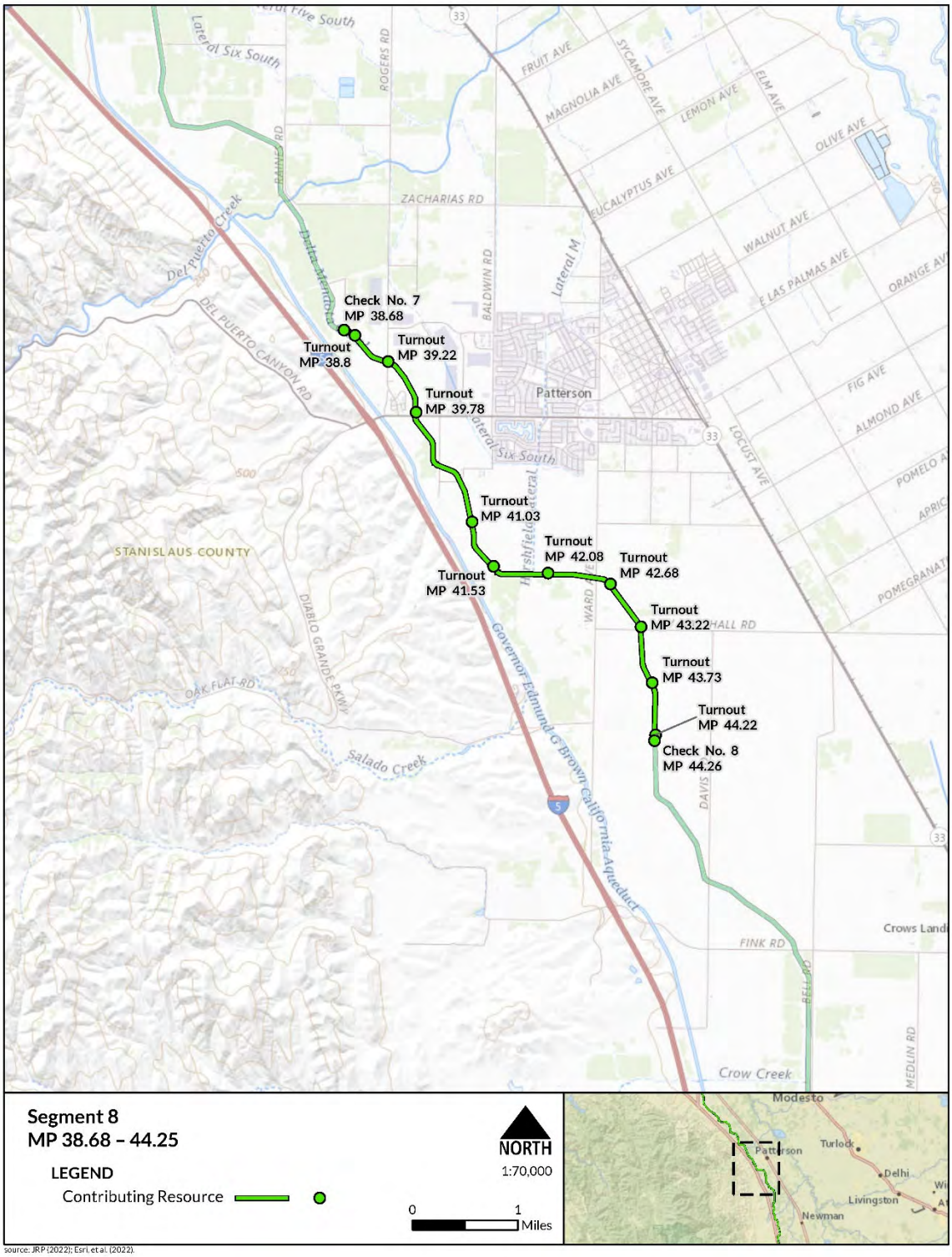
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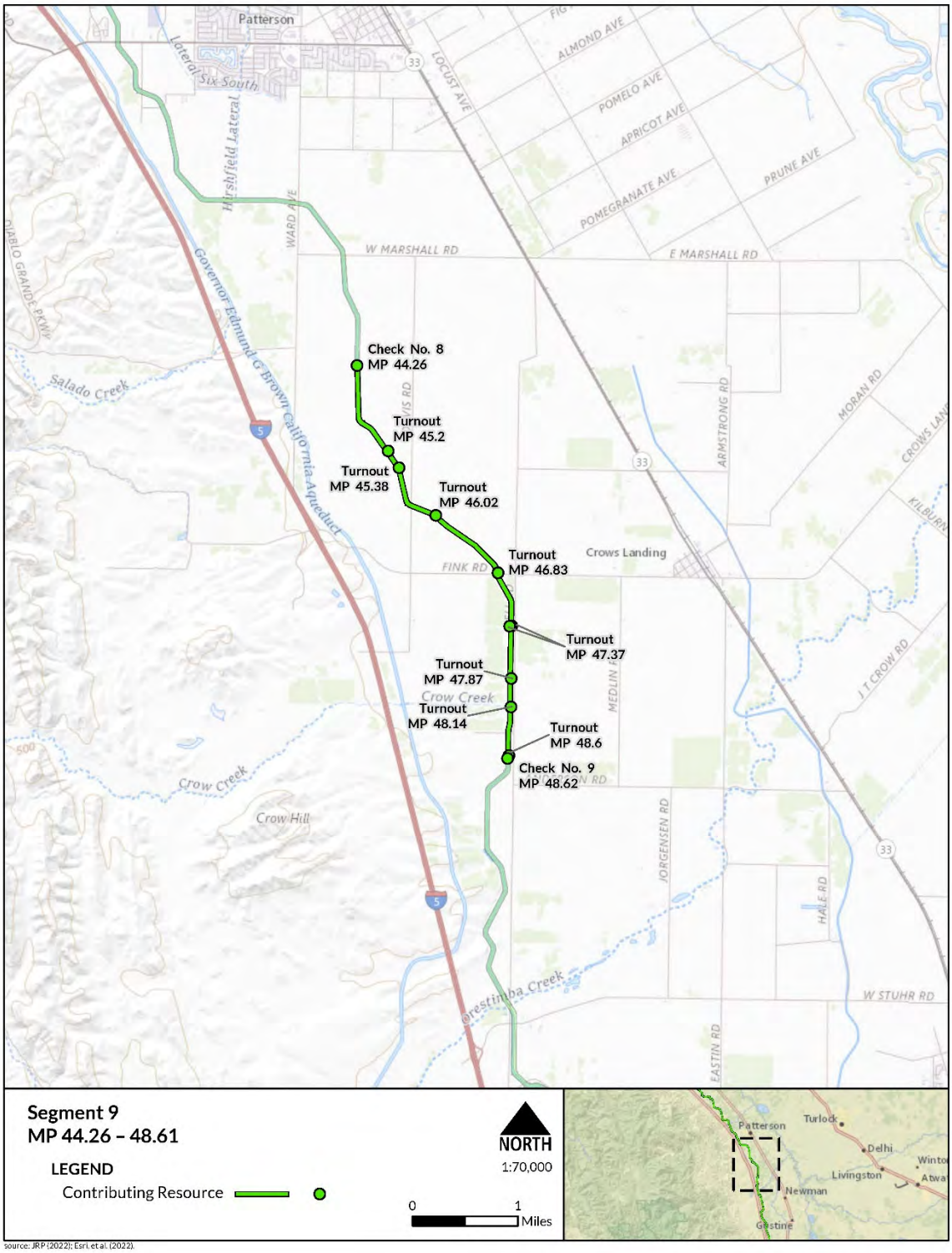

Sign
MP 21.49
Check No. 3
MP 20.63
Turnout
MP 21.25
Turnout
MP 22.2
Turnout
MP 21.65
Turnout
MP 22.5
Turnout
MP 22.78
Turnout
MP 23.41
Turnout
MP 23.81
Siphon
MP 23.95-24.01
Turnout
MP 23.94
Turnout
MP 24.38
Check No. 4
MP 24.42
Segment 4
MP 20.63 – 24.42
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
source: JRP (2022); Esri, et al. (2022).
W LINNE RD
Three West
Lateral Four West
Lateral Five West Lateral Five East
DURHAM FERRY RD
VERNALIS RD
BEVIS RD
S KOSTER RD
AHERN RD
CHRISMAN RD
S MACARTHUR DR
S BIRD RD
KASSON RD
New Jerusalem Airport
Hospital Creek
Lone Tree Creek
Governor Edmund G Brown California Aqueduct
Delta-Mendota Canal
WESTSIDE FWY
GAFFERY RD
WELTY RD
MCCRACKEN RD
Martin Creek
Hetch Hetchy Aqueduct
Manteca
Ripon
Tracy
Salida
Modesto
Riverbank
Patterson
Turlock
Livermore
Dublin
Pleasanton

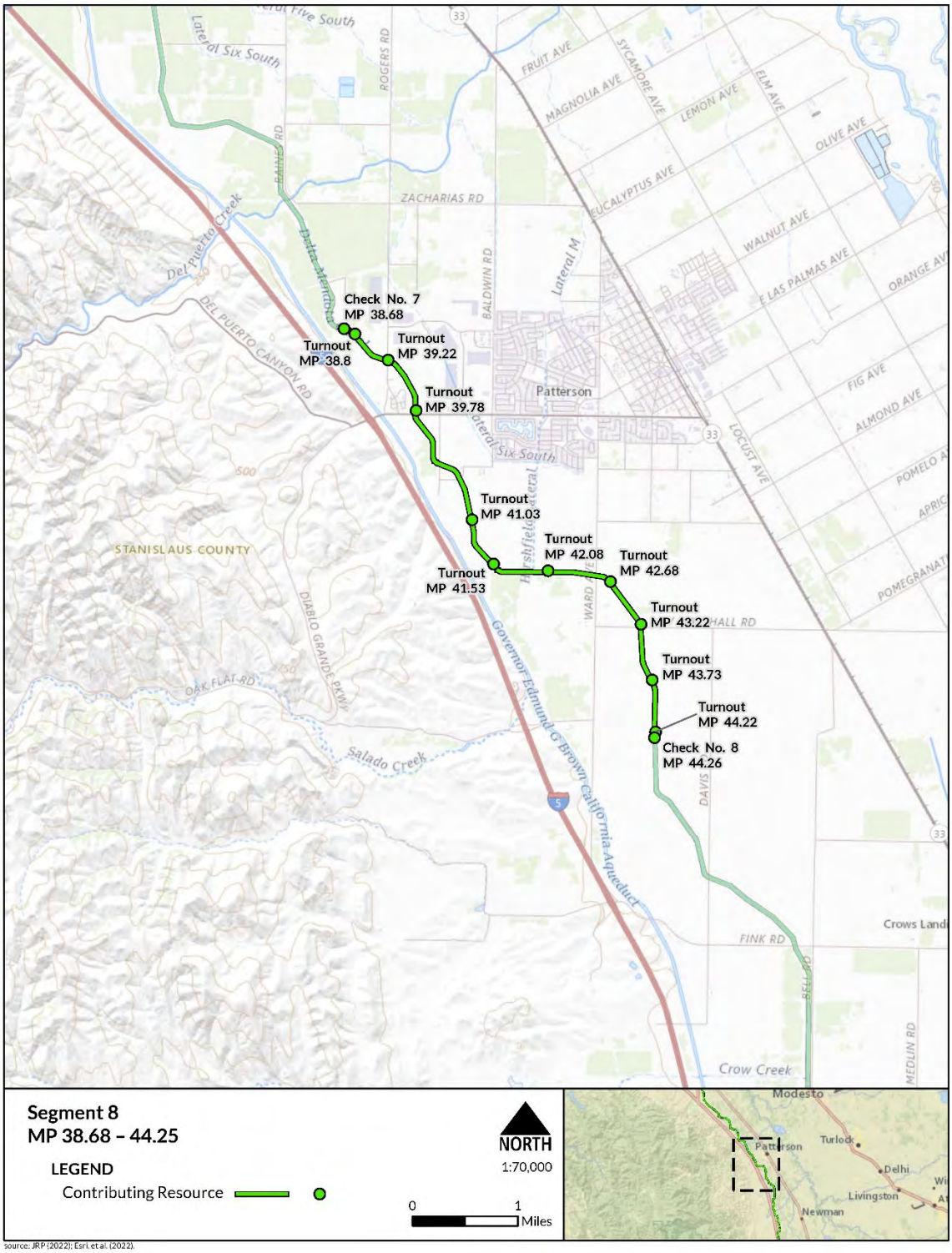

Lateral Five East
Lateral Six East
BEVIS RD
AHERN RD
VERNALIS RD
Lone Tree Creek
BLEWETT RD
Hetch Hetchy Aqueduct
S BIRD RD
Governor Edmund G Brown California Aqueduct
Hospital Creek
WELTY RD
RIVER RD
ORCHARD RD
CENTER RD
GAFFERY RD
MCCRACKEN RD
Lateral Four North
WESTSIDE FWY
Marblin Creek
W HAMILTON RD
INGRAM CREEK RD
HOWARD RD
Ingram Creek
Check No. 4
MP 24.42
Turnout
MP 26.95
Turnout
MP 27.42
Turnout
MP 28.19
Turnout
MP 28.89
Check No. 5
MP 29.81
Turnout
MP 29.56
Segment 5
MP 24.43 – 29.81
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Livermore
Pleasanton
Tracy
Salida
Riverbank
Modesto
Patterson
Turlock
source: JRP (2022); Esri, et al. (2022).

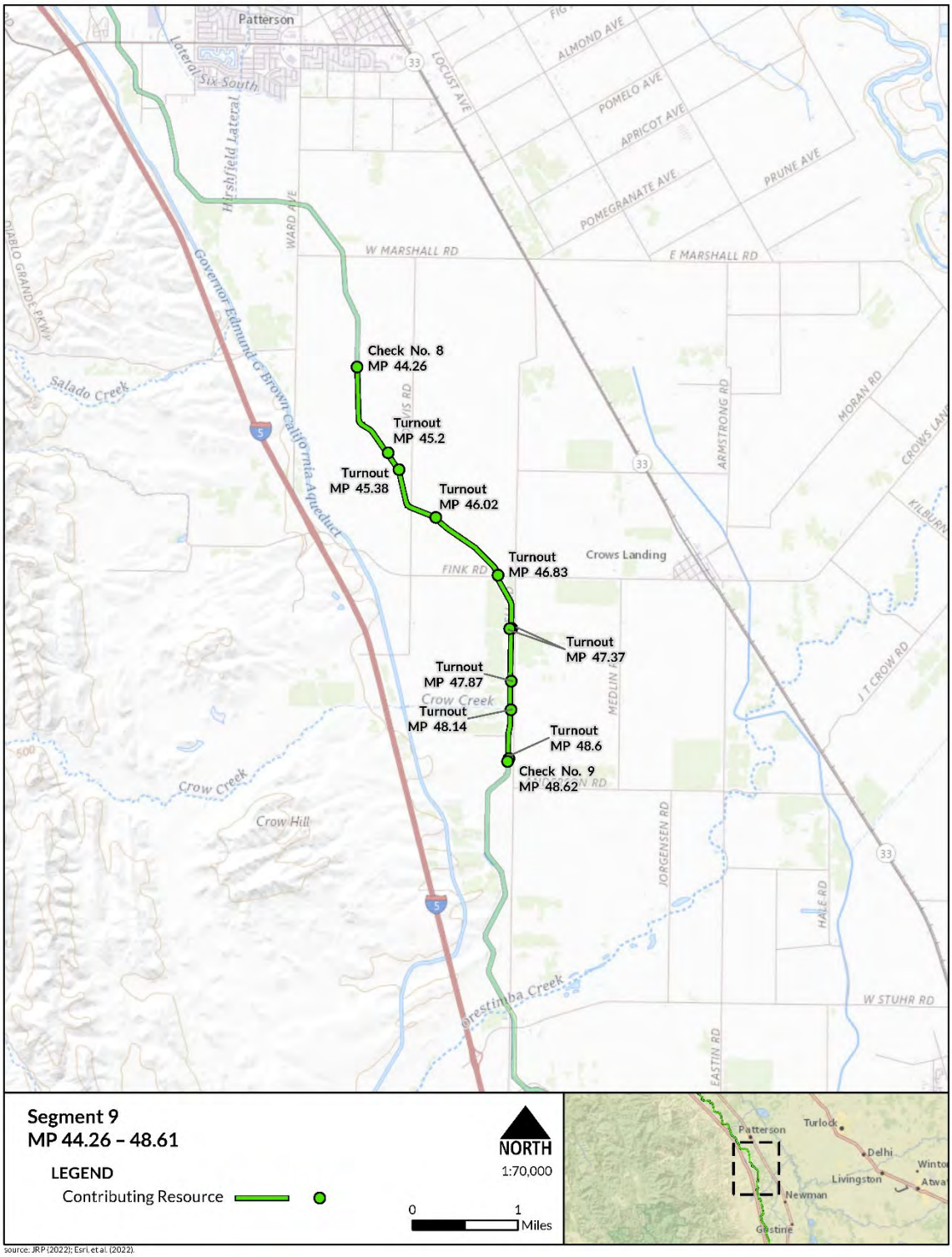

Turnout
MP 30.33
Turnout
MP 30.96
Check No. 5
MP 29.81
Turnout
MP 31.6
Turnout
MP 32.36
Turnout
MP 32.94
Turnout
MP 33.71
Turnout
MP 34.08
Westley Wasteway
MP 34.32
Check No. 6
MP 34.42
Lateral Four North
Lateral Four South
Lateral Five South
Lateral Six South
Delta-Mendota Canal
Del Puerto Creek
Marsh Creek
Ingram Creek
Grayson
Westley
W HAMILTON RD
HOWARD RD
GAFFERY RD
CENTER RD
WELTY RD
MCCRACKEN RD
FRANK COX RD
ROGERS RD
ZACHARIAS RD
DEL PUERTO CANYON RD
WESTSIDE FWY
Segment 6
MP 29.82 – 34.41
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Livermore
Salida
Modesto
Patterson
Turlock
Delhi
Livingston
source: JRP (2022); Esri, et al. (2022).

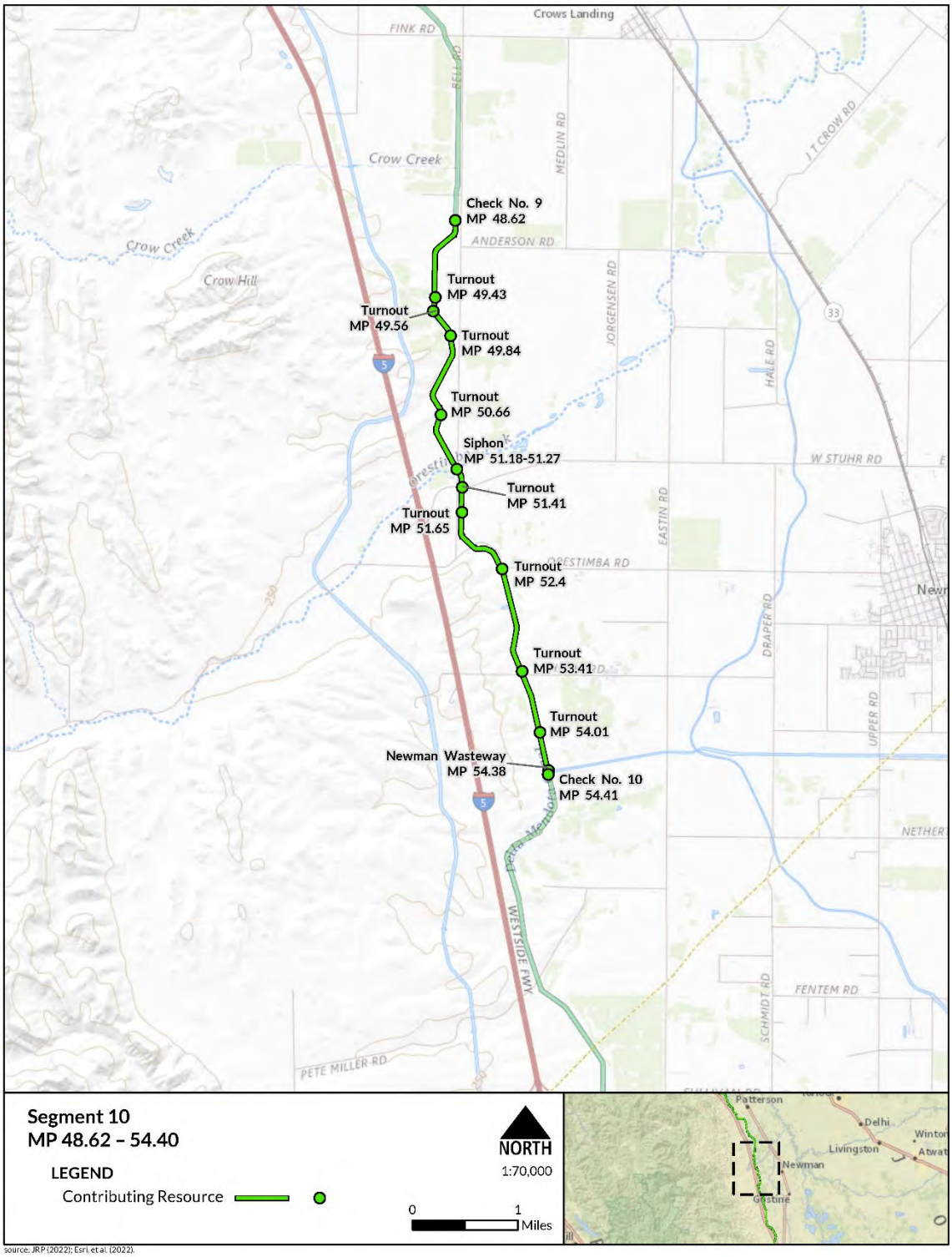

W HAMILTON RD
Westley
FRANK COX RD
COX RD
HOWARD RD
Lateral Four South
VINEYARD AVE
LOQUAT AVE
Del Puerto Creek
Lateral Five South
Lateral Six South
ROGERS RD
FRUIT AVE
SYCAMORE AVE
MAGNOLIA AVE
LEMON AVE
Check No. 6
MP 34.42
Turnout
MP 34.55
Turnout
MP 35.18
Turnout
MP 36.39
Turnout
MP 36.68
Turnout
MP 36.01
ZACHARIAS RD
EUCALYPTUS AVE
Siphon
MP 37.24-37.31
Turnout
MP 37.58
Turnout
MP 38.15
Check No. 7
MP 38.68
BALDWIN RD
Lateral M
DEL PUERTO CANYON RD
Patterson
Lateral Six South
Hirshfield Lateral
STANISLAUS COUNTY
DIABLO GRANDE PKWY
WARD AVE
W MARSHALL RD
OAK FLAT RD
Segment 7
MP 34.42 – 38.67
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Modesto
Waterford
Turlock
Delhi
Livingston
Newman
source: JRP (2022); Esri, et al. (2022).

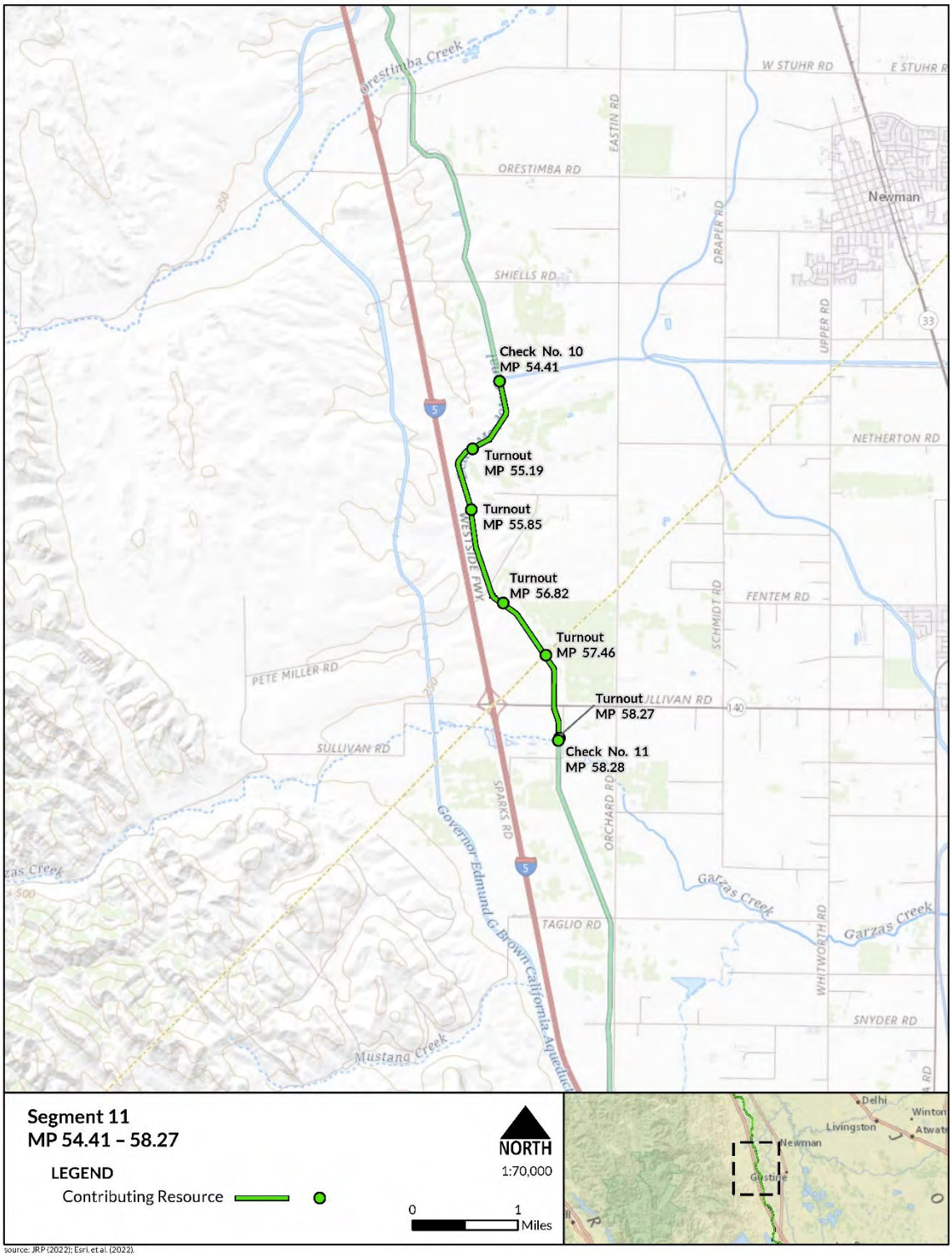

Check No. 7
MP 38.68
Turnout
MP 38.8
Turnout
MP 39.22
Turnout
MP 39.78
Turnout
MP 41.03
Turnout
MP 42.08
Turnout
MP 42.68
Turnout
MP 41.53
Turnout
MP 43.22
Turnout
MP 43.73
Turnout
MP 44.22
Check No. 8
MP 44.26
Patterson
STANISLAUS COUNTY
Crows Land
Crow Creek
Salado Creek
Segment 8
MP 38.68 – 44.25
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Modesto
Turlock
Delhi
Livingston
Newman
source: JRP (2022); Esri, et al. (2022).

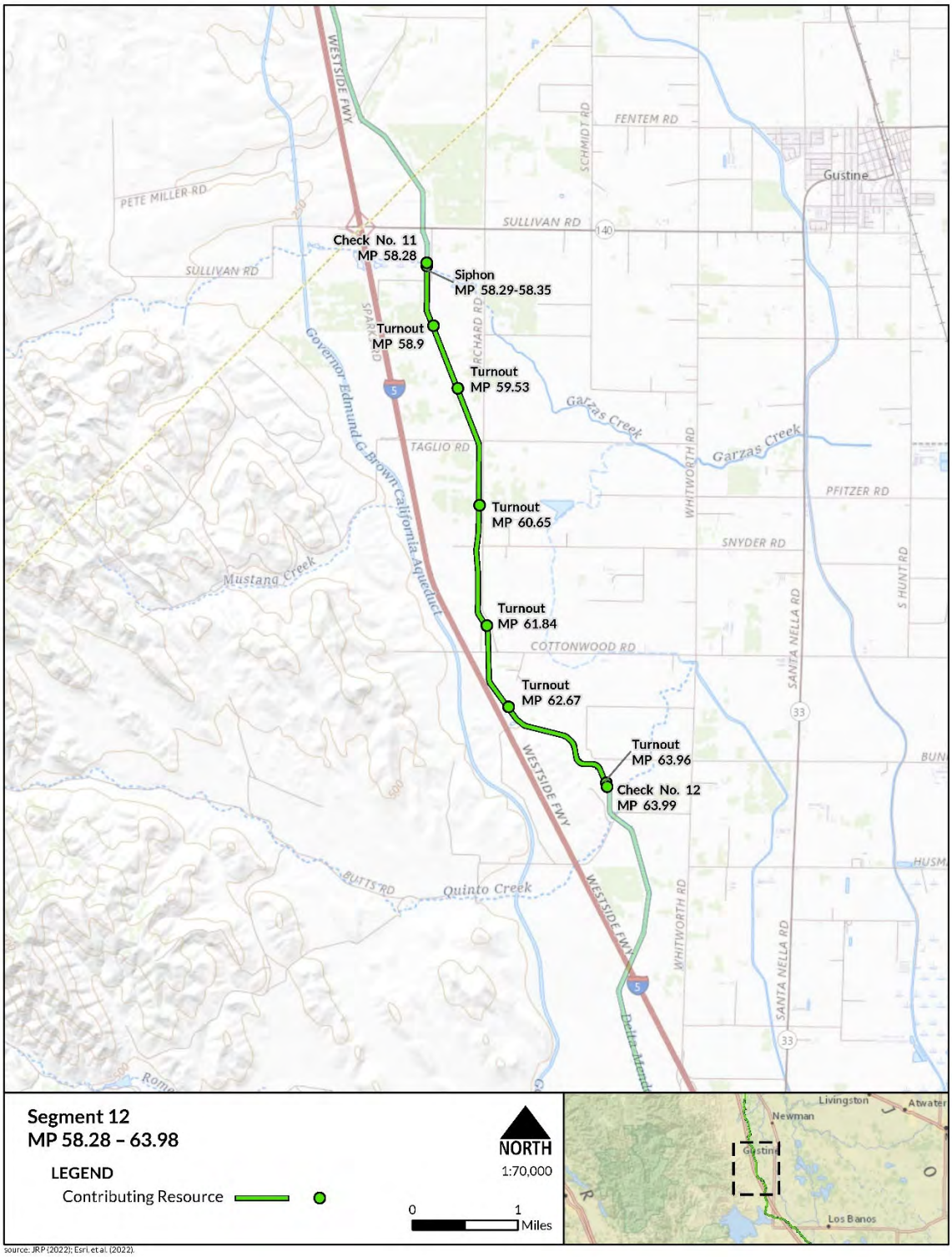

Patterson
Lateral Six South
Hirshfield Lateral
Governor Edmund G Brown California Aqueduct
Salado Creek
Crow Creek
Crow Hill
Orestimba Creek
W MARSHALL RD
E MARSHALL RD
FINK RD
W STUHR RD
ALMOND AVE
POMELO AVE
APRICOT AVE
POMEGRANATE AVE
PRUNE AVE
LOCUST AVE
WARD AVE
ARMSTRONG RD
MORAN RD
CROWS LANDING RD
KILBURN
J T CROW RD
MEDLIN
JORGENSEN RD
HALE RD
EASTIN RD
DIABLO GRANDE PKWY
Crows Landing
Check No. 8
MP 44.26
Turnout
MP 45.2
Turnout
MP 45.38
Turnout
MP 46.02
Turnout
MP 46.83
Turnout
MP 47.37
Turnout
MP 47.87
Turnout
MP 48.14
Turnout
MP 48.6
Check No. 9
MP 48.62
Segment 9
MP 44.26 – 48.61
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Turlock
Delhi
Livingston
Newman
Gustine
source: JRP (2022); Esri, et al. (2022).

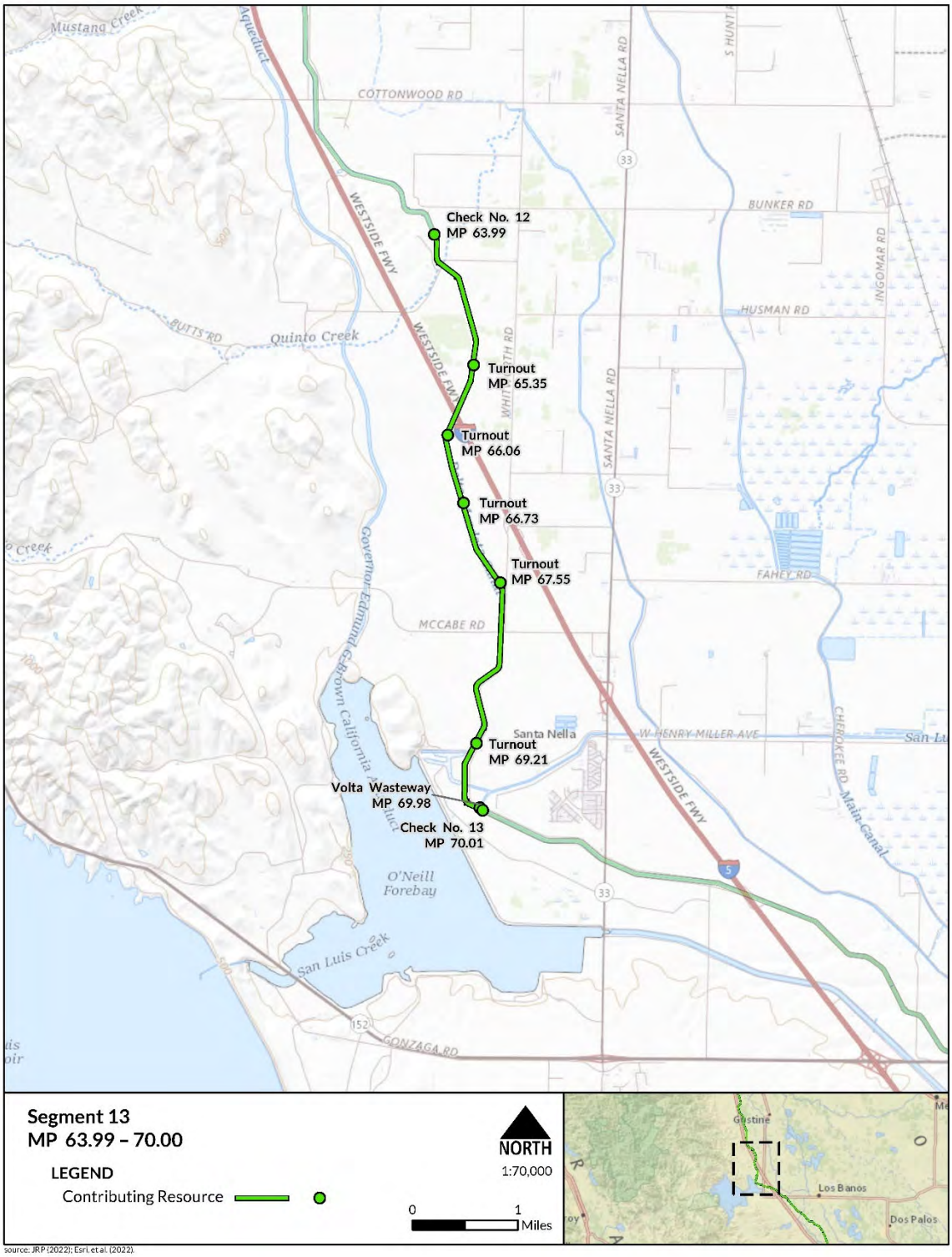

Check No. 7
MP 38.68
Turnout
MP 38.8
Turnout
MP 39.22
Turnout
MP 39.78
Turnout
MP 41.03
Turnout
MP 41.53
Turnout
MP 42.08
Turnout
MP 42.68
Turnout
MP 43.22
Turnout
MP 43.73
Turnout
MP 44.22
Check No. 8
MP 44.26
Patterson
STANISLAUS COUNTY
Crows Land
Modesto
Turlock
Delhi
Livingston
Newman
Segment 8
MP 38.68 – 44.25
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
source: JRP (2022); Esri, et al. (2022).

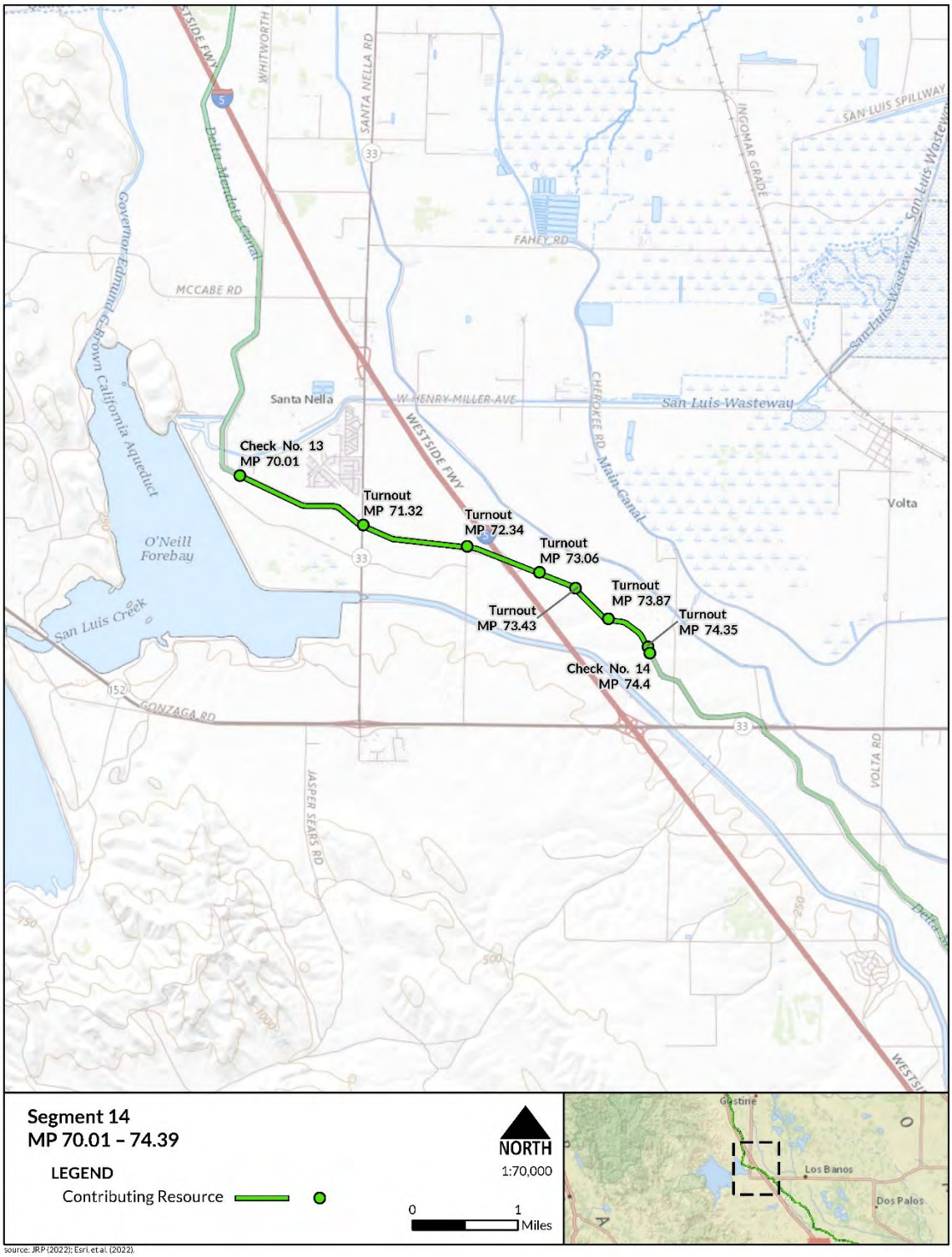

Patterson
Lateral Six South
Hirshfield Lateral
Governor Edmund G Brown California Aqueduct
Salado Creek
Crow Creek
Crow Hill
Orestimba Creek
W MARSHALL RD
E MARSHALL RD
FINK RD
W STUHR RD
Crows Landing
ALMOND AVE
POMELO AVE
APRICOT AVE
POMEGRANATE AVE
PRUNE AVE
LOCUST AVE
WARD AVE
ARMSTRONG RD
MORAN RD
JORGENSEN RD
HALE RD
EASTIN RD
MEDLIN RD
J T CROW RD
DIABLO GRANDE PKWY
Check No. 8
MP 44.26
Turnout
MP 45.2
Turnout
MP 45.38
Turnout
MP 46.02
Turnout
MP 46.83
Turnout
MP 47.37
Turnout
MP 47.87
Turnout
MP 48.14
Turnout
MP 48.6
Check No. 9
MP 48.62
Segment 9
MP 44.26 – 48.61
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Turlock
Delhi
Livingston
Newman
Gustine
source: JRP (2022); Esri, et al. (2022).


Crows Landing
FINK RD
Crow Creek
MEDLIN RD
J T CROW RD
ANDERSON RD
Crow Hill
JORGENSEN RD
HALE RD
W STUHR RD
EASTIN RD
DRAPER RD
UPPER RD
FENTEM RD
SCHMIDT RD
PETE MILLER RD
WESTSIDE FWY
Check No. 9
MP 48.62
Turnout
MP 49.43
Turnout
MP 49.56
Turnout
MP 49.84
Turnout
MP 50.66
Siphon
MP 51.18-51.27
Turnout
MP 51.41
Turnout
MP 51.65
Turnout
MP 52.4
Turnout
MP 53.41
Turnout
MP 54.01
Newman Wasteway
MP 54.38
Check No. 10
MP 54.41
Segment 10
MP 48.62 – 54.40
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Patterson
Delhi
Livingston
Newman
Gustine
source: JRP (2022); Esri, et al. (2022).

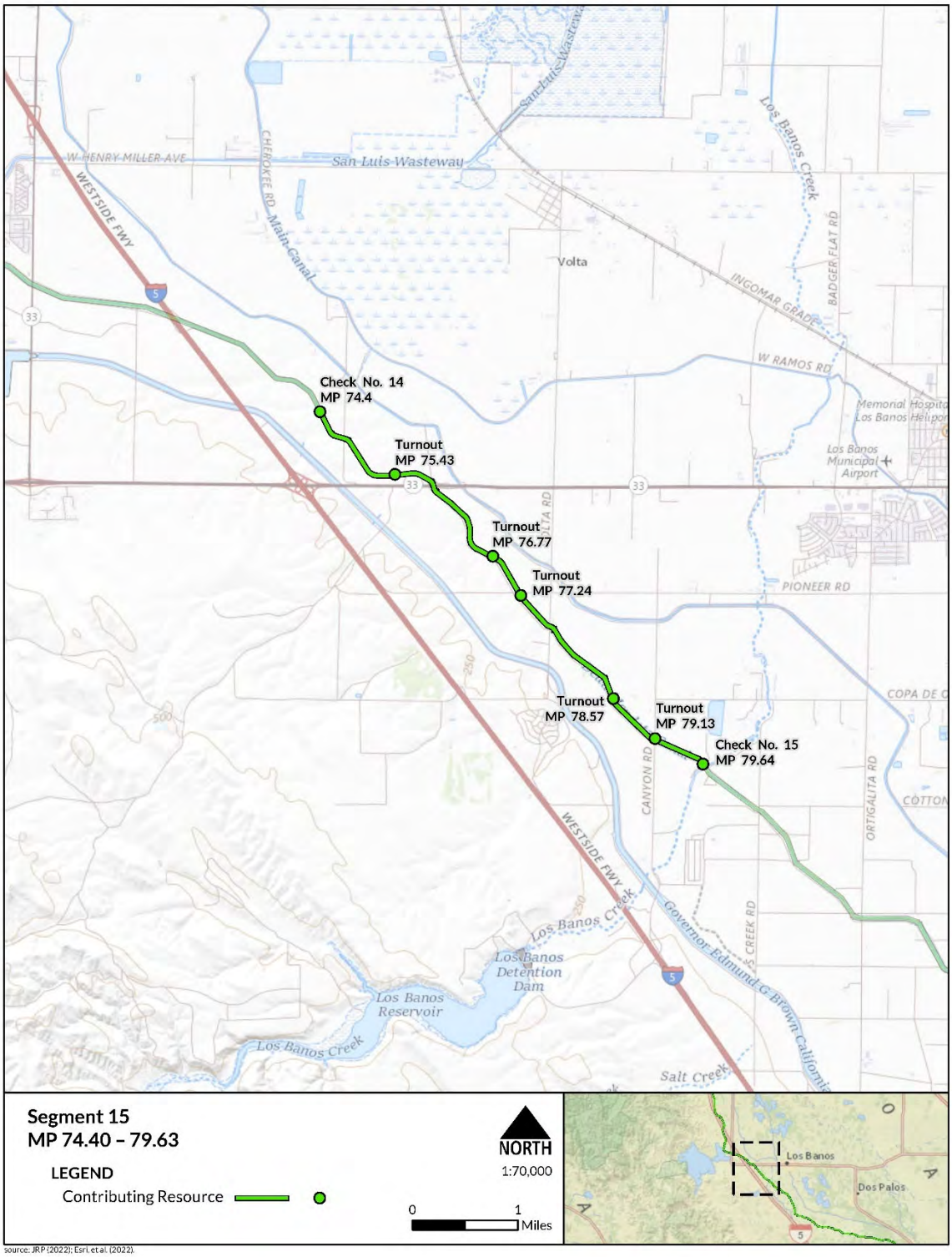

Orestimba Creek
W STUHR RD
E STUHR R
EASTIN RD
ORESTIMBA RD
Newman
DRAPER RD
SHIELLS RD
UPPER RD
Check No. 10
MP 54.41
Turnout
MP 55.19
Turnout
MP 55.85
Turnout
MP 56.82
Turnout
MP 57.46
Turnout
MP 58.27
Check No. 11
MP 58.28
NETHERTON RD
WESTSIDE FWY
SCHMIDT RD
FENTEM RD
PETE MILLER RD
ILLIVAN RD
SULLIVAN RD
SPARKS RD
ORCHARD RD
Governor Edmund G. Brown California Aqueduct
Garzas Creek
TAGLIO RD
WHITWORTH RD
SNYDER RD
Mustang Creek
Segment 11
MP 54.41 – 58.27
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Delhi
Livingston
Newman
Gustine
source: JRP (2022); Esri et al. (2022).


Check No. 11
MP 58.28
Siphon
MP 58.29-58.35
Turnout
MP 58.9
Turnout
MP 59.53
Turnout
MP 60.65
Turnout
MP 61.84
Turnout
MP 62.67
Turnout
MP 63.96
Check No. 12
MP 63.99
WESTSIDE FWY
SULLIVAN RD
FENTEM RD
PETE MILLER RD
SCHMIDT RD
RICHARD RD
SPARKS RD
Governor Edmund G. Brown California Aqueduct
Garzas Creek
TAGLIO RD
WHITWORTH RD
PFITZER RD
SNYDER RD
Mustang Creek
COTTONWOOD RD
SANTA NELLA RD
S HUNT RD
BUTTS RD
Quinto Creek
Gustine
Segment 12
MP 58.28 – 63.98
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Livingston
Atwater
Newman
Los Banos
source: JRP (2022); Esri, et al. (2022).

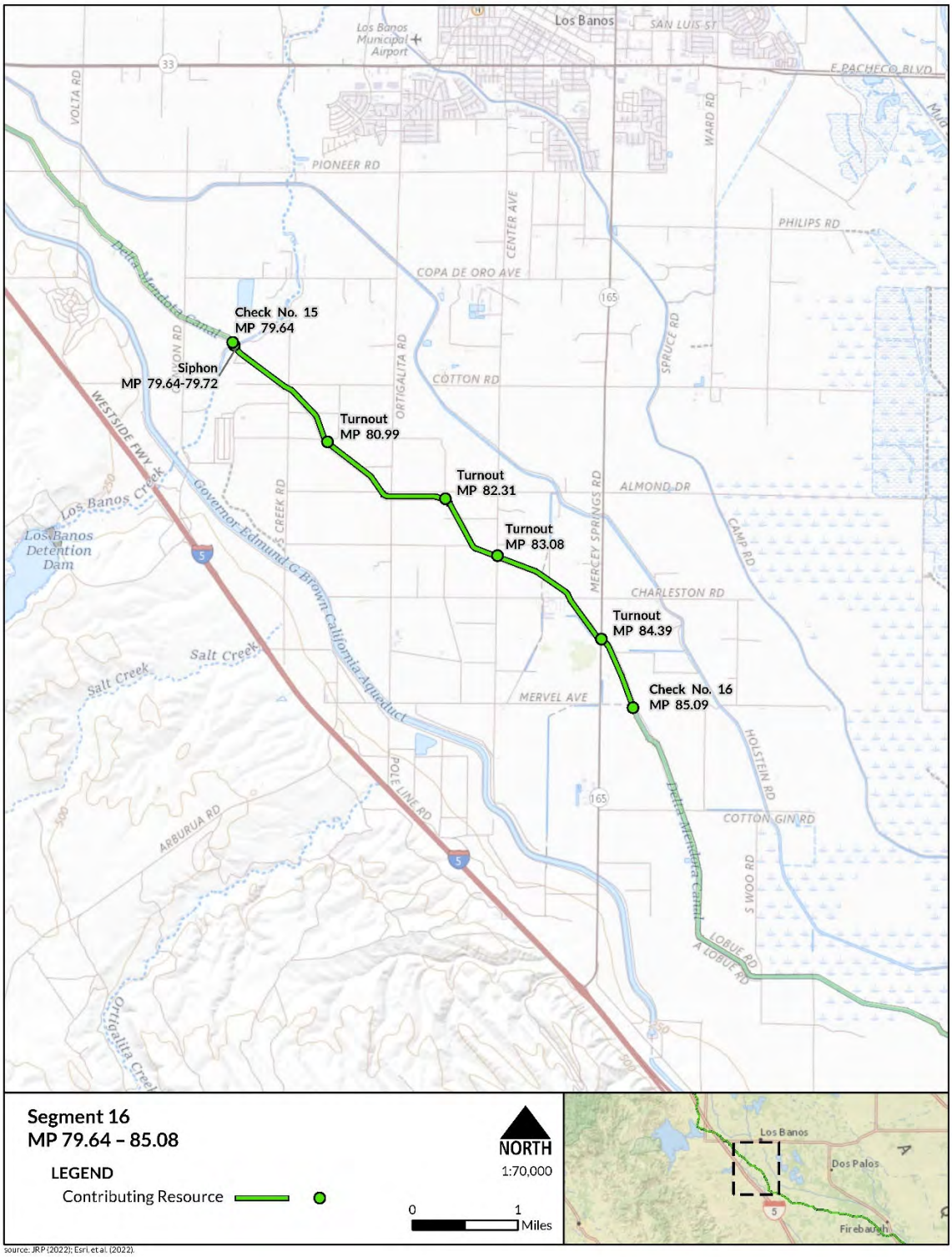

Check No. 12
MP 63.99
Turnout
MP 65.35
Turnout
MP 66.06
Turnout
MP 66.73
Turnout
MP 67.55
Turnout
MP 69.21
Volta Wasteway
MP 69.98
Check No. 13
MP 70.01
Segment 13
MP 63.99 – 70.00
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
COTTONWOOD RD
BUNKER RD
HUSMAN RD
FAHEY RD
MCCABE RD
W HENRY MILLER AVE
GONZAGA RD
SANTA NELLA RD
WESTSIDE FWY
Mustang Creek
Quinto Creek
San Luis Creek
O'Neill Forebay
Santa Nella
Los Banos
Dos Palos
source: JRP (2022); Esri, et al. (2022).

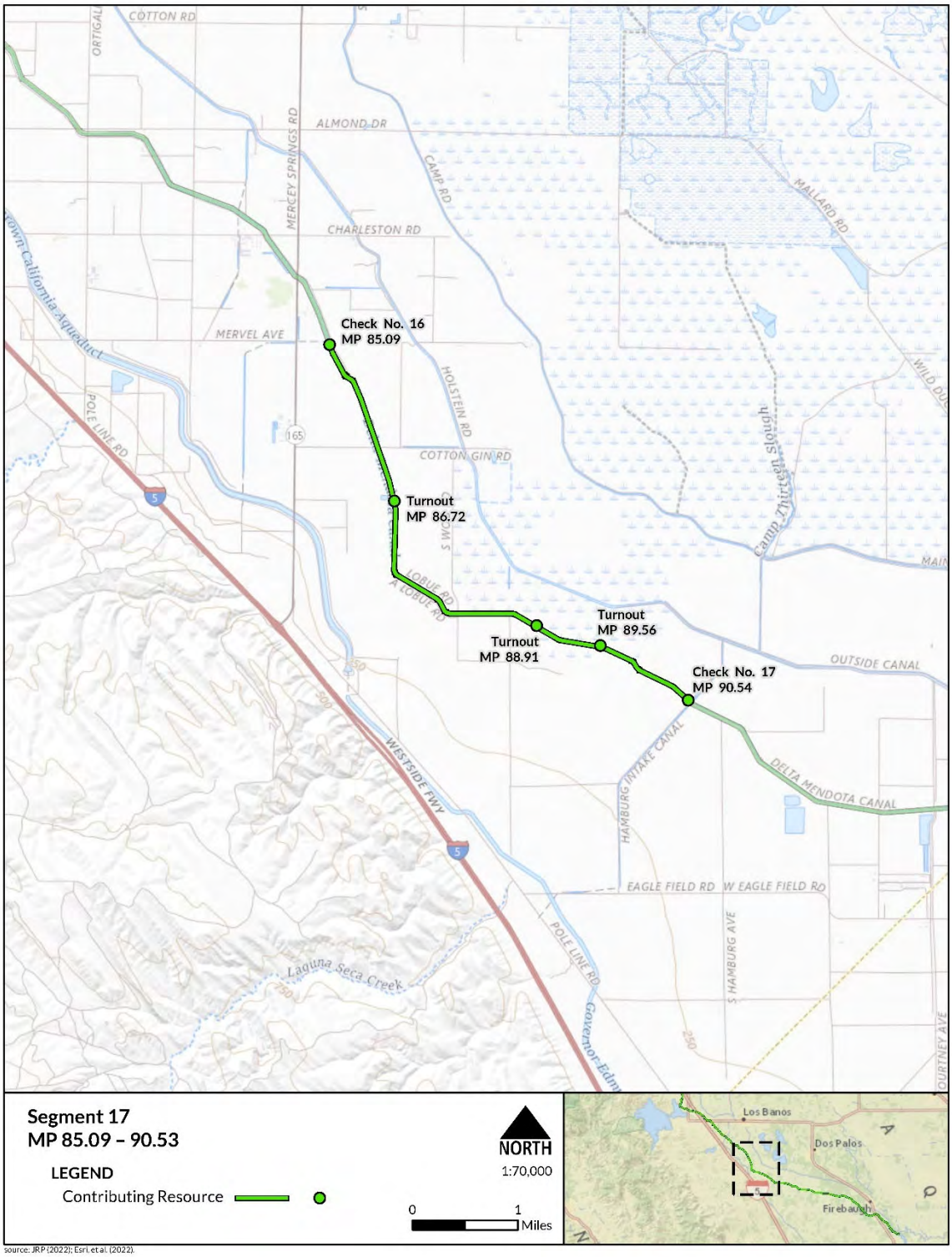


source: JRP (2022); Esri, et al. (2022).

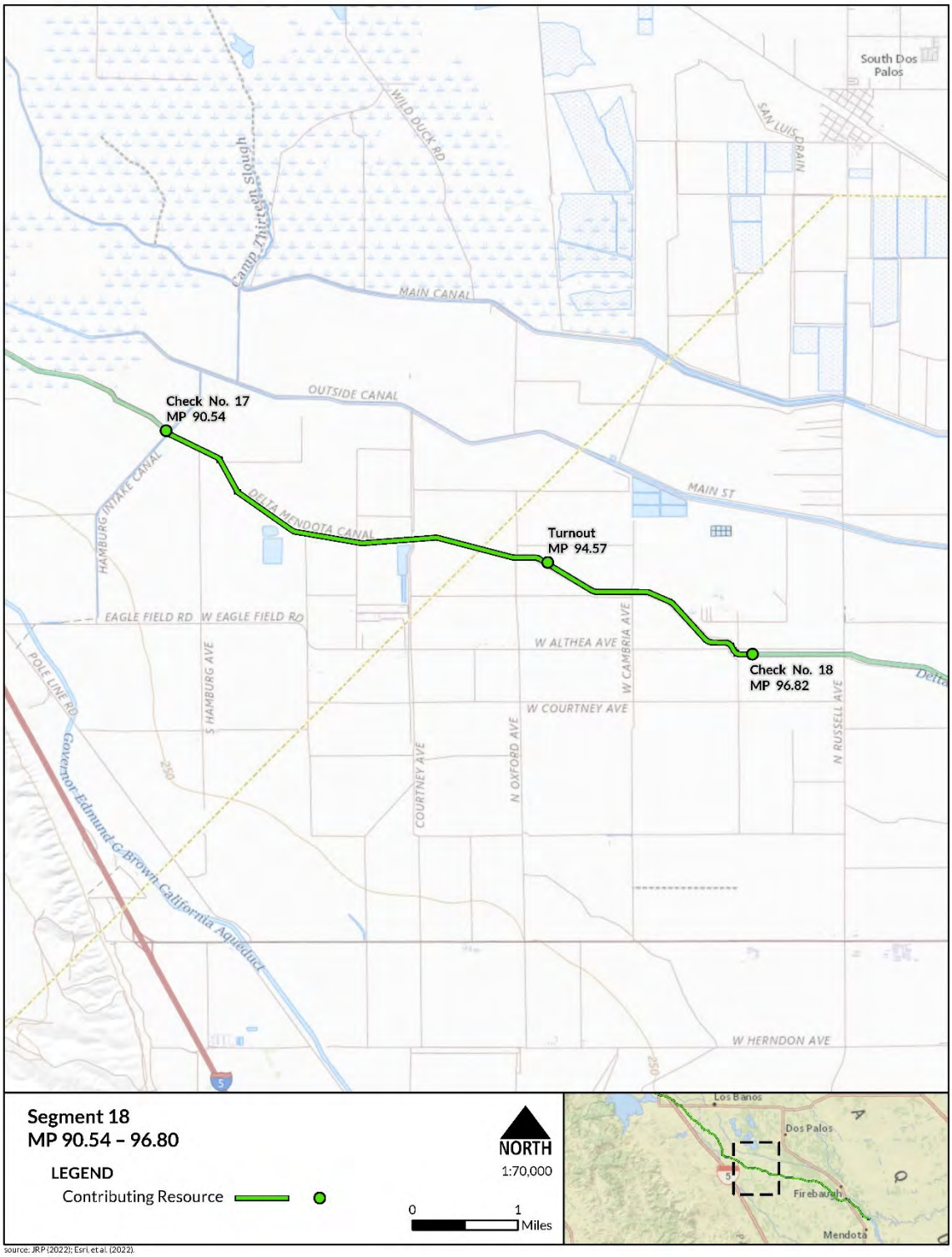


source: JRP (2022); Esri, et al. (2022).

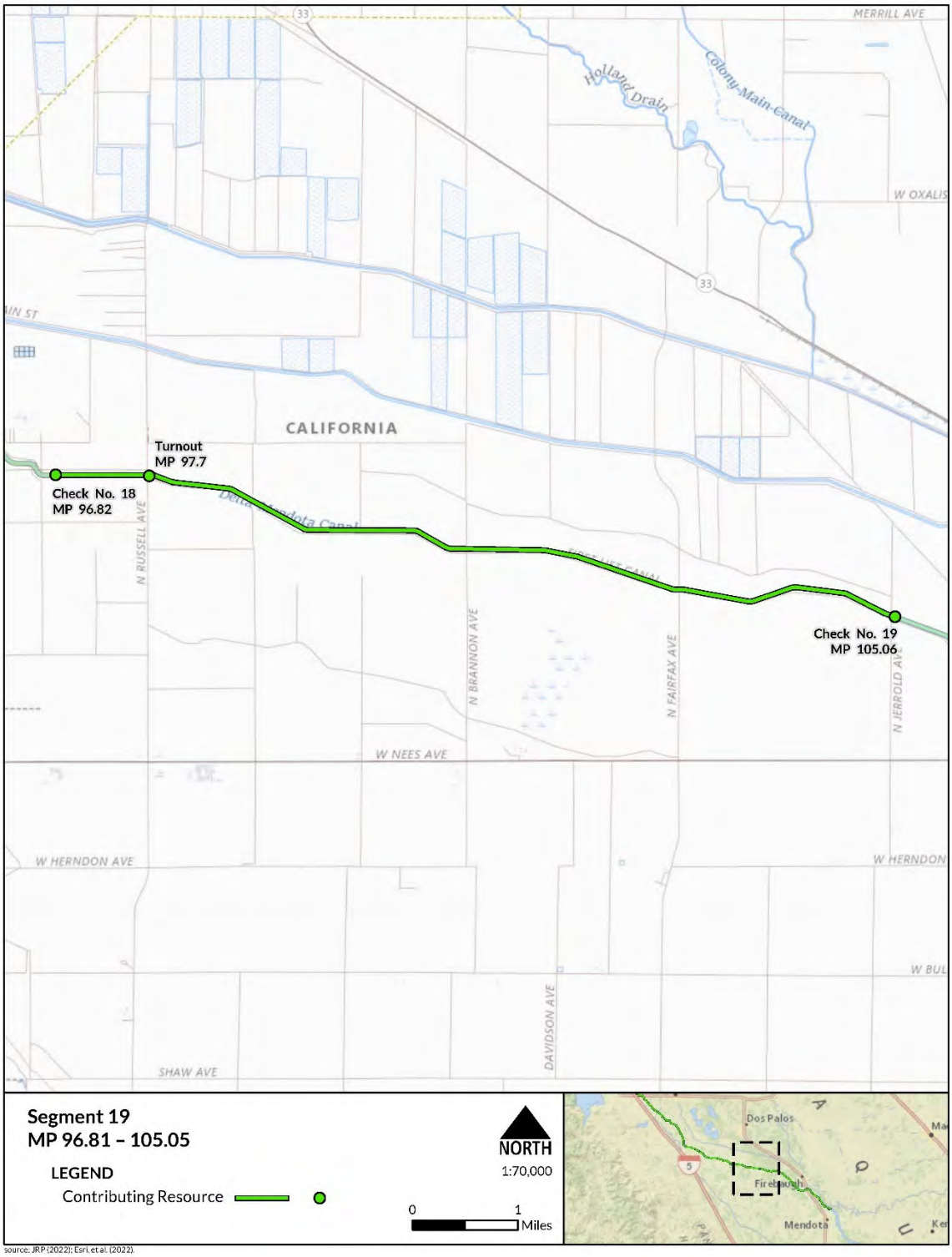

Los Banos
Los Banos Municipal Airport
SAN LUIS ST
E PACHECO BLVD
VOLTA RD
PIONEER RD
WARD RD
CENTER AVE
PHILIPS RD
COPA DE ORO AVE
Delta-Mendota Canal
Check No. 15
MP 79.64
Siphon
MP 79.64-79.72
ORTIGALITA RD
COTTON RD
SPRUCE RD
WESTSIDE FWY
Turnout
MP 80.99
Turnout
MP 82.31
Turnout
MP 83.08
Los Banos Creek
Los Banos Detention Dam
CREEK RD
Governor Edmund G Brown California Aqueduct
MERCEY SPRINGS RD
ALMOND DR
CAMP RD
CHARLESTON RD
Turnout
MP 84.39
Salt Creek
Check No. 16
MP 85.09
MERVEL AVE
HOLSTEIN RD
POLE LINE RD
ARBURUA RD
COTTON GIN RD
Delta-Mendota Canal
S WOOD RD
LOBUE RD
A LOBUE RD
Ortigalita Creek
Segment 16
MP 79.64 – 85.08
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Los Banos
Dos Palos
Firebaugh
source: JRP (2022); Esri, et al. (2022).

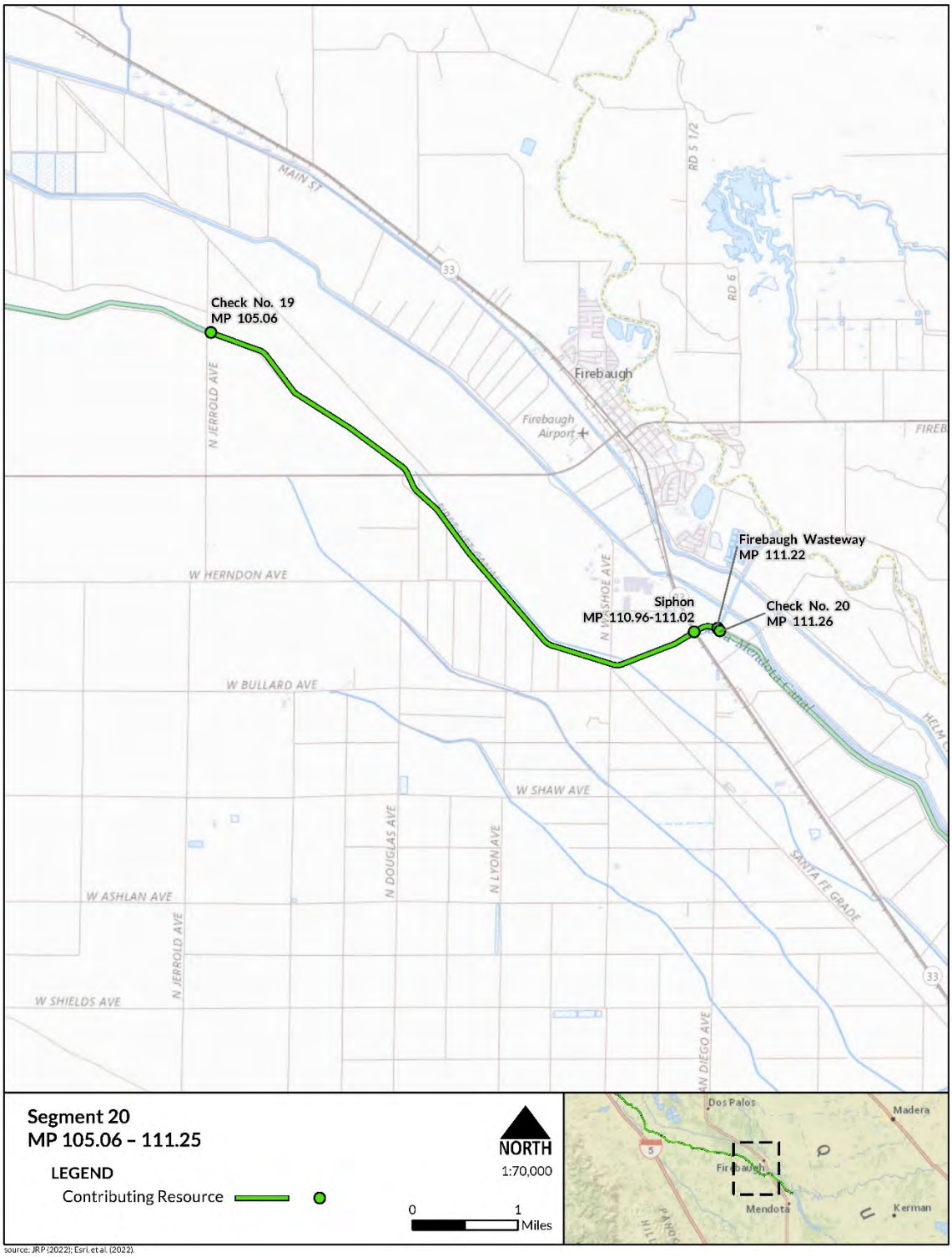


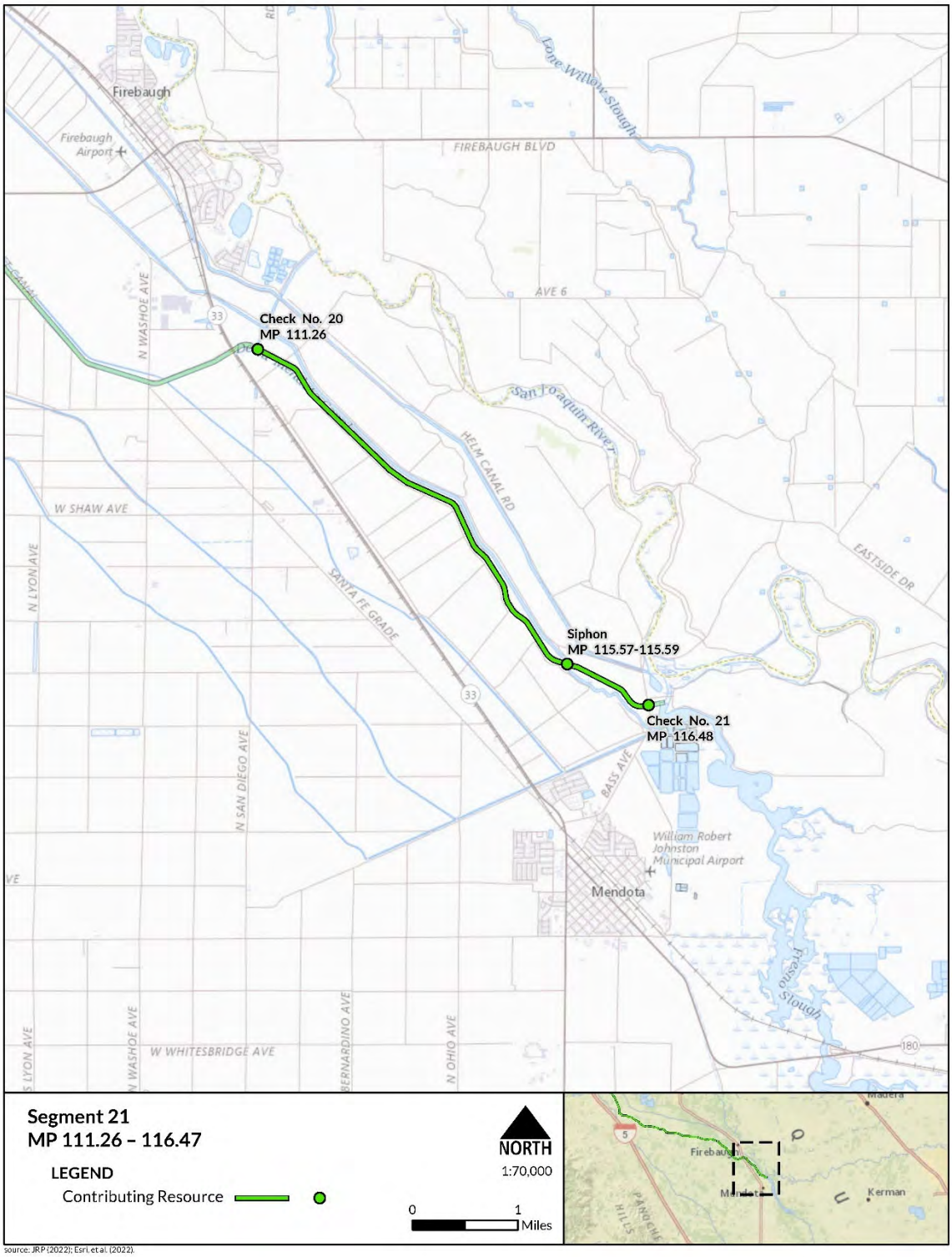
source: JRP (2022); Esri, et al. (2022).



source: JRP (2022); Esri, et al. (2022).


MERRILL AVE
Holland Drain
Colony Main Canal
W OXALIS
33
CALIFORNIA
Turnout
MP 97.7
Check No. 18
MP 96.82
Check No. 19
MP 105.06
N RUSSELL AVE
N BRANNON AVE
N FAIRFAX AVE
N IERROLD AVE
W NEES AVE
W HERNDON AVE
W HERNDON
DAVIDSON AVE
SHAW AVE
Segment 19
MP 96.81 – 105.05
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Dos Palos
Firebaugh
Mendota
5
source: JRP (2022); Esri, et al. (2022).


Check No. 19
MP 105.06
Firebaugh
Firebaugh Airport
Firebaugh Wasteway
MP 111.22
Siphon
MP 110.96-111.02
Check No. 20
MP 111.26
MAIN ST
RD 5 1/2
RD 6
N JERROLD AVE
N WALNUT SHOE AVE
W HERNDON AVE
W BULLARD AVE
W SHAW AVE
W ASHLAN AVE
W SHIELDS AVE
N DOUGLAS AVE
N LYON AVE
SAN DIEGO AVE
SANTA FE GRADE
Segment 20
MP 105.06 – 111.25
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Dos Palos
Madera
Mendota
Kerman
source: JRP (2022); Esri, et al. (2022).


Firebaugh
Firebaugh Airport
FIREBAUGH BLVD
Lone Willow Slough
AVE 6
N WASHOE AVE
Check No. 20
MP 111.26
San Joaquin River
HELM CANAL RD
W SHAW AVE
N LYON AVE
SANTA FE GRADE
EASTSIDE DR
Siphon
MP 115.57-115.59
Check No. 21
MP 116.48
BASS AVE
N SAN DIEGO AVE
William Robert Johnston Municipal Airport
Mendota
Fresno Slough
W WHITESBRIDGE AVE
S LYON AVE
N WASHOE AVE
BERNARDINO AVE
N OHIO AVE
180
33
Segment 21
MP 111.26 – 116.47
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Madera
Firebaugh
Kerman
PANOCHE HILLS
source: JRP (2022); Esri, et al. (2022).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary # _____
HRI # _____
Trinomial _____
NRHP Status Code 3S
Other Listings _____
Review Code _____ Reviewer _____ Date _____

***Resource Name or #** (Assigned by recorder) San Luis Drain

P1. Other Identifier: San Luis Drain

***P2. Location:** ☐ **Not for Publication** ☒ **Unrestricted** ***a. County** Fresno

and (P2b and P2c or P2d. Attach a Location Map as necessary.)

***b. USGS 7.5' Quad** See Continuation Sheet **Date** _____ **T** __; **R** __; _____ **¼ of Sec** ; __ **B.M.**

c. Address NA City _____ Zip _____

d. UTM: (give more than one for large and/or linear resources) Zone _____; _____mE/ _____mN
Segment recorded from UTM Zone 10S, 725735.70mE / 4081383.62mN at the north, to Zone 10S, 734830.29mE / 4070262.12mN at the south.

e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate)
Assessor Parcel Numbers: 008-02-031ST; 012-03-018ST; 012-03-023; 012-03-030ST; 012-06-034ST;012-07-024ST; 012-07-026ST; 012-13-022ST; 012-13-024ST; 013-03-051ST; 013-28-008ST; 013-28-010ST; 013-28-023ST; 019-26-002ST.

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries)

This form records one linear segment and two point-observations along the San Luis Drain (SLD), a component of the San Luis Unit of the Central Valley Project (CVP) (**Photograph 1**). The San Luis Drain spans roughly 87 miles between a point in the vicinity of the unincorporated community of Five Points in western Fresno County at the south end to the Kesterson Reservoir near the city of Gustine in western Merced County at the north end. San Luis Drain is a concrete-lined, trapezoidal drainage canal flanked by two compacted earth embankment levees, with numerous major and minor appurtenant structures distributed throughout its span—including check structures, pipe crossings, siphons, and a trapezoidal crossing in the drain recorded herein. SLD mile posts (M.P.) run north to south, and the structure is recorded herein at three locations (i.e., the study area for this form) between Firebaugh and Mendota in Fresno County, in the vicinity of and where the drainage canal crosses the area of potential effects (APE) for the project cited in *P11. See attached Linear Feature Records for descriptions of points, appurtenant structures, and the canal segment recorded on this form.

***P3b. Resource Attributes:** (List attributes and codes) HP20 – Canal / Aqueduct

***P4. Resources Present:** ☐ Building ☒ Structure ☐ Object ☐ Site ☐ District ☐ Element of District ☐ Other (Isolates, etc.)

P5a. Photo or Drawing (Photo required for buildings, structures, and objects.)



P5b. Description of Photo: (View, date, accession #) **Photograph 1:** San Luis Drain with Delta-Mendota Canal (background left); camera facing east, July 20, 2022.

***P6. Date Constructed/Age and Sources:**
☒ Historic ☐ Prehistoric ☐ Both
1973 (U.S. Bureau of Reclamation)

***P7. Owner and Address:**
U.S. Department of the Interior
Bureau of Reclamation
Mid Pacific Regional Office
2800 Cottage Way
Sacramento, CA 95825

***P8. Recorded by:** (Name, affiliation, address)
Samuel Skow & Danielle Baza
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

***P9. Date Recorded:** July 20, 2022

***P10. Survey Type:** (Describe) Intensive

***P11. Report Citation:** (Cite survey report and other sources, or enter "none.") JRP Historical Consulting, LLC, "Finding of Eligibility Delta-Mendota Canal Subsidence Correction Project," 2022, prepared for US Bureau of Reclamation and San Luis & Delta-Mendota Water Authority.

***Attachments:** ☐ None ☒Location Map ☒ Sketch Map ☒ Continuation Sheet ☒ Building, Structure, and Object Record ☐ Archaeological Record ☐ District Record ☒ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐Other (list) _____

***NRHP Status Code** 3S

***Resource Name or #** (Assigned by recorder) San Luis Drain

B1. Historic Name: San Luis Interceptor Drain

B2. Common Name: San Luis Drain

B3. Original Use: Drainage B4. Present Use: Drainage

***B5. Architectural Style:** Utilitarian

***B6. Construction History:** (Construction date, alteration, and date of alterations) San Luis Drain segments constructed 1969-1973; service discontinued in 1986; various appurtenant inlet drains added at unknown dates.

***B7. Moved?** ☒ **No** ☐ **Yes** ☐ **Unknown** **Date:** _____ **Original Location:** _____

***B8. Related Features:** Kesterson Reservoir; other San Luis Unit features of the Central Valley Project.

B9. Architect: U.S. Department of the Interior (USDI), Reclamation, Central Valley Project, West San Joaquin Division – San Luis Unit – California b. Builder: Multiple (see Continuation Sheet)

***B10. Significance: Theme** Environmental History **Area** United States

Period of Significance 1982-1988 **Property Type** Drainage canal **Applicable Criteria** A/1

(Discuss importance in terms of historical or architectural context as defined by theme, period, and geographic scope. Also address integrity.)

This evaluation concludes that the recorded segment and point observations of the San Luis Drain are significant under National Register of Historic Places (NRHP) Criterion A / California Register of Historical Resources (CRHR) Criterion 1, as well as meet the standards under Criteria Consideration G, and retain sufficient historic integrity to their period of significance, 1982-1988. The resource is significant for its important associations with the Kesterson Reservoir ecological disaster, an environmental crisis that drew national attention to the issue of toxic selenium contamination and contributed to a dramatic policy shift toward agricultural drainage disposal practices in the United States. The recorded segment and point observations have been evaluated in accordance with Section 106 of the National Historic Preservation Act of 1966 (as amended) (54 U.S.C. 306108) and its implementing regulations (36 CFR Part 800), and Section 15064.5(a)(2)-(3) of the CEQA Guidelines, using the criteria outlined in Section 5024.1 of the California Public Resources Code (see Continuation Sheet).

B11. Additional Resource Attributes: (List attributes and codes) _____

***B12. References:** Robert Autobee, "San Luis Unit, West San Joaquin Division, Central Valley Project" (Denver, Colorado: Bureau of Reclamation History Program, unpublished manuscript, 1995); Philip Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley* (Berkeley: University of California Press, 2011); See footnotes.

B13. Remarks:

***B14. Evaluator:** Samuel Skow, JRP Historical Consulting, LLC

***Date of Evaluation:** August 2022

(This space reserved for official comments.)

Sketch map with north arrow required

See Continuation Sheet.

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____

***Resource Name or #** (Assigned by recorder): San Luis Drain

***Recorded by:** S. Skow and D. Baza

***Date:** July 20, 2022

L1. Historic and/or Common Name: San Luis Drain

L2a. Portion Described: ☐ Entire Resource ☐ Segment ☒ Point Observation **Designation:** SLD-1 (M.P. 119.31)

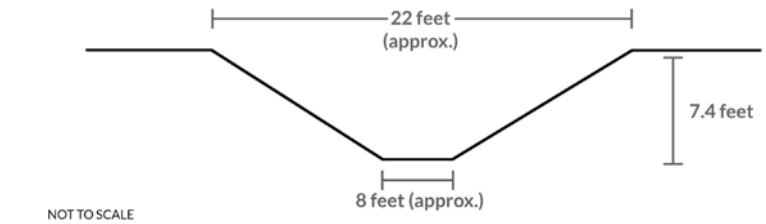
***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) This point of San Luis Drain is located at the intersection of West Nees Avenue and the Outside Canal on the western outskirts of the community of Firebaugh. UTM: Zone 10S, 725721.12mE / 4081354.59mN

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
At this recorded point, San Luis Drain contains a concrete check structure where the canal crosses beneath West Nees Avenue in a concrete siphon with concrete wingwalls (**Photograph 2** and **Photograph 3**).The check structure (at SLD M.P. 119.31) is comprised of a concrete deck with metal handrails and it is separated from the public thoroughfare by chain-link fencing. The concrete-lined, trapezoidal drainage canal has an elevated right bank and a lower left bank, both with 1 ½: 1 slope. Some vegetative overgrowth is present along the earth embankment and in the canal bed. Parallel dirt and gravel operating and maintenance (O&M) roads extend along the levee crests on both sides of the drain.

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width:** 22 feet (approx.)
b. **Bottom Width:** 8 feet
c. **Height or Depth:** 7.4 feet
d. **Length of Segment:** n/a

L4e. Sketch of Cross-Section (not to scale) **Facing:** South



L5. Associated Resources: San Luis Unit canals and water control features

L8a. Photograph, Map, or Drawing.



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This resource is located in a rural agricultural area of Fresno County on the outskirts of the city of Firebaugh. The terrain is generally flat.

L7. Integrity Considerations: None.

L8b. Description of Photo, Map, or Drawing:
Photograph 2: Upstream view of San Luis Drain at Checkpoint 37 (M.P. 119.31) from south side of W. Nees Ave.; camera facing southeast, July 20, 2022.

L9. Remarks:

L10. Form prepared by:
Samuel Skow
JRP Historical Consulting, LLC
2850 Spafford St., Davis, CA 95618

L11. Date: July 20, 2022



Photograph 3: Downstream view of San Luis Drain from north side of W. Nees Ave.; camera facing northwest, July 20, 2022.

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____

***Resource Name or #** (Assigned by recorder): San Luis Drain

***Recorded by:** S. Skow and D. Baza

***Date:** July 20, 2022

L1. Historic and/or Common Name: San Luis Drain

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation:** SLD-2 (M.P. 121.36-125.92)

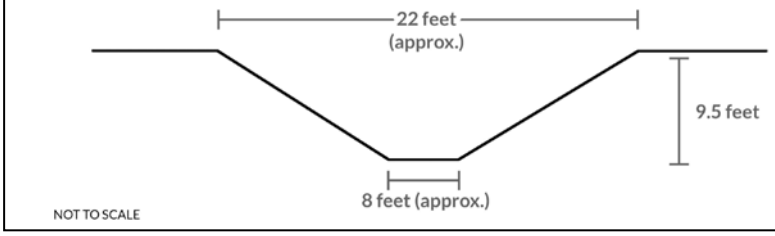
***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) This segment of San Luis Drain is located where the drainage canal intersects and extends parallel to the Delta-Mendota Canal between Firebaugh and Mendota. UTM: Zone 10S, 727802.66mE / 4079226.53mN (north endpoint); 733108.67mE / 4074269.88mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
This approximately five-mile recorded segment of the San Luis Drain is within the APE for the project cited in *P11. From the north, the canal extends southeast parallel to the Union Pacific Railroad (UPRR) / State Route (SR) 33 transportation corridor, which it traverses at a 90-degree angle underground via concrete siphon turning at Check Structure 38 (M.P. 121.38) before turning southeast 90 degrees and passing below the Delta-Mendota Canal (DMC) via similar precast concrete pressure pipe (**Photograph 4 – Photograph 6**). From here, the San Luis Drain extends southeasterly and parallel to the DMC for roughly 4.5 miles before veering south and exiting the APE just east of the intersection of the DMC and Outside Canal (**Photograph 1, Photograph 7,** and **Photograph 8**) (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width:** 22 feet (approx.)
b. **Bottom Width:** 8 feet
c. **Height or Depth:** 9.5 feet
d. **Length of Segment:** 5 miles (approx.)

L4e. Sketch of Cross-Section (not to scale) **Facing:** North



L8a. Photograph, Map, or Drawing.



L5. Associated Resources: San Luis Unit canals and water control features

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This resource is located in a rural agricultural area of Fresno County between the cities of Firebaugh and Mendota. The terrain is generally flat.

L7. Integrity Considerations: Inlet pipes added sometime after initial construction period (1969-1974).

L8b. Description of Photo, Map, or Drawing:
Photograph 4: Downstream view of San Luis Drain from O&M road, with UPRR / SR 33 corridor (background right); camera facing northwest, July 20, 2022.

L9. Remarks:

L10. Form prepared by:
Samuel Skow
JRP Historical Consulting, LLC
2850 Spafford St., Davis, CA 95618

L11. Date: July 20, 2022

L3. Description (Continued):

The concrete-lined, trapezoidal drainage canal has an elevated right bank and a lower left bank, both with 1 ½: 1 slope. Vegetative overgrowth is prominent throughout several sections of the canal bed. Parallel dirt and gravel O&M roads extend along the levee crests on both sides of the drain. In this segment, the San Luis Drain features three check structures, including Check 38 and Check 39, which are connected to siphons that traverse SR 33 and Sierra Avenue, respectively, and Check 40, a standalone structure (**Photograph 5, Photograph 7,** and **Photograph 9**). As described above, the concrete check structures comprise decks with metal handrails that span the width of the drain, with wingwalls channeling flows through two 4.5-foot-wide openings with wood flashboards to control access. This segment likewise features a trapezoidal crossing—an approximately 15-foot-wide and roughly 12-foot-tall, reinforced concrete vehicular bridge—a stainless steel safety ladder affixed with galvanized metal chain link, and various inlet pipes added after the original period of construction (1972-1973) (**Photograph 6**, **Photograph 8,** and **Photograph 10** - **Photograph 12**).

Photographs:



Photograph 5: Downstream view of San Luis Drain from right-bank O&M road, with Check Structure 38 (center) and SR 33 (background); camera facing southwest, July 20, 2022.



Photograph 6: Upstream view of San Luis Drain from right bank O&M road, with non-original inlet drain (center right) and Delta-Mendota Canal left-bank levee (background); camera facing east, July 20, 2022.



Photograph 7: Upstream view of San Luis Drain at Check Structure 39 (M.P. 121.91), with DMC (left); camera facing southeast, July 20, 2022.



Photograph 8: Upstream view of San Luis Drain, with non-original inlet drain (center) and DMC Outside Canal siphon (background center); camera facing northeast, July 20, 2022.



Photograph 9: Downstream view of San Luis Drain at Check Structure 40 (M.P. 124.42); camera facing northwest, July 20, 2022.



Photograph 10: Downstream view of San Luis Drain trapezoidal crossing at M.P. 125.59; camera facing north, July 20, 2022.



Photograph 11: Downstream view of San Luis Drain stainless steel safety ladder (partially obscured by erosion from the embankment); camera facing northwest, July 20, 2022.



Photograph 12: Upstream view of San Luis Drain, with non-original inlet pipe; camera facing southeast, July 20, 2022.

L1. Historic and/or Common Name: San Luis Drain

L2a. Portion Described: ☐ Entire Resource ☐ Segment ☒ Point Observation **Designation**: SLD-3 (M.P. 129.07)

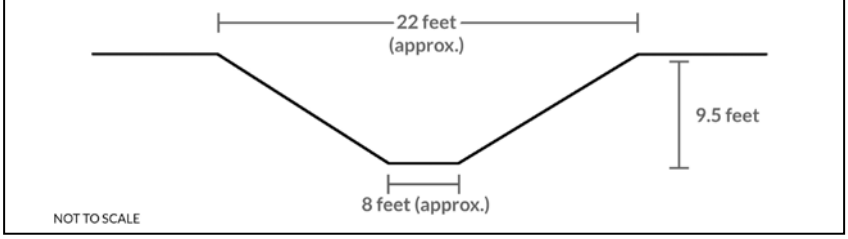
***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) This point of San Luis Drain is located at the intersection of Marie Street and West Belmont Avenue in the city of Mendota. UTM: Zone 10S, 734852.23mE / 4070263.39mN

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
At this recorded point, San Luis Drain contains a concrete check structure where the canal crosses beneath Marie Street, West Belmont Avenue, and the UPRR tracks in a concrete siphon with concrete wingwalls (**Photograph 13** and **Photograph 14**). Comprising a concrete deck with metal handrails, the check structure is separated from the public thoroughfare by chain-link fencing. The concrete-lined, trapezoidal drainage canal has an elevated right bank and a lower left bank, both with 1 ½: 1 slope. Vegetative overgrowth is prominent throughout several sections of the canal bed. Parallel dirt and gravel O&M roads extend along the levee crests on both sides of the drain.

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 22 feet (approx.)
b. **Bottom Width**: 8 feet
c. **Height or Depth**: 9.5 feet
d. **Length of Segment**: n/a

L4e. Sketch of Cross-Section (not to scale) **Facing**: South



L5. Associated Resources: San Luis Unit canals and water control features

L8a. Photograph, Map, or Drawing.



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This resource is located in an industrial section of the small city of Mendota in rural Fresno County. The terrain is generally flat.

L7. Integrity Considerations: None.

L8b. Description of Photo, Map, or Drawing:
Photograph 13: Downstream view of San Luis Drain from north side of Marie Street; camera facing north, July 20, 2022.

L9. Remarks:

L10. Form prepared by:
Samuel Skow
JRP Historical Consulting, LLC
2850 Spafford St., Davis, CA 95618

L11. Date: July 20, 2022

Photograph:



Photograph 14: Upstream view of San Luis Drain from south side of West Belmont Avenue, with Check Structure 42 (M.P. 129.07); camera facing south, July 20, 2022.

P2b. Location (continued):

USGS 7.5' QUAD	DATE	TOWNSHIP / RANGE	SECTION(S)	BASE MERIDIAN
Firebaugh	2021	T12S / R13E	29 and 32	Mount Diablo
		T13S / R13E	3, 4, 10, 11, 13, 14, and 24	
Mendota	2021	T13S / R15E	31	
Tranquility	2021	T14S / R15E	6	

B9b. Builders (continued):

Builder	Canal Segment(s)	Completion Date	Description of Work
Oscar C. Holmes, Inc., and Holmes-Clair, Inc.	Various	1970	Construction of pipe portions of canal crossings (DC-6681)
Gordon H. Ball, Inc.	M.P. 78.64 – 104.05 and Kesterson Reservoir	Pre-1973	Earthwork, concrete lining, and structures and Kesterson Reservoir first stage (DC-6823)
Carl W. Olson & Sons Co.	M.P. 104.05 – 119.33	1970	Earthwork, concrete lining and structures (DC-6703)
Ball, Ball & Brosamer Co.	M.P. 119.33 – 137.77	1973	Earthwork, concrete lining and structures (DC-6948)

Builder	Canal Segment(s)	Completion Date	Description of Work
Darkenwald Construction Co., Inc.	(about) M.P. 131.00 – 137.5	Pre-1973	Earthwork and structures (DC-6611)
Ball, Ball & Brosamer Co.	M.P. 137.77 – 163.47	1973	Earthwork, concrete lining and structures (DC-6958)

B10. Significance (continued):

Historic Context

The San Luis Drain recorded on this form was constructed in sections between 1969 and 1973 as part of the San Luis Unit addition to the Central Valley Project, which expanded the federal water-distribution network to irrigators in the western San Joaquin Valley. The following provides a broad historical overview of the San Luis Unit, chronicles the development of the San Luis Drain, and discusses the significance and lasting impact of the Kesterson Reservoir ecological disaster in the early to mid-1980s. For a discussion of the original Central Valley Project, see the DPR 523 form set prepared for the Delta-Mendota Canal appended to the report cited in *P11.

Central Valley Project – San Luis Unit

The San Luis Drain was constructed as a critical element of the San Luis Unit, a joint state-federal expansion of the Central Valley Project (CVP) to distribute irrigation water to farmers on the west side of the San Joaquin Valley in the 1960s.

As compared to the east side of the valley, agricultural development arrived comparably late to the arid west side of Merced, Fresno, and Kings counties. Through the turn of the twentieth century, the regional economy revolved around ranching—primarily sheepherding—with an economic boom period of oil and coal strikes, which attracted railroads and light municipal development to the area. Irrigation efforts were modest during this period, with farmers digging small canals from the San Joaquin River and repurposing abandoned mining ditches. But, beginning in the 1910s, an influx of local farmers, aided by advances in turbine pump technology, began to extract increasing quantities of high-quality groundwater, converting acres of former pasturage to irrigable lands and progressively pushing ranchers west into the Coast Range foothills. By 1922, 33,000 acres had been irrigated, and by 1948, following the introduction of cotton, hay, grain, alfalfa, and sugar beet crops to the region and boosted by wartime demand, that total had exponentially increased to 484,000 acres. At this time, regional irrigation farmers primarily discharged drainage wastewater into the San Joaquin River and/or its tributaries. However, this growing dependence on underground water resources severely depleted the groundwater table, leading to a 10-foot-per-year drop in the 1930s, with farmers drilling wells as deep as 2,000 feet below the surface. By the early 1950s, the aquifer overdraft reached 500,000 acre-feet per year, an increase from 100,000 annual acre-feet in 1929. In 1942, in response to the growing threat of water scarcity, landowners in western Fresno and Kings counties—among whom several owned over 1,000 acres each in the San Joaquin Valley—established the Westside Landowners Association and began petitioning the US Bureau of Reclamation (Reclamation) to divert surface water from the CVP to the west side of the valley. In response, Reclamation determined that water resources at existing facilities at Shasta Dam on the Sacramento River and Friant Dam on the San Joaquin River would be insufficient to meet the permanent needs of westside farmers and that the CVP would require expansion to meet this growing demand.[1]

To raise political support for transferring water resources to the western San Joaquin Valley, the Westside Landowners Association was reorganized in 1952 as the Westlands Water District (WWD). The new irrigation district was comprised of various incorporated interests—including the Southern Pacific Railroad Company, Standard Oil, and the J. G. Boswell Company, one of the largest agricultural entities in the world—with a service area stretching almost 70 miles between Mendota in Fresno County to Kettleman City in Kings County encompassing 399,000 acres, which was ultimately expanded to 600,000

[1] Robert Autobee, "San Luis Unit, West San Joaquin Division, Central Valley Project" (Denver, Colorado: Bureau of Reclamation History Program, unpublished manuscript, 1995), 5-7, available at https://www.usbr.gov/projects/pdf.php?id=109 (accessed July 2022); Philip Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley* (Berkeley: University of California Press, 2011), 200-202.

acres in 1965 following a merger with the Westplains Water Storage District. In 1955, Reclamation released a feasibility study for delivering water to the westside, which it named the "San Luis Unit," and detailed an elaborate expansion of the existing CVP, whereby surplus water from the Sacramento-San Joaquin Delta would be delivered south via the Delta-Mendota Canal and pumped into a new storage reservoir: the San Luis Reservoir, with a one-million-acre-foot storage capacity, to be located in the inner Coast Range foothills roughly due west from Los Banos in Merced County. The study likewise identified the need for drainage facilities, as the west side experienced poor drainage conditions resulting from the impermeable Corcoran clay layer. To meet increased drainage needs attendant with the expansion of the water-delivery system, Reclamation envisioned an intricate system of underground drains for roughly 96,000 acres of the San Luis service area that would drain saline subsurface groundwater away from low-lying croplands into an open surface interceptor drain (that became the San Luis Drain, recorded on this form), which would convey the water north for release into the Sacramento-San Joaquin Delta. During this same period, the California Department of Water Resources (DWR) produced the California Water Plan as part of the State Water Project (SWP). The water plan included the Feather River Project, which proposed erecting the Oroville Dam on the Feather River; developing a statewide aqueduct system to convey water to the San Francisco Bay Area, the west side of the San Joaquin Valley, and south to Southern California; and constructing a storage reservoir at the San Luis site. In addition to conflict between state and federal authorities concerning their overlapping systems, opposition to the westside expansion of the CVP arose from other contingents as well, namely: groups that argued that the project would serve an area dominated by large landowners in defiance of the 1902 Reclamation Act, which stipulated a 160-acre limit on all lands served by federal irrigation; and water agencies located downstream from the San Luis Unit's service areathat would receive the west side's drainage flows. Following years of negotiations, which included an explicit 160-acre limitation for all lands served by the San Luis Unit along with the inclusion of a drainage provision for affected water agencies, the U.S. Congress passed and U.S. President Dwight Eisenhower signed into law the San Luis Act in 1960, which authorized the annual export of about 1.25 million acre-feet of water to the western San Joaquin Valley to irrigate approximately 500,000 acres in Merced, Fresno, and Kings counties. The act likewise provided for the return of said irrigation water to the Sacramento-San Joaquin Delta as drainage wastewater via proposed interceptor drain (ultimately constructed as the drain recorded on this form).[2]

In 1961, Reclamation and the State of California, which had authorized the SWP with the passage of the Burns-Porter Act of 1959 and narrowly passed bond measures to fund its construction in November 1960, officially resolved the overlapping areas of the CVP and SWP by entering into an agreement to jointly operate the San Luis Unit (**Figure 1**). Reclamation would construct and DWR would operate and maintain the San Luis Dam and Reservoir, now to be enlarged to over two million acre-feet—the largest off-stream reservoir in the United States—to accommodate both projects. In 1963, Morrison-Knudsen Company, Inc., Utah Construction and Mining Company, and Brown and Root, Inc. won the joint contract to build the dam and reservoir, which they completed in August 1967. Transporting SWP water from the Sacramento-San Joaquin Delta to the reservoir, the California Aqueduct would be known as the San Luis Canal where it delivered federal water to the San Luis Unit service area between the reservoir and Kettleman City, south of which it would resume its SWP designation and function: to supply irrigation water to farmers in Kings and Kern counties and in Southern California. Under Reclamation in the San Luis Unit, the San Luis Canal was constructed in five reaches between 1963 and 1968, when water released near Los Banos was finally received in Kettleman City. The San Luis facilities continue to serve the SWP and CVP, and presently comprise of the Governor Edmund G. Brown California Aqueduct / San Luis Canal; B. F. Sisk San Luis Dam; San Luis Reservoir; O'Neill Forebay and Dam, where CVP water from the Delta-Mendota Canal is impounded for distribution; the William R. Gianelli Pumping-Generating Plant, which pumps water from O'Neill Forebay into San Luis Reservoir for distribution via the San Luis Canal; the Dos Amigos Pumping Plant, a secondary pumping facility on the San Luis Canal; and the Los Banos and Little Panoche detention dams and reservoirs, which provide flood protection for the San Luis Canal, Delta-Mendota Canal, and various populated areas. Federal-only facilities include the O'Neill Pumping Plant and Intake Canal; Coalinga Canal, a distribution structure erected to sustain the local mining industry, encourage local agriculture, and provide clean drinking water to the city of Coalinga; Pleasant Valley Pumping Plant, which pumps CVP water into the Coalinga Canal; and the San Luis

[2] Autobee, "San Luis Unit," 7; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 202-205; U.S. Bureau of Reclamation (Reclamation), "San Luis Unit, Central Valley Project, California: A Report on the Feasibility of Water Supply Development" (Sacramento, California: Reclamation Region 2, 1955); Philip Garone, "The Tragedy at Kesterson Reservoir: A Case Study in Environmental History and a Lesson in Ecological Complexity," *Environs* 22, no. 2 (Spring 1999): 114-15.

Drain, discussed below.[3]

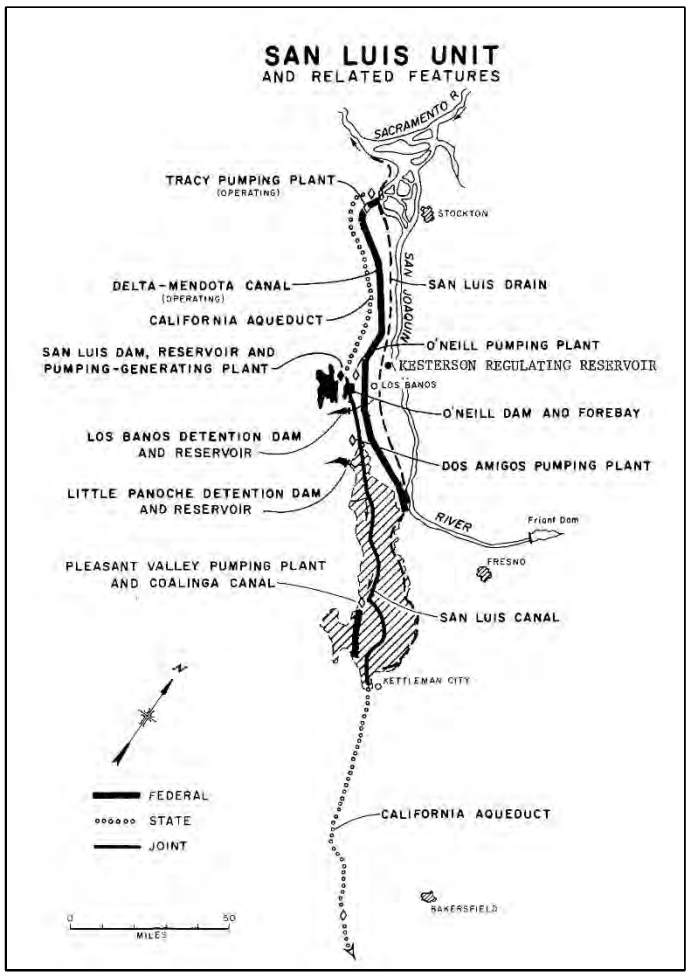


Figure 1: Map of "San Luis Unit and Related Features," ca. 1972.[4]

San Luis Drain

While construction forged ahead on the water storage and distribution elements of the joint state-federal San Luis Unit, the development of drainage facilities lagged. According to the San Luis Act of 1960, drainage infrastructure would either be built by DWR as a "master drain" for the entire San Joaquin Valley or by Reclamation as a smaller interceptor drain for those lands in the San Luis service area. Initially opting out of constructing the master drain, DWR reversed its position in 1964, proposing an approximately 280-mile, concrete-lined structure to extend north from Bakersfield in Kern County to a discharge point near the city of Antioch in Contra Costa County in the Sacramento-San Joaquin Delta, thereby serving the entire western San Joaquin Valley. Construction was stalled, however, when the Contra Costa County Water Agency objected to the plan because it would discharge nitrogen-rich saline drainage that may also contain pesticide residues into its freshwater resources. State and federal officials drafted several alternatives to the Antioch outfall, which included diluting discharge flows in natural streams like the San Joaquin River and Salt Slough or storing drainage in evaporation ponds. Reclamation and other supporters

[3] Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 208-209; Autobee, "San Luis Unit," 9, 14-17; California Department of Water Resources, "San Luis," 2022, https://water.ca.gov/Programs/State-Water-Project/SWP-Facilities/San-Luis (accessed August 2022).

[4] U.S. Bureau of Reclamation, "San Luis Unit and Related Features" (March 1972), dwg. no. 805-208-1947, reprinted in W. Turrentine Jackson and Alan M. Paterson, "The Sacramento-San Joaquin Delta: The Evolution and Implementation of Water Policy, an Historical Perspective" (Davis: California Water Resources Center, University of California, Davis, Contribution No. 163, June 1977), 137.

of the drain in the San Joaquin Valley did not accept these alternatives, however, because they failed to remove salt from the region, or they continued to utilize the San Joaquin River as a drain. Meanwhile, opposition to the Antioch outfall spread throughout the San Francisco Bay / Sacramento-San Joaquin Delta region, where congressional representatives called for investigations into the drain's pollution potential. In response, in early 1965 U.S. President Lyndon Johnson removed the San Luis Drain from the federal budget while requesting a $300,000 appropriation to fund an environmental investigation into a joint state-federal master drain by the U.S. Public Health Service. Two years later, the Federal Water Pollution Control Administration, subsequently tasked with the investigation, issued a comprehensive report that conditionally endorsed the drain, identifying fertilizer-derived nitrogen as the most dangerous pollutant and discounting subsurface drainage as a source of toxic pesticide residue. While nitrogen treatment and removal studies continued, the report advised partial construction of the San Luis Drain to enable drainage storage, which continued to threaten groundwater resources and agricultural output. In 1967, following the election of Ronald Reagan as California governor, DWR again reversed its position on the drain, finding no political support among San Joaquin Valley farmers for repayment rates at $18 per acre-foot and lacking even 25 percent of the upfront capital drainage construction costs. Responsibility for maintaining compliance with the San Luis Act of 1960 was retained by Reclamation alone, which was then being sued by the Central California Irrigation District for failing to provide drainage in accordance with the act; meanwhile, water deliveries were slated to begin as early as 1968.[5]

Following DWR's abandonment of the regionwide master drain, Reclamation set about designing and constructing an interceptor drain, initially conceived as a 188-mile structure to serve the area between Kettleman City in Kings County to the south and an undetermined discharge point in the Sacramento-San Joaquin Delta to the north. Until a final outfall location was made available, the drain was to empty into Kesterson Reservoir— a proposed complex of 12 interim storage ponds outside of Gustine in Merced County used to store and partially evaporate drainage flows (discussed below). This drainage network was to be developed alongside a drainage collection system constructed by Reclamation for the WWD, which would be comprised of underground concrete pipelines that gathered irrigation drainage from buried drainage pipes installed on private farms. In 1968, Reclamation began SLD's first phase of construction between Tranquility in Fresno County and Kesterson Reservoir. That March, the Sacramento-based Darkenwald Construction Company, Inc. won the first contract for a seven-mile stretch of drain excavation along with 11 irrigation crossings, five road crossings, and two encasement pipes between Highway 180 and Adams Avenue in Fresno County (south of the study area). That October, Menlo Park-based firms, Oscar C. Holmes, Inc. and Holmes-Clair, Inc., won the joint contract to construct precast concrete pipe portions of siphons below the Laguna, Main, Outside, and Bass Avenue / Intake canals, and—in the study area described above—the Delta-Mendota Canal (M.P. 121.50). In January 1969, San Mateo-based contracting company, Carl W. Olson & Sons, Inc., was awarded the contract to construct roughly 15 miles of earthwork, concrete lining, and structures between Dos Palos in Merced County and Firebaugh—including Check 37 recorded herein (M.P. 119.31). Work was slated to begin that April and involved a unique construction method to accommodate for the groundwater level located above the drain floor.[6] As explained by journalist Joe Thome, "Although several excavation techniques were tried and varying ones are being used, the best method has proven to be a sled system developed and built right on the job. It is called a 'pre-trimmer [(**Figure 2**)].'" Thome continues:

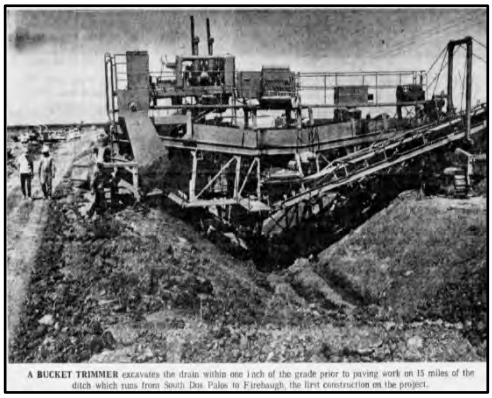
[5] Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 209-212; Jackson and Paterson, "The Sacramento-San Joaquin Delta," 139-143.

[6] Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 210; Jackson and Paterson, "The Sacramento-San Joaquin Delta," 144; "Major Recent Contract Awards," *Reclamation Era* 54, no. 2 (May 1968): 54; U.S. Bureau of Reclamation, "San Luis Unit, Central Valley Project: Plan for Disposal of Subsurface Agricultural Drainage" (Sacramento, California: USBR Region 2, June 1969), 17-21, on file at USBR Library, Sacramento, California; U.S. Bureau of Reclamation, Office of Design and Construction, "Designers' Operating Criteria: San Luis Drain, San Luis Unit, West San Joaquin Division, Central Valley Project, California" (Denver, Colorado: USBR, January 1975), 4; Memo Re: Field Inspection for Transfer from Construction to O&M Status for: Stage 1 Kesterson Reservoir and the Three Completed Reaches of the San Luis Drain—Specification Nos. DC-6611, DC-6681, DC-6703, DC-6823—San Luis Unit, CVP, California (December 17, 1973), ff. San Luis Drain (Spec. No. DC-6611), on file at USBR Library, Sacramento, California; "Major Recent Contract Awards," *Reclamation Era* 55, no. 1 (February 1969): n.p.; "Bureau Awards Contract for San Luis Drain," *The Fresno Bee* (January 17, 1969): 12A; "Reservoir Job Contract Due Danville Firm," *Salinas Californian* (March 7, 1969): 13; "Work on First Section of San Luis Drain Begins," *The Modesto Bee* (April 6, 1969): C4.

The 'pre-trimmer' is pulled along the drain alignment as it excavates the drain to within six inches of the final cut. It also simultaneously excavates three trenches, each 14 inches wide, extending below the rough cut [sic] drain bottom. The center trench, extending about 30 inches below the drain bottom, is used by the contractor to 'de-water' the immediate drain route to allow further excavation and placing of the lining. The two trenches, which run along each edge of the eight-foot wide [sic] bottom, will function to collect and hold water and keep it from lifting the lining out of the ground. In the center trench the contractor lays a 4-inch perforated plastic pipe, which is covered with gravel, and ground water is pumped out at points 1,000 feet apart. The outer trenches, similarly built but only 15 inches deep, will be connected to the canal portion by weep valves, spaced 10 feet apart. This will allow water to seep into the canal through these valves, when it builds up in the trench, and will thus relieve uplift pressure which could 'float' the concrete lining. The action of the valve will, however, prevent drain water from going from the drain canal back into the trench.[7]



SHAPING THE ROUGH cut of the drain, the pretrimmer utilizes a sled system to excavate it to within six inches of the final cut.



A BUCKET TRIMMER excavates the drain within one inch of the grade prior to paving work on 15 miles of the ditch which runs from South Dos Palos to Firebaugh, the first construction on the project.



THE FINAL STEP—A huge paving train moves along a stretch of the San Luis Drain south of South Dos Palos, laying a concrete V which will carry off brackish irrigation water.

Figure 2: Published photographs of San Luis Drain construction between Dos Palos and Firebaugh, 1969.[8]

Progress on the construction of San Luis Drain, however, was stalled by budget cuts. In April 1969, U.S. President Richard Nixon slashed $2 million from the San Luis Drain budget (among other cuts to the CVP), pushing the timeline back one year, with Carl Olson & Sons (discussed above) completing construction of their section in January 1970. That July, Gordon H. Ball, Inc., based in Danville, Contra Costa County, won the contract for the northernmost 26-mile stretch of earthwork, concrete lining, and structures between Gustine and Dos Palos, along with the 1,283-acre, 12-pond, Kesterson Reservoir, all outside the study area. As mentioned, while the drain's discharge point in the Delta was debated, Kesterson continued to function as a drainage detention and evaporation facility.[9] Aided by advanced technology, Ball reportedly streamlined the canal excavation method employed by Carl Olson & Sons, Inc. (described above), as reported in *Construction Methods & Equipment*, "By mounting a specially-designed digging unit on a canal trimmer, [Gordon H. Ball, Inc.] gained a one-pass machine that simultaneously excavates canal finger drains, trims slopes and bottom, lays continuous plastic pipe, backfills, and screeds drains level with the slopes. Any area passed over by the machine is immediately ready for concreting."[10] In June 1972, Ball, Ball & Brosamer of Danville won construction contracts for an approximately 18-mile stretch of earthwork, concrete lining, and structures comprising the bulk of the study area (M.P. 119.33 – 137.77), along with the southernmost segment terminating at Five Points, outside the study area. For much of the segment in the study area, Reclamation adapted a preexisting earth-lined drainage canal originally dug by the Firebaugh Canal Company around the same time that the Delta-

[7] Joe Thome, "San Luis Drain Paving Begins Near South Dos Palos," *The Modesto Bee* (August 18, 1969): B2.
[8] Bee Photos, published in Thome, "San Luis Drain Paving Begins Near South Dos Palos."
[9] Memo Re: Field Inspection for Transfer from Construction to O&M Status for: Stage 1 Kesterson Reservoir and the Three Completed Reaches of the San Luis Drain—Specification Nos. DC-6611, DC-6681, DC-6703, DC-6823—San Luis Unit, CVP, California (December 17, 1973), ff. San Luis Drain (Spec. No. DC-6611), on file at USBR Library, Sacramento, California; Michael Green, "Budget Cut Costs CVP $11.7 Million," *The Modesto Bee* (April 16, 1969): A2; "San Luis Drain May be Finished in 6 or 7 Years," *The Fresno Bee* (April 4, 1970): 6B; "San Luis Drain is Year Ahead," *The Modesto Bee* (October 1, 1970): C1.
[10] David C. Etheridge, "Hybrid Rig is Versatile Canal Builder," *Construction Methods & Equipment* (October 1972): 61.

Mendota Canal was built, rerouting the earth-lined drain (Drain U-121.2, recorded and evaluated on a separate DPR 523 form attached to the report cited in *P11) immediately adjacent to the San Luis Drain segment (**Figure 3**). Ball, Ball & Brosamer completed all work the following year, when construction on the San Luis Drain was halted altogether (**Figure 4**).[11]



Figure 3: Excerpt of 1957 aerial photograph, with Firebaugh Canal Company drain (indicated by arrows) in same alignment as San Luis Drain, adjacent to Delta Mendota Canal.[12]

[11] Memo Re: Field Inspection for Transfer from Construction to O&M Status for: Stage 1 Kesterson Reservoir and the Three Completed Reaches of the San Luis Drain—Specification Nos. DC-6611, DC-6681, DC-6703, DC-6823—San Luis Unit, CVP, California (December 17, 1973), ff. San Luis Drain (Spec. No. DC-6611), on file at USBR Library, Sacramento, California; Michael Green, "Budget Cut Costs CVP $11.7 Million," *The Modesto Bee* (April 16, 1969): A2; "San Luis Drain May be Finished in 6 or 7 Years," *The Fresno Bee* (April 4, 1970): 6B; Declaration of Taking, United States of America vs. Redfern Ranches, No. F-232, October 4, 1968, 5629 O.R. 444, Fresno County Recorder, Fresno, California; Aero Exploration Co., Flight ABI, Frame ABI-18G-51, February 13, 1950, 1:20,000, flown for U.S. Department of Agriculture (USDA) – Production and Marketing, available at http://malt.lib.csufresno.edu/MALT/ (accessed July 2022); Cartwright and Company, Flight ABI-1957, Frame ABI-29T-138, June 22, 1957, 1:20,000, flown for USDA – Commodity Stabilization Service, available at https://mil.library.ucsb.edu/ap_indexes/FrameFinder/ (UCSB; accessed July 2022); "San Luis Drain Takes Shape in Fresno County," *The Fresno Bee* (September 16, 1973): C1.

[12] Cartwright and Company, Frame ABI-29T-138, 1957, UCSB.



Figure 4: Archival photograph of Ball, Ball & Brosamer constructing outlet transition at UPRR / SR 33 siphon undercrossing, September 20, 1973. San Luis Drain indicated by arrows. Note Delta-Mendota Canal next to the SLD in the middle ground.[13]

Collectively, Gordon H. Ball, Inc., and Ball, Ball & Brosamer constructed 69.51 miles of the extant San Luis Drain, nearly 80 percent of the completed structure, along with the Kesterson Reservoir evaporation ponds. Hailing from a contracting family, Gordon H. Ball began his career working for his father, N. M. Ball, an early proponent of underground concrete irrigation construction who branched out into highway building in the 1920s. Following his father's death in 1935, Gordon Ball partnered with his two brothers forming N. M. Ball Sons, which took on numerous military projects during World War II, including 200 miles of roads for the Hanford Atomic Energy Plant in Hanford, Washington. In the early 1950s, Gordon split off from his brothers, ultimately incorporating as Gordon H. Ball, Inc., in 1957, and was active throughout California, Oregon, Washington, and Hawaii, specializing in concrete paving, as well as highway and bridge construction. In addition to the company's work on the San Luis Drain and Kesterson Reservoir, other CVP work included the Tehama-Colusa Canal and preliminary work for the proposed but never built Auburn Dam (the contract for which issued to Auburn Constructors, a joint venture between Gordon H. Ball, Inc., Guy F. Atkinson Company, and the Arundel Corporation). By 1975, the company had been purchased and operated as a subsidiary of Dillingham Corporation. Some later projects included: the Woodburn-Hayesville Interchange on Interstate 5 between Salem and Portland, Oregon; the Stapleton International Airport runway in Denver, Colorado; runways at Mather and McLellan air force bases in Sacramento; a cofferdam and forebay for a powerhouse at Grand Coulee Dam in Washington; a subway tunnel for the Washington Metropolitan Area Transit Authority (jointly built with the J. F. Shea Company, Inc., and Norair Engineering); and numerous sections of highway throughout California and Oregon, including

[13] F. A. Shrader, Photograph No. CN805-243-9106NA: San Luis Drain, San Luis Unit, Bureau of Reclamation, Central Valley Project, California (August 20, 1973), available at U.S. Bureau of Reclamation, California-Great Basin Digital Library, https://usbr.contentdm.oclc.org/digital/collection/p15911coll7/id/3074/rec/7 (accessed August 2022).

California State Route 99 in Bakersfield, and Interstate 5 north of Los Angeles.[14] Ball, Ball & Brosamer was formed as joint venture between Gordon H. Ball's two sons, Gordon N. Ball and Dennis W. Ball, and Robert G. Brosamer. In addition to its work on the San Luis Drain, other CVP work includes rehabilitation of a portion of the Friant-Kern Canal, with other works for Reclamation including installation of the Gallegos Canyon Siphons as part of the Navajo Indian Irrigation Project in New Mexico and the Sonoqui Dike in Arizona. As with Gordon H. Ball, Inc., Ball, Ball & Brosamer was most actively involved in heavy highway construction. Gordon N. Ball went on to form Gordon N. Ball, Inc., and Robert Brosamer formed R & L Brosamer, Inc, both active firms based in the San Francisco Bay Area.[15]

The San Luis Drain was ultimately built out to about half of its proposed alignment, extending from a point near Five Points in Fresno County north to Kesterson Reservoir, when construction was halted in 1973 (**Figure 5**). Construction of the southernmost 29 miles of canal between Five Points and Kettleman City was impeded by a federal spending freeze that year and funding was never reinstated for its completion. The northernmost 75 miles between Kesterson Reservoir and the proposed Delta discharge outfall faced mounting opposition, not only from environmentalists in the San Francisco Bay Area, who claimed that nitrate-rich drainage water would cause algal blooms and compromise regional ecology, but also over half of all landowners along the proposed canal route between Kesterson and Antioch, most of whom saw the open canal as a loss to their property for the benefit of farmers further south. As a result, the San Luis Drain remained unfinished, and the 12 evaporation ponds at Kesterson Reservoir functioned as the ultimate discharge terminus through 1986, when use of the reservoir and drain was ultimately discontinued following the ecological disaster at Kesterson, discussed below.[16]

[14] "Small Staff Takes on Big Highway Program," *Contractors and Engineers* (January 1965): 35; "Major Recent Contract Awards," *Reclamation Era* 58, no. 2 (May 1972): 33; "Scrapers are Modified to Haul 26-yd Payloads," *Construction Methods & Equipment* 43, no. 9 (September 1961): 86; "Slip-form Machine Paves Three Lanes in One Pass," *Contractors and Engineers* 60, no. 7 (July 1963): 64; "80-ton Bottom-dump Trains Clock Million Yards Monthly," *Roads and Streets* 112, no. 8 (August 1969): 40; "How Ball Handles Maintenance on Oregon's Biggest Highway Job," *Western Construction* 50, no. 10 (October 1975): 24; "Slipform Lanes 50 Feet Wide and 18 Inches Deep," *Western Construction* 50, no. 12 (December 1975): 26; "Aggregate Base and CTB Mixed in Pugmill Plant," *Contractors and Engineers Magazine* 69, no. 5 (May 1972): 16; "Auburn Dam," *Compressed Air Magazine* 80, no. 11 (November 1975): 18; "Blaw-Knox Road and Airport Duo-forms Speed Air Base Paving," *Construction Methods & Equipment* 41, no. 5 (May 1959): 241; "Loaders, Trucks, and Scrapers Move Million Yards a Month," *Contractors & Engineers Magazine* 67, no. 11 (November 1970): 11; "Subway Contractors Overcome Poor Soil Conditions," *Contractors & Engineers Magazine* 68, no. 1 (January 1971): 18;

[15] "Irrigation Trickles," *Irrigation Journal* 27, no. 3 (May-June 1977): 34; "Contractors," *Western Construction* 50, no. 7 (July 1975): 127; U.S. Department of Interior, *Decisions of the United States Department of the Interior Vol. 93, January-December 1986* (Washington, D.C.: U.S. Government Printing Office, 1987), 144; "County Repays FAA $480,000 for False Billing," Los Angeles Times (June 29, 2000): B1; "Gordon N. Ball, Inc.," NewBayBridge.org, n.d. https://www.newbaybridge.org/the_builders/gordon_ball/ (accessed August 2022); "Featured Projects," Gordon N. Ball Inc., 2017, http://ballconco.com/featured-projects/ (accessed August 2022); Robert L. "Bob" Brosamer, "Message from Bob Brosamer," R & L. Brosamer, Inc. [newsletter] (Spring 2001): 2, available at https://www.thenewsletterguy.com/samples/CustomerNewsletters/RLBrosamer.pdf (accessed August 2022).

[16] Jackson and Paterson, "The Sacramento-San Joaquin Delta," 144; William Schiffman, "San Luis Project is Dwindling," Merced *Sun-Star* (October 29, 1973): 2; "Landowners Oppose San Luis Interceptor Drain as Proposed," Newman *Index* (December 14, 1972): 8.

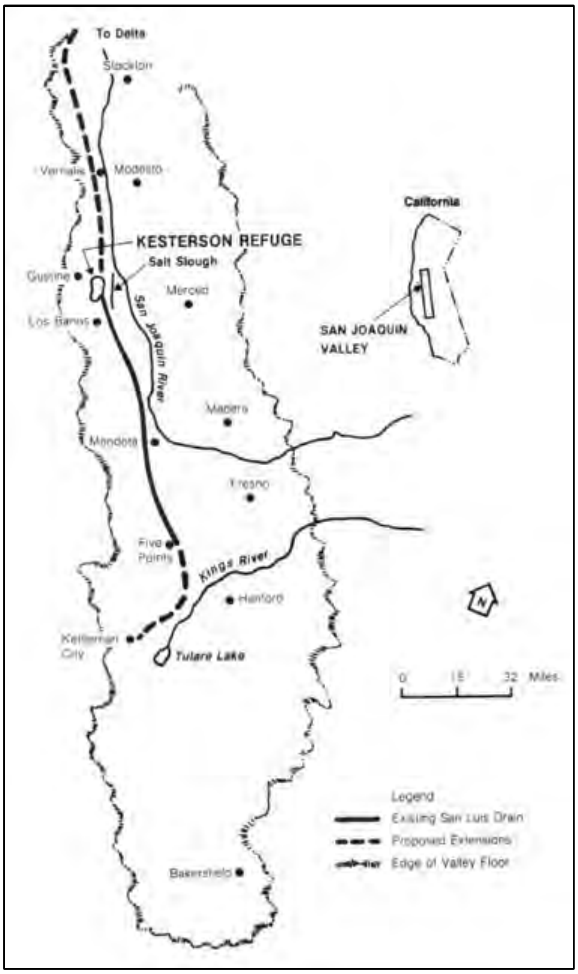


Figure 5: Location of the completed San Luis Drain, from Five Points to Kesterson Reservoir, with proposed segments at north and south ends, no date.[17]

Ecological Disaster at Kesterson Reservoir[18]

As discussed above, the ultimate build-out of the San Luis drainage system terminated at Kesterson Reservoir, a roughly 1,283-acre complex of 12, roughly 100-acre evaporation and seepage ponds separated by earthen berms with a combined storage capacity of 4,330 acre-feet (**Figure 6**). Completed in 1971, Kesterson Reservoir was contained within the larger Kesterson National Wildlife Management Area, created via joint agreement in 1970 between Reclamation and the U.S. Fish

[17] U.S. Bureau of Reclamation, untitled map of San Luis Drain, no date, reprinted in Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 211.

[18] The following provides an overview of the ecological disaster at Kesterson Reservoir in the mid-1980s. For a detailed scholarly account, see: Philip Garone, "The Tragedy at Kesterson Reservoir: A Case Study in Environmental History and a Lesson in Ecological Complexity," *Environs* 22, no. 2 (Spring 1999): 107-144; and the expanded chapter, "Tragedy at Kesterson Reservoir" in Philip Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley* (Berkeley: University of California Press, 2011). For a journalistic account, see: Russell Clemings, *Mirage: The False Promise of Desert Agriculture* (San Francisco: Sierra Club Books, 1996); and Tom Harris, *Death in the Marsh* (Washington, D.C.: Island Press, 1991). Since the closure of the Kesterson Reservoir, Reclamation and recipients of CVP irrigation water in the western San Joaquin Valley have struggled with the issue of drainage up to the present. However, this study does not discuss this ongoing aspect of the history of the San Luis Drain. For more information on the evolution of Reclamation's drainage policies in the twenty-first century, see: Kathleen Nitta, "A Tale of Two Water Districts: The Future of Agriculture in California's San Joaquin Valley Lies in Compromise Over Drainage," *Golden Gate University Environmental Law Journal* 5, no. 2 (May 2012): 439-480; and Nigel W. T. Quinn, "Policy Innovation and Governance for Irrigation Sustainability in the Arid, Saline San Joaquin River Basin," *Sustainability* (2020), available at https://escholarship.org/uc/item/7dn0w5g2 (accessed July 2022).

and Wildlife Service (USFWS), which would manage the area as a wildlife refuge. Historically, the area contained within Kesterson had been used for cattle ranching and waterfowl hunting, a popular area among local duck clubs. With about half of the fall and winter marsh acreage comprised of seasonally flooded grasslands and other copious food sources, Kesterson was a key stopping point on the Pacific Flyway for migratory birds and other grazing animals. As a partial remediation for summer water scarcity, the Grasslands Water District, under contract with Reclamation, was to furnish several thousand acre-feet of water per year. At the same time, surface agricultural drainage water began flowing into the Kesterson Reservoir via the San Luis Drain in 1972—one year prior to the completion of construction of the reaches further south. Diluted with irrigation-quality water supplied by the Grasslands Water District, the discharge initially produced high-quality wetland habitat between 1972 and 1978, fostering breeding activities among various duck species that nested there in the spring. In 1975, Reclamation officially changed the status of Kesterson from a regulating reservoir to a terminal holding reservoir for storing and concentrating drainage water for release into the San Joaquin River during sufficiently high flows. Meanwhile, in compliance with the San Luis Act of 1960, Reclamation developed the WWD Drainage Collector System, comprised of a network of plastic drains lain six-to-eight feet below the ground surface, between 1976 and 1980. In 1978, for the first time, Reclamation began conveying subsurface irrigation drainage water to Kesterson Reservoir, and by 1981, virtually all the inflow that the SLD conveyed to Kesterson consisted of subsurface water, which contained higher concentrations of trace elements, saline, and other contaminants leached into the soil than surface drainage.[19]

For about a decade prior to the development of the San Luis drainage facilities, state and federal agencies had warned against reusing drainage water. As early as 1960, DWR had identified irrigated agricultural drainage as a key source of water quality degradation in the lower San Joaquin Valley, specifically regarding drainage waters in the Panoche Fan area of the WWD (located in the vicinity west of Firebaugh and Mendota) as "unusable for beneficial purposes" (**Figure 7**).[20] Four years later, DWR discovered selenium in water sampled from this area. As discussed below, selenium is the natural mineral trace element that later caused the ecological disaster at Kesterson Reservoir. In 1961, scientists with the U.S. Department of Agriculture reported on the high probability of selenium in alkali soils, such as those prevalent in the arid San Joaquin Valley. The USFWS warned Reclamation the following year about the risks of toxins bioaccumulating in various organisms exposed to agricultural drainage, as well as the potential harms posed to humans that consumed them. In 1963, the USFWS likewise warned that agricultural contaminants rendered irrigation drainage water unsuitable for wetlands habitat restoration. That same year, the agency further warned that impounded agricultural irrigation drainage water would likely contaminate groundwater, a warning reissued in 1977 by the California State Water Resources Control Board (SWRCB), which determined that the groundwater below Kesterson would ultimately be contaminated should the area continue to serve as the terminus of the San Luis Drain.[21]

[19] Reclamation, "Designers' Operating Criteria: San Luis Drain," 7; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 212-213; S. M. Benson, M. Delamore, and S. Hoffman, "Kesterson Crisis: Sorting Out the Facts" (prepared for the U.S. Department of Energy under Contract Number DE-AC03-76SF00098, July 1990), 2; U.S. Department of the Interior, "Kesterson Reservoir Closure and Cleanup Plan: State Water Resources Control Board Order No. WQ 85-1 for Cleanup and Abatement of Kesterson Reservoir" (July 5, 1985), 2-3; Arnold Schultz, "Background and Recent History," in *Selenium and Agricultural Drainage: Implications for San Francisco Bay and the California Environment, Proceedings of the Second Selenium Symposium, March 23, 1985, Berkeley, California* (Berkeley, California: Bay Institute of San Francisco, 1986), 6.

[20] DWR, "Lower San Joaquin Valley Water Quality Investigation: Bulletin No. 89" (Sacramento: California Department of Water Resources, 1960), 95, qtd. in Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 215.

[21] H. W. Lakin, "Geochemistry of Selenium in Relation to Agriculture," in Selenium in Agriculture" (Washington, D.C.: U.S. Department of Agriculture, Agricultural Research Service, Agriculture Handbook No. 200, 1961), 12; S. B. Moore, "Fish and Wildlife Resources and Agricultural Drainage in the San Joaquin Valley, California: Vol. 1" (Sacramento: San Joaquin Valley Drainage Program, 1990), 3-6; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 215.

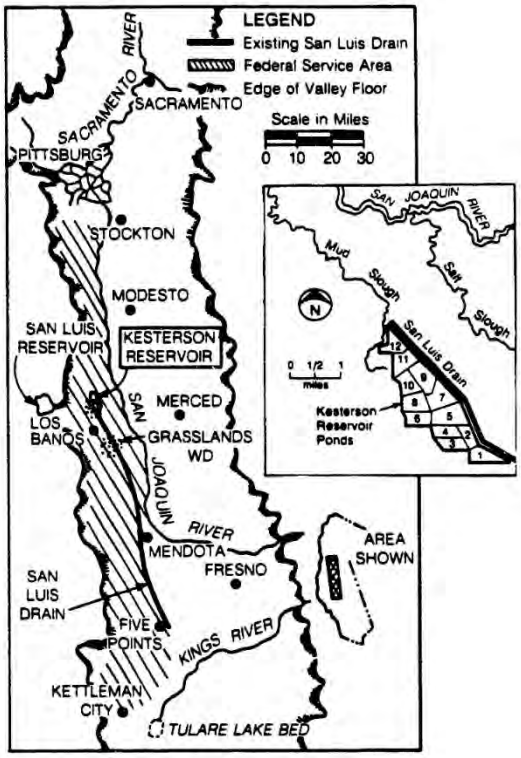


Figure 6: Location map of Kesterson Reservoir, Merced County, showing 12 evaporation ponds in inset, ca. 1990.[22]

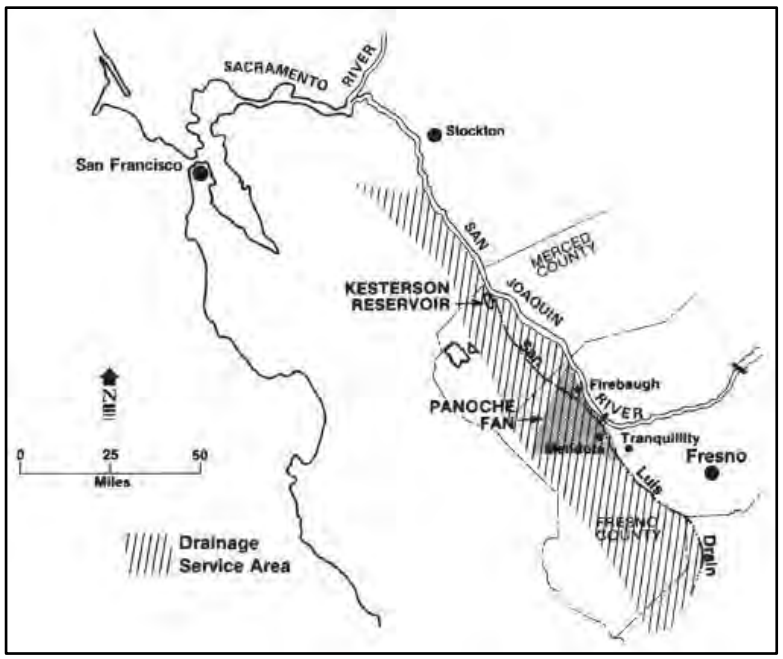


Figure 7: Map of San Luis drainage service area, showing Panoche Fan area—source of high quantities of selenium that contaminated Kesterson Reservoir.[23]

[22] Benson, Delamore, and Hoffman, "Kesterson Crisis," 2.
[23] U.S. Bureau of Reclamation, untitled map of San Luis drainage service area, no date, reprinted in Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 207.

As various agencies had warned, discharging subsurface irrigation drainage via the SLD for indefinite storage in the wetland habitat at Kesterson had disastrous consequences. In 1982 following four years of receiving WWD wastewater in the SLD that was sent to Kesterson Reservoir, perennial cattails were dying off, algal blooms were present throughout the pond complex, the migratory bird population had decreased substantially, and all but one fish species—the mosquitofish—had completely died off. Scientists found the highest recorded selenium concentrations of any living fish among Kesterson mosquitofish. The following summer, USFWS biologists reported that roughly 10 percent of all nests among Kesterson's resident waterfowl breeding populations contained one or more chicks with various developmental deformities. Noting multiple similarities between these deformities and those reported among chicken populations in South Dakota raised on seleniferous soils in the 1930s, the USFWS issued a series of memoranda calling attention to the growing crisis at Kesterson and expressing concern over using agricultural wastewater for habitat management. Around this time, the USFWS closed the Kesterson wildlife refuge to the public and began a hazing program to ward off migrating waterfowl. The following year, scientists also found adult birds dead from selenium poisoning, with one final estimate of at least 1,000 migratory birds, including adults, chicks, and embryos having died of selenium toxicosis from bioaccumulation between 1983 and 1985; scientists have since come to refer to these symptoms of selenium poisoning as the "Kesterson Syndrome." In August 1983, U.S. Geological Survey (USGS) scientists conducted tests in the Kesterson collection ponds, the San Luis Drain, drainage effluents, and shallow groundwater, finding dangerous levels of selenium—140-1,400 micrograms per liter (µ/L), as opposed to that found in typical freshwater, 0.2-0.4 µ/L. Additional testing by the USGS found elevated levels of selenium throughout the WWD service area, from Los Banos to Kettleman City. In September, regional media picked up the Kesterson story and followed the unfolding saga for the next few years—the story even featured on CBS' *60 Minutes*, which fueled public outrage with graphic images of deformed birds and reports of bureaucratic negligence. In March 1984, adjoining landowners, discovering sick and deformed birds on their property, petitioned the Central Valley Regional Water Quality Control Board and ultimately, the SWRCB to take enforcement action against Reclamation.[24]

Compelled by state authorities, Reclamation finally addressed the crisis at Kesterson. Following two hearings in December 1984 and February 1985, and under the authority of the state Porter-Cologne Water Quality Control Act and the Toxic Pits Cleanup Act of 1984, the SWRCB issued Cleanup and Abatement Order No. WQ 85-1, which required the U.S. Department of Interior to resolve the problems at Kesterson and ordered Reclamation to submit a cleanup and abatement plan within five months. The following month, at a House Subcommittee on Water and Power Resources congressional hearing in Los Banos, the Department of Interior dramatically announced its decision to close Kesterson Reservoir and the San Luis Drain and to immediately cease all irrigation water deliveries to the WWD service area that drained into Kesterson for fear of violating the Migratory Bird Treaty Act. Shortly thereafter, Department of Interior amended this arrangement with WWD, which pledged to reduce the export of drainage wastewater by 20 percent every two months beginning in September 1985, plugging all subsurface drains by July 1986. In October 1986, Reclamation, in cooperation with the USFWS and the U.S. Army Corps of Engineers, submitted its environmental impact statement for the Kesterson cleanup project, which offered four solutions, ordered least to most expensive: a flexible response plan; an immobilization plan; a wetland restoration / onsite disposal plan; and an offsite disposal plan.[25] Reclamation proposed a phased approach, graduating from the flexible response plan to the onsite disposal plan as necessary. The SWRCB rejected the phased approach and ordered Reclamation to implement the onsite disposal plan, which called for the excavation, disposal, and replacement of the uppermost six-inch soil layer, including vegetation. However, subsequent studies showed that selenium had concentrated in shallow groundwater at comparable levels to the drainage ponds, indicating that their release into the wetland would render the ponds as toxic as before. Therefore, in July 1988 the SWRCB ordered Reclamation to fill all low-lying areas where ephemeral pools formed six inches above the

[24] Michael K. Saiki, "Concentrations of Selenium in Aquatic Food Chain Organisms and Fish Exposed to Agricultural Tile Drainage Water," in *Selenium and Agricultural Drainage: Implications for San Francisco Bay and the California Environment, Proceedings of the Second Selenium Symposium, March 23, 1985, Berkeley, California* (Berkeley, California: Bay Institute of San Francisco, 1986), 6; Theresa S. Presser and Ivan Barnes, "Selenium Content in Waters Tributary to and in the Vicinity of Kesterson NWR" (Menlo Park, California: U.S. Geological Survey, 1984), 16; Deborah Blum, "Mineral is Linked to Bird Deformities," *The Fresno Bee* (September 21, 1983): 1; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 217-231.

[25] U.S. Bureau of Reclamation, "Final Environmental Impact Statement, Kesterson Program, Merced and Fresno Counties, California" (Sacramento: U.S. Department of the Interior, Bureau of Reclamation, 1986).

expected seasonal groundwater level by January 1, 1989. By November 1988, Reclamation contractors had filled about 710 low-lying acres of the former reservoir with 1,050,437 cubic yards of imported earth, converting the former wetland to an upland habitat and attracting a variety of terrestrial bird species. By the early 1990s, selenium concentrations among plants and animals at Kesterson had stabilized.[26]

The Kesterson disaster fundamentally transformed scientific understanding of selenium-contaminated irrigation drainage, spurring advances in environmental research, wetlands preservation, and governmental policy. Prior to Kesterson, selenium contamination research was largely confined to problems at the individual farm scale, such as how the trace element contaminates crops and impairs livestock. However, following the demonstrated dangers of high selenium concentrations in irrigation drainage at Kesterson, environmental scientists better understood the problem to be an environmental protection issue at the watershed scale with major consequences for irrigation management throughout the western United States. California emerged (and remains) as a global center for selenium contamination research and environmental management. As early as 1985, government scientists began proactively testing for selenium concentrations throughout the Central Valley, with USFWS biologists detecting high rates of selenium poisoning among plants, insects, birds, and fish in the Tulare Basin. Around that same time, as part of the Department of Interior's National Irrigation Water Quality Program, scientists investigated all federal irrigation and drainage facilities for concentrated toxins, finding Kesterson-level rates of selenium toxicosis at five sites in the western United States. By the early 1990s, scientists had established firm links between human activity and high selenium concentrations, identifying sites of irrigated agriculture, mining, and fossil fuel refinement as areas of particular concern. Researchers likewise noted intensified rates of bioaccumulation and biomagnification in aquatic ecosystems, particularly wetland habitats like Kesterson, where selenite—one of the element's primary dissolved forms—was observed to readily concentrate in stagnant areas among various invertebrates and fish species before spreading up the food chain and throughout the ecosystem.[27]

In response to heightened awareness and a more refined understanding of aquatic selenium contamination, environmental managers in California and elsewhere developed new water quality regulations and environmental management strategies. In 1987, the U.S. Environmental Protection Agency (EPA) established new criteria for imposing maximum limits for selenium concentrations in freshwater and saltwater environments, based partly on observed laboratory results and partly on field studies—including those conducted at Kesterson Reservoir. These standards were made legally binding for 14 states, including California, with the promulgation of the 1992 Water Quality Standards. Noting excessive selenium concentrations in the area surrounding Kesterson, between 1988 and 1990 the California Legislature added 8,224 acres of grasslands watershed marshes, a section of the lower San Joaquin River downstream from subsurface drainage, Salt Slough, and Mud Slough to California's Clean Water Act section 303(d) list of impaired waters. In 1996, Reclamation and the San Luis & Delta-Mendota Water Authority developed the Grasslands Bypass Project to rectify this problem in accordance with total maximum daily load limits for selenium and best management practices introduced that same year by the Central Valley Regional Water Quality Control Board. The Grasslands Bypass Project incorporates the northernmost 28 miles of the San Luis Drain in Merced County to discharge drainage water into Mud Slough for release into the San Joaquin River. Discharges are closely and regularly monitored for selenium, salinity, boron, molybdenum and various nutrients by the USFWS, California EPA, the Central Valley Regional Water Quality Control Board, and California Department of Fish and Wildlife.[28] According to Reclamation, "Since

[26] Garone, "The Tragedy at Kesterson Reservoir," 122-123; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 229.

[27] Matteo Francesco Kausch, "From Soil Aggregate to Watershed, from California's Central Valley to the Salton Sea – Agricultural Selenium Contamination Across Ecosystems, Scales, and Disciplines" (PhD. diss., University of California, Berkeley, Spring 2013), 9-13; Arnold Schultz, "Highlights Since Selenium II," in *Selenium and Agricultural Drainage: Implications for San Francisco Bay and the California Environment, Proceedings of the Third Selenium Symposium, March 15, 1986, Berkeley, California*, ed. Alice Q. Howard (Berkeley, California: Bay Institute of San Francisco, 1989), 5, 7; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 231-235.

[28] Kausch, "From Soil Aggregate to Watershed, from California's Central Valley to the Salton Sea," 9-13; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 231-235; U.S. Environmental Protection Agency, "Ambient Water Quality Criteria for Selenium – 1987" (EPA-440/5-87-006, September 1987), 25, available at https://www.epa.gov/sites/default/files/2019-03/documents/ambient-wqc-selenium-1987.pdf (accessed August 2022); U.S. EPA, "Section 319: Nonpoint Source Program Success Story

the implementation of the [Grasslands Bypass Project], all discharges of drainage water from the Grassland Drainage Area into wetlands and refuges have been eliminated. The Project has reduced the load of selenium discharged from the Grassland Drainage Area by 61 percent (from 9,600 lbs. to 3,000 lbs.)."[29] Perhaps most importantly, the disaster at Kesterson illustrated an urgent ecological need to reform the CVP—which had historically served the interests of agribusinesses—to incorporate environmental stewardship among its mandates. In 1992, the U.S. Congress passed the Central Valley Project Improvement Act (CVPIA) into law, which mandated reform of the CVP to better protect, restore, and enhance fish and wildlife habitat by placing environmental goals on par with irrigation and domestic water usage. Some environmental policy changes implemented under the Act include: the dedication of 800,000 acre-feet of water per year to fish and wildlife along with firm water commitments to Central Valley wildlife refuges; the restoration of anadromous fish populations; the establishment of a habitat restoration fund financed by water and power users; and the installation of mitigative technology at various sites, including temperature control devices and fish passage infrastructure. The Act also stipulates that the CVP would establish no new contracts until it had achieved its environmental goals. Since the passage of the CVPIA, Reclamation, in partnership with various federal, state, and local agencies, has implemented aquatic habitat improvement projects on the American, Stanislaus, Yuba, and Upper Sacramento rivers and Clear, Mill, and Deer creeks; provided annual water allotments and upgraded or built conveyance facilities to 19 federal, state, and private managed wetlands; and funded independent restoration programs on the San Joaquin and Trinity rivers through the habitat restoration fund.[30]

NRHP / CRHR Evaluation

Criteria for Evaluation

The eligibility criteria for designating historic properties under federal and state criteria are essentially the same. The criteria for listing properties in the National Register of Historic Places (NRHP) are codified in 36 CFR 60 and expanded upon in numerous guidelines published by the National Park Service. Buildings, structures, objects, sites, and districts listed in, eligible for listing in, or that appear eligible for listing in the NRHP are considered historic properties under the regulations for Section 106 of the National Historic Preservation Act (NHPA). Eligibility for listing buildings, structures, objects, sites, and districts (i.e., historic properties) in the NRHP rests on twin factors of *historic significance* and *integrity*. A resource must have both significance and integrity to be considered eligible. Loss of integrity, if sufficiently great, will overwhelm the historic significance a property may possess and render it ineligible. Likewise, a property can have complete integrity, but if it lacks significance, it must also be considered ineligible. Historic significance is judged by applying the NRHP criteria, identified as Criteria A through D. The NRHP guidelines state that a historic property's "quality of significance in American history, architecture, archeology, engineering, and culture" must be determined by meeting at least one of the four main criteria. Properties may be significant at the local, state, or national level. The NRHP criteria are:

Criterion A: association with "events that have made a significant contribution to the broad patterns of our history;"

Criterion B: association with "the lives of persons significant in our past;"

– California Grasslands Bypass Project Reduces Selenium in the San Joaquin Basin" (September 2011), https://www.epa.gov/sites/default/files/2015-10/documents/ca_sanjoaquin.pdf (accessed August 2022).

[29] U.S. Bureau of Reclamation, "Grassland Bypass Project," July 29, 2020, https://www.usbr.gov/mp/grassland/ (accessed August 2022).

[30] U.S. Bureau of Reclamation, " Central Valley Project Improvement Act (CVPIA)," April 27, 2022, https://www.usbr.gov/mp/cvpia/ (accessed August 2022); U.S. Bureau of Reclamation, "Central Valley Project Improvement Act: Fact Sheet," October 2021, https://www.usbr.gov/mp/mpr-news/docs/factsheets/cvpia.pdf (accessed August 2022); U.S. Bureau of Reclamation, "CVP Habitat Restoration," February 2022, https://www.usbr.gov/mp/mpr-news/docs/factsheets/habitat-restoration.pdf (accessed August 2022); California Department of Fish and Wildlife, "Refuge Water Supply Program," n.d., https://wildlife.ca.gov/Conservation/Watersheds/Refuge-Water (accessed August 2022).

Criterion C: resources "that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values;"

Criterion D: resources "that have yielded, or may be likely to yield, information important to history or prehistory."[31]

Integrity is determined through applying seven factors to the historic resource: location, setting, design, workmanship, materials, feeling, and association. These seven can be roughly grouped into three types of integrity considerations. Location and setting relate to the relationship between the property and its environment. Design, materials, and workmanship, as they apply to historic buildings, relate to construction methods and architectural details. Feeling and association are the least objective of the seven criteria and pertain to the overall ability of the property to convey a sense of the historical time and place in which it was constructed.

Central Valley Project Draft Multiple Property Listing

In 2009, Reclamation prepared a *Draft National Register of Historic Places Multiple Property Documentation Form: Central Valley Project* (CVP MPL).[32] The CVP MPL identifies the period of significance for the CVP as 1935 when the project received its first authorizations to 1956 when the last of the major project components was completed. However, as stated, "This MPL is also designed to be easily amended as more project engineering features become historic," as with the multiple elements that comprise the San Luis Unit, the bulk of which were constructed by the late 1960s, and the San Luis Drain, which was constructed between 1969 and 1973—all of which were identified in the section "CVP Engineering Features 1957-2000: An Overview."[33] The document provides registration criteria regarding NRHP significance and integrity. The subsections of the registration requirements relied upon for this evaluation of San Luis Drain for individual eligibility for listing in the NRHP are the subsections for "Canals" and "Drains" as quoted below.[34] The NRHP and CRHR evaluation of San Luis Drain contained in this report utilizes in part the framework provided in the CVP MPL.

The following is excerpted from the CVP MPL:

Main Canals

Main canals form the CVP's primary arteries. These canals consist of Contra Costa (the first built and operational), Madera, Delta-Mendota (both intake and distribution sections), Delta Cross Channel, and the Friant-Kern, all built and operational before 1952. The longest main canal is the Friant-Kern Canal at 151.8 miles, while the shortest is the Delta Cross Channel at 1.2 miles. All main canals are located on Reclamation fee title or easement land.

Appurtenant Features: Conveyance; Regulating; Water Management; Protective; and Miscellaneous Structures and Objects

1. Conveyance Structures

Conveyance structures are features such [as] inverted siphons, drops, chutes, flumes, tunnels, and pipelines that are used to safely transport water from one location to another traversing various existing natural and manmade topographic features along the way.

2. Regulating Structures

[31] USDI, National Park Service, *Guidelines for Applying the National Register Criteria for Evaluation, National Register Bulletin 15* (Washington, D.C.: USDI, National Park Service, 1990, rev. 1997).
[32] Jim Bailey, "National Register of Historic Places Multiple Property Documentation Form, Central Valley Project: Planning and Construction of the First Four Divisions, 1935-1956," draft prepared for Reclamation, 2009, updated 2018.
[33] Bailey, draft CVP MPL (2009, updated 2018), 100-105, 107.
[34] For San Luis Drain, this evaluation uses the CVP MPL evaluative framework for "canals" and "drains," the latter classification largely grouped with minor lateral and sub-lateral canals, because the drain recorded on this form is an explicitly identified engineering feature—the only drain identified as such in the document—and possesses numerous appurtenant structures; Bailey, draft CVP MPL (2009, updated 2018), 105.

Regulating structures are used to raise, lower, or control the release and volume of the water flow. Regulating structures that are located at the source of the water supply include headworks and turnouts. Headworks control the release of water into the canal and are often located downstream from a major diversion or storage facility. Regulating structures located along the course of a canal include turnouts, checks, check-drops, and diversion structures. The smaller regulating structures like checks and turnouts are basic components of an irrigation system.

3. Protective Structures

Protective structures protect the canal system and adjacent property from damage which would result from uncontrolled storm runoff or drainage water, or an uncontrolled excess of flow within the canal. Several different types of structures perform this function, including overchutes, drainage inlets, siphon spillways, and wasteways.

4. Water Measurement Structures and Objects

Water measurement structures are used to gauge water flow and ensure its equitable distribution. Many different types of water measurement structures are used in irrigation systems. The type most commonly used in Reclamation systems are Parshall flumes, weirs, open-flow meters, and constant head orifices.

Drains

Drains are water conveyance structures (either open channels or buried pipes) that carry excess water away from irrigated agricultural fields to prevent rising water tables. A drain classification was instituted by Reclamation in 1920 that categorized drains into three classes according to their size and relative importance. Class I or "deep drains" are the largest and most significant, with Class III being the smallest and least significant.[35]

Significance

In conjunction with the storage and diversion dams, canals form the CVP's backbone. They provide the means to transfer, transport, and deliver water through the system and ultimately to the water users. Traversing across hundreds of miles, the canals form a significant feature of the physical landscape and define the geographical limits of the project. In keeping with the original CVP plan of large-scale water transfers, canals are the primary means behind the geographical redistribution of fresh water from the valley's wetter northern reaches to the drier southern stretches.[36]

The need for continual maintenance and repairs to canals requires special consideration of integrity. Irrigation systems are constantly evolving as features are upgraded, repaired, or replaced. Alterations made to canals during the period of significance and even subsequent to that may not nullify eligibility if a canal retains certain basics. Most important are integrity of location, association, and overall design configuration of the prism (i.e. depth and width). A canal which has retained its original form and associated appurtenant features has a high degree of integrity. It is not uncommon for a canal lining to be replaced, or for previously unlined segments to be lined. Such changes may not preclude a canal's eligibility if they do not significantly damage the canal's historic association or its overall design. If in addition to integrity of association, location, and overall design, the historical setting and feeling of a canal are maintained, then the likelihood is even higher that an altered canal would be eligible. On the other hand, if an entire canal is piped, it would no longer convey any of its original design, workmanship, materials, or historical association and would not be contributing. Conversely, partial piping of a significant canal may not preclude eligibility if a majority of a canal is still open and intact.[37]

Secondary to the canals in distributing water are the thousands of laterals and their appurtenant features. As with canals, many appurtenant features are upgraded, altered, or even replaced over time due to the constant ongoing maintenance needs. For laterals to be considered contributing, they must exhibit a high level of integrity, and serve as principal laterals or incorporate a larger number of contributing appurtenant features. Because of the vast number of appurtenant features and the many miles of laterals, it may only be appropriate to identify representative samples of contributing elements. In unusual cases, laterals

[35] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 124.
[36] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 125.
[37] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 126-127.

and appurtenant features may have individual significance if they are: surviving examples of a rare type of design or construction; of innovative engineering design that impacted subsequent designs; or were specifically designed to meet an unusual engineering challenge.[38]

Sub-lateral canals and their branches are not considered as contributing resources to the CVP. The small size of sub-laterals does not make a significant contribution to the function or design of the CVP and are not individually eligible. Sub-laterals could, however, be eligible if they are associated with a historic farm or district where the impact the lateral has in combination with the other resources is substantial.[39]

The evaluation of the significance of drains is similar to that of laterals. The principal, or Class I drains, are contributing features if they retain a high level of integrity and fall within the period of significance. Class II and III drains are not considered contributing resources. In unusual cases, drains may have individual significance if they fall within the period of significance and are: rare, surviving examples of a type of design or construction, of innovative engineering design that impacted subsequent designs, or were specifically designed to meet an unusual engineering challenge. Like laterals and sub-laterals, drains are considered as ineligible components of the CVP.[40]

Registration Requirements

The period of significance for historic CVP water conveyance structures begins in 1937 with the initial construction of the first CVP canal, the Contra Costa Canal, and ends in 1952 with the completion of the Friant-Kern, Delta-Mendota, and Delta Cross Channel canals. Like the dams, these canals are part of the initial CVP authorizations.[41]

Water conveyance structures with adequate integrity are considered eligible as part of the multiple property listing for the National Register for the following reasons:

Criterion A: They have had a significant impact on the settlement, agricultural economy, or development patterns of the project area; they have been defining elements in the evolution of the cultural landscape; they are directly associated with important events.

Criterion B: They are the result of the direct efforts of a prominent individual associated with the CVP and are the most prominent feature associated with that individual.

Criterion C: They represent the distinctive characteristics of Reclamation canal design and/or methods of construction used on the CVP; they involved challenging engineering design problems due to topography, grade, length, natural obstacles, and resulted in complex or innovative solutions; they are among the best or a rare surviving example of a distinctive type of water conveyance structure; they represent the evolving technology in design of water conveyance structures; they were identified during the construction period as an individually significant feature; or they embody the work of a significant engineer or builder.

Criterion D: They have the ability to yield information important to understanding the history of the CVP. None of the CVP water conveyance structures are eligible under this criterion.[42]

Evaluation

The following evaluates two point-observations and one linear segment of the San Luis Drain together for individual eligibility for listing in the NRHP and CRHR under the themes and within the framework presented above. This evaluation concludes that the San Luis Drain is historically significant under NRHP / CRHR Criterion A / 1 at the national level for its important association with the ecological disaster at Kesterson Reservoir, an historically significant event that profoundly impacted subsequent governmental policies toward drainage and wildlife habitat management. While this evaluation concludes that the

[38] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 127.
[39] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 127.
[40] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 128.
[41] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 129.
[42] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 129.

San Luis Drain meets NRHP and CRHR criteria, it does not conclude that the entire multi-component resource is eligible for listing in the NRHP and CRHR because assessing the integrity of any part of the San Luis Drain beyond the APE for the project cited in *P11 is outside the scope of this project. This evaluation assesses the historic integrity of one linear segment and two point-observations of the San Luis Drain in and adjacent to the APE and concludes that they retain historic integrity to their period of significance, 1982-1988, and would be contributing elements of the overall San Luis drainage system if the entire linear resource is found to possess sufficient integrity to be listed.

Criteria A and 1

The San Luis Drain does not possess significance under these criteria for its involvement with the CVP. The San Luis Drain, an integral but short-lived component of the San Luis Unit of the CVP, returned subsurface irrigation drainage water from irrigation districts within the San Luis service area between 1972 and 1986. Following decades of lobbying by agricultural interests in the region, Reclamation was authorized in 1960 to deliver irrigation water to the western San Joaquin Valley with the formation of the San Luis Unit, a first in federal-state joint-use facilities. In addition to rallying support for supplementing their depleted groundwater sources with CVP surface water, local irrigators also lobbied for the addition of critical drainage facilities, as the rising groundwater table of highly saline subsurface irrigation wastewater threatened to drown crops and sterilize thousands of acres of valuable agricultural lands. During planning, the San Luis Drain sparked controversy among residents in the San Francisco Bay Area and Sacramento-San Joaquin Delta, where the drain was originally planned to discharge near Antioch in Contra Costa County. Following years of negotiations and federal budgetary constraints, the San Luis Drain was ultimately built out to about half of its intended length, roughly 88 miles, and rather than discharging into the Delta, irrigation wastewater containing high levels of toxic selenium was instead pooled in a complex of evaporation ponds at Kesterson Reservoir near Gustine in Merced County. Following high rates of deformity and death among migratory and nesting waterfowl and other wetland species at Kesterson (discussed below), Reclamation discontinued use of the San Luis Drain and reservoir. The San Luis Drain failed to meet the drainage needs of the San Luis service area, was effectively retired, and is thus not eligible for listing in the NRHP or CRHR under these criteria for its involvement with the CVP.

However, under these same criteria, the San Luis Drain possesses significance for its important association with the ecological disaster at Kesterson Reservoir in the early to mid-1980s and the associated subsequent advances in environmental research / wetlands preservation, along with shifts in governmental reclamation policies and the broadening of CVP's attention to encompass ecological issues that went well beyond its previous focus centered on the interests of agribusiness in the western San Joaquin Valley. According to *National Park Service National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation*, properties like San Luis Drain, the significant associations of which have occurred within a period of less than 50 years ago, must also meet Criteria Consideration G. To meet Criteria Consideration G, the property needs to show that its associations within the last 50 years are of "exceptional importance."[43] The San Luis Drain appears to meet this high threshold, and sufficient historical perspective exists to demonstrate this significance. In the early 1980s, USFWS scientists began to discover high rates of embryonic and infant deformity and adult mortality among various plant, fish, and waterfowl species at Kesterson Reservoir, which they soon traced to toxic exposure to selenium, and as the tragedy unfolded, ultimately culminating in the retirement of the San Luis drainage system in 1986, the ecological crisis at Kesterson Reservoir garnered national attention. The disaster was dubbed an "avian holocaust," and it illustrated the extreme environmental risks posed by selenium-contaminated irrigation drainage, reframing the problem from an individual farm-scale issue to a watershed-level environmental protection crisis.[44] California emerged as a global center for selenium-contamination research and environmental management during this period, with scientists establishing firm links between human activity and sites of selenium concentration. In response, environmental managers at the federal, state, and regional levels instituted a growing body of water quality regulations that established maximum daily load limits for selenium among discharges of agricultural drainage, as illustrated by the Grasslands Bypass Project—a joint-state federal drainage program that monitors drainage for trace elements in the Central Valley Grasslands. Perhaps most importantly, the disaster at Kesterson dramatically illustrated

[43] National Park Service, *National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation*, 1990, rev. 1995, 41, 43.
[44] Harold E. Thomas, "Ode to the San Luis Drain," *Groundwater* 24, no. 1 (January 1986): 79.

the ecological burden that decades of unrestrained and federally subsidized agriculture had placed on the region, leading reformers to fundamentally transform the CVP—which had historically served the interests of agribusinesses—to incorporate environmental stewardship among its mandates. In 1992, the Central Valley Project Improvement Act (CVPIA) was passed into law, which, for the first time, placed wildlife habitat management on equal footing with the agricultural and industrial goals of the CVP. Since the passage of the CVPIA, Reclamation and its federal, state, and local partner agencies have implemented habitat improvement projects on the American, Stanislaus, Yuba, and Sacramento rivers and delivered CVP water to federal, state, and private managed wetlands throughout the state. Most importantly, it has ceased all drainage discharges into wildlife refuges.

As the structural vehicle for delivering selenium-contaminated subsurface irrigation drainage water to Kesterson Reservoir, the San Luis Drain possesses strong and meaningful associations with the Kesterson disaster, an environmental calamity of exceptional historical significance for the critical role it played in transforming governmental policy. Thus, the two point-observations and one linear segment of the San Luis Drain recorded on this form contribute to its significance under these criteria. The period of significance under these criteria dates from 1982, when USFWS scientists first detected selenium toxicosis among various plant and animal species at Kesterson, and 1988, when the U.S. Department of Interior—having discontinued use of the San Luis drainage facilities—remediated the selenium contamination problem at Kesterson by dewatering and infilling the evaporation ponds.

Criteria B and 2

The CVP was the result of the efforts of many individuals and agencies over many years and no one person or group of people rises in the historical record as playing a direct role in its implementation in a way that would be best demonstrated by San Luis Drain; therefore, San Luis Drain is not individually eligible for listing in the NRHP under Criterion B or in the CRHR under Criterion 2.

Criteria C and 3

San Luis Drain does not possess individual eligibility for listing in the NRHP and CRHR under Criterion C or Criterion 3. While the San Luis Drain is a rare structural type (interceptor drain) within the CVP, construction of the structure was ultimately not completed to its full schematics, and it failed to adequately remedy the regional drainage problem (which persists to the present). Originally planned to span 188 miles between Kettleman City in Kings County to a discharge point near Antioch in Contra Costa County, construction on the San Luis Drain was impeded by political opposition and budgetary constraints, and it was ultimately built out to 88 miles—less than half the intended span—from a point near Five Points in Fresno County to the Kesterson Reservoir outside of Gustine in Merced County. The structure is a largely non-operational concrete-lined trapezoidal channel with numerous appurtenant structures—such as checks, siphons, and crossings. The San Luis Drain was designed and built to receive and convey subsurface drainage water from regionally distributed drainage collector systems that were operated by irrigation districts, which in turn collected drainage from underground pipe networks lain on private farms. The San Luis drainage system has largely been retired as designed. It not only was not built out to its full extent, but it also did not meet its the drainage objectives, and thus does not possess significance for its engineering.

Under these same criteria, the San Luis Drain is likewise not significant for its construction methodology. Reclamation had employed large industrial trimmers for canal excavation for decades prior to the construction of the drain recorded on this form. During construction of the Delta-Mendota Canal in particular, contractors navigated the same issues relating to the regional groundwater table elevated above the canal trench. While construction on the San Luis Drain innovated upon and in many ways streamlined earlier methods, this effort did not introduce fundamentally new technologies or methodologies. Therefore, the drain recorded on this form does not possess individual significance in this regard.

Also considered under these criteria, San Luis Drain does not represent the important work of a master engineer or builder. Lead project engineer for San Luis Drain, Edward J. Brannan joined Reclamation in 1937 as a transitman on the Columbia Basin Project before he was promoted to construction engineer on the Spokane Valley Project in Washington in 1965 and ultimately the San Luis Drain in the late 1960s and early 1970s. Brannan does not appear to have developed new designs but

rather follow the standardized designs drafted earlier by Reclamation engineer Harry Raymond McBirney.[45] Additionally, Gordon H. Ball, Inc., and Ball, Ball & Brosamer, who collectively won three construction contracts for San Luis Drain comprising nearly 80 percent of the extant structure (69.51 miles) in addition to Kesterson Reservoir, were the companies responsible for the largest share of the drain's construction. While they were prolific contractors, there is insufficient evidence to support Gordon H. Ball and Ball, and Ball & Brosamer, as master builders. Moreover, both firms appear to have specialized in heavy highway construction, not canal building. While construction of San Luis Drain was a large undertaking for the companies, it does not best represent their body of work. They were most known during the 1960s and 1970s for construction of highways, runways, and general concrete work. San Luis Drain would not best represent the work of any of the other contractors who won contracts for San Luis Drain because their contributions to the project were only to a small fraction of the overall project. For these reasons, the drain recorded on this form is not individually eligible for listing in the NRHP or CRHR under these criteria.

Criteria D and 4

San Luis Drain is not eligible under NRHP Criterion D or CRHR Criterion 4 for information potential because it was designed and built according to well-documented practices, and the project is well documented through drawings, textual records, and photographs.

Character-defining Features, Integrity, and Boundary of San Luis Drain

In general, the character-defining features of the recorded segment of the San Luis Drain are its alignment, the size, shape, and dimensions of the canal prism, and its concrete lining material. Individual elements within the study area that contribute to the significance of San Luis Drain along the approximately five-mile recorded segment are those structures that are directly related to its significance under NRHP Criterion A / CRHR Criterion 1, i.e. structures that directly relate to the conveyance of subsurface irrigation drainage water from the southern terminus in Fresno County north to Kesterson in Merced County. Structures like check structures and siphons that convey and control the water's northerly flow all related directly to the drain's significance and purpose and therefore contribute to the significance of the historic property. Structures in the study area that accommodate pre-existing uses like the Drain U-121.2 undercrossing and trapezoidal road crossing do not contribute to the historical significance of this linear historic property because they are not directly related to the conveyance of subsurface irrigation wastewater, and instead serve ancillary purposes.

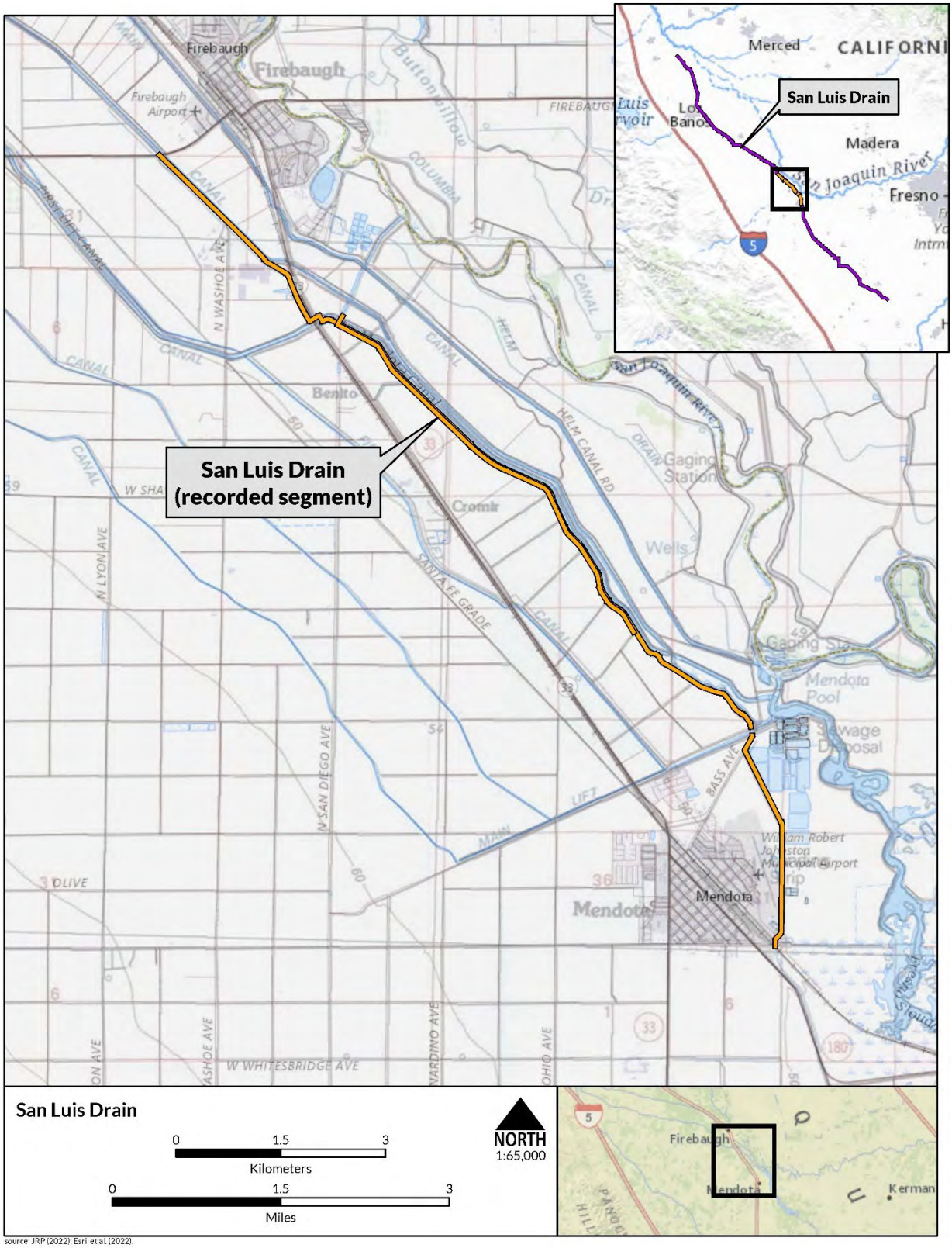
The recorded segment of the San Luis Drain along with its contributing structures all retain historic integrity to their period of significance, 1982-1988, and would contribute to the overall resource if the San Luis Drain possesses sufficient integrity throughout its span. In terms of design and setting, the recorded segment of the San Luis Drain remains in its original location, the setting of which remains defined by flat rural farmland. In terms of design, materials, and workmanship, research did not reveal that any substantial modifications have been made to any of the character-defining features that would reduce the integrity of this segment of the study property. While it is unclear when some inlets were added to the structure, these additions are comparably minor and do not detract from the overall feeling of the resource. The recorded drain segment suffers diminished integrity of association because it is no longer operational.

The boundaries of the San Luis Drain are the channel's right-of-way, encompassing the canal prism and two flanking embankments, between the southern terminus—a point near Five Points in Fresno County—and the northern terminus at the former Kesterson Reservoir.

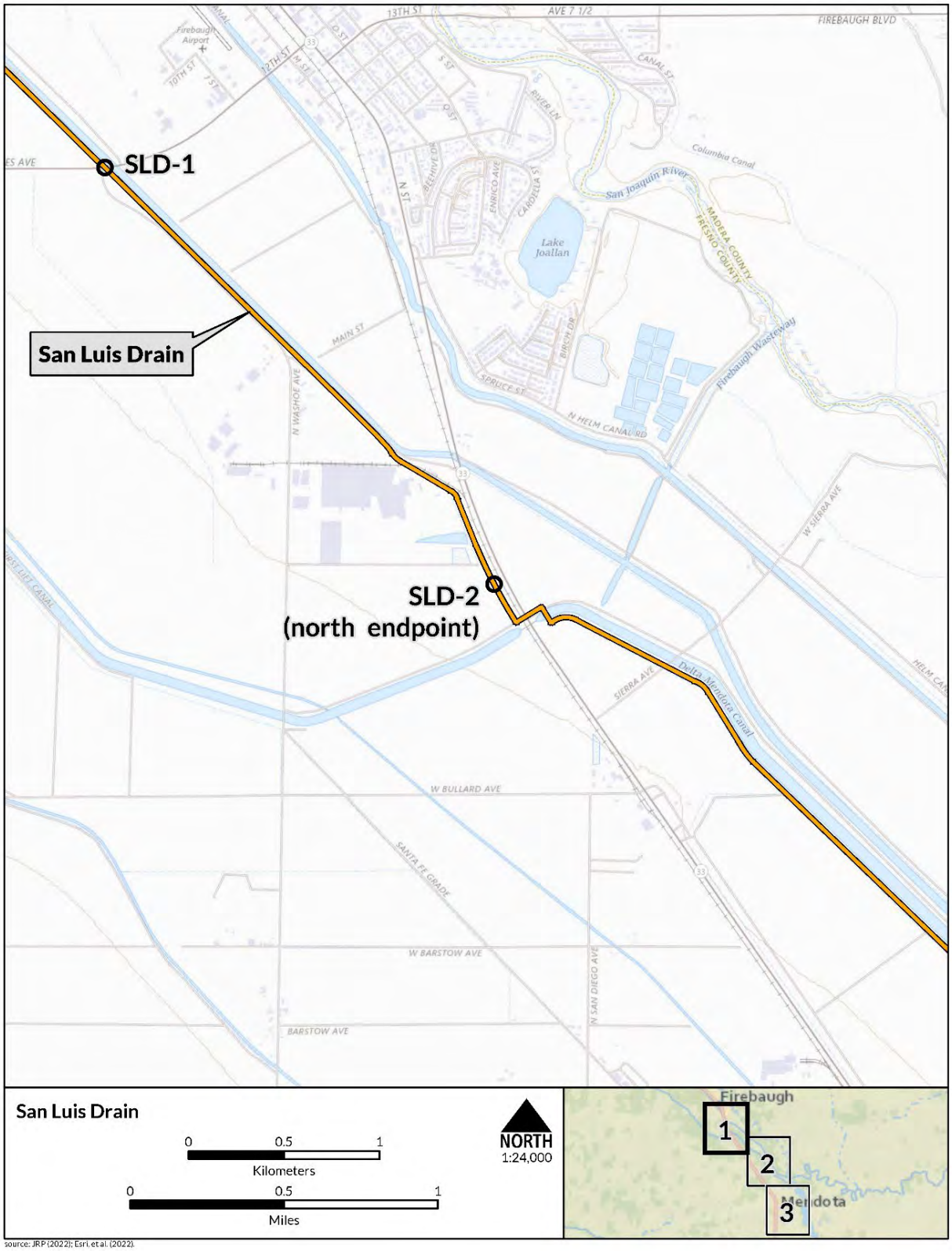
[45] "Water Project Post is Filled," *Spokane Daily Chronicle* (February 16, 1965): 3.

***Resource Name or #** (Assigned by recorder) San Luis Drain

***Map Name:** San Luis Drain – Recorded Segment ***Scale:** 1:24,000 ***Date of map:** 2022



source: JRP (2022); Esri, et al. (2022).

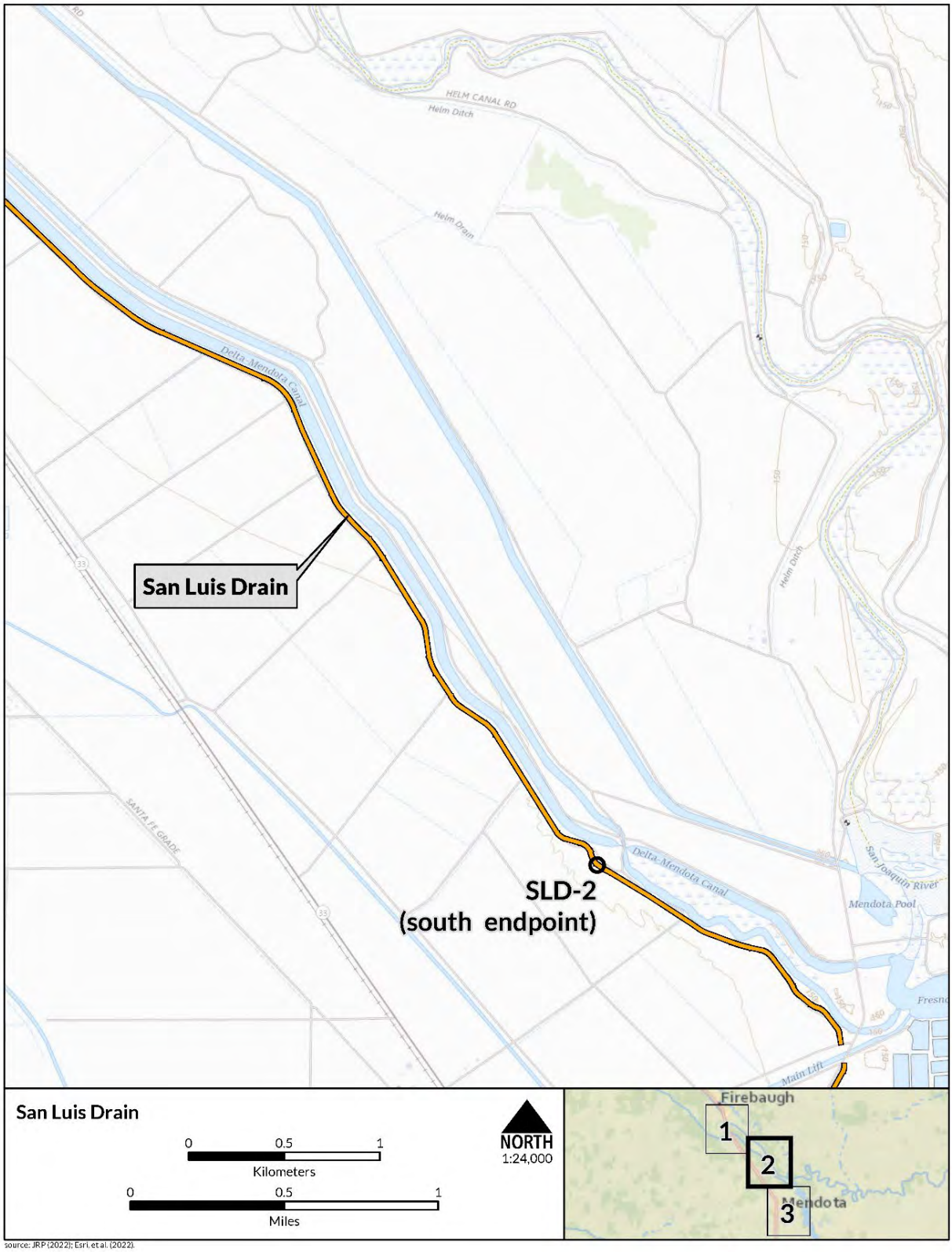


source: JRP (2022); Esri, et al. (2022).

***Resource Name or #** (Assigned by recorder) San Luis Drain

***Drawn by:** JRP Historical Consulting, LLC

***Date of map:** 2022

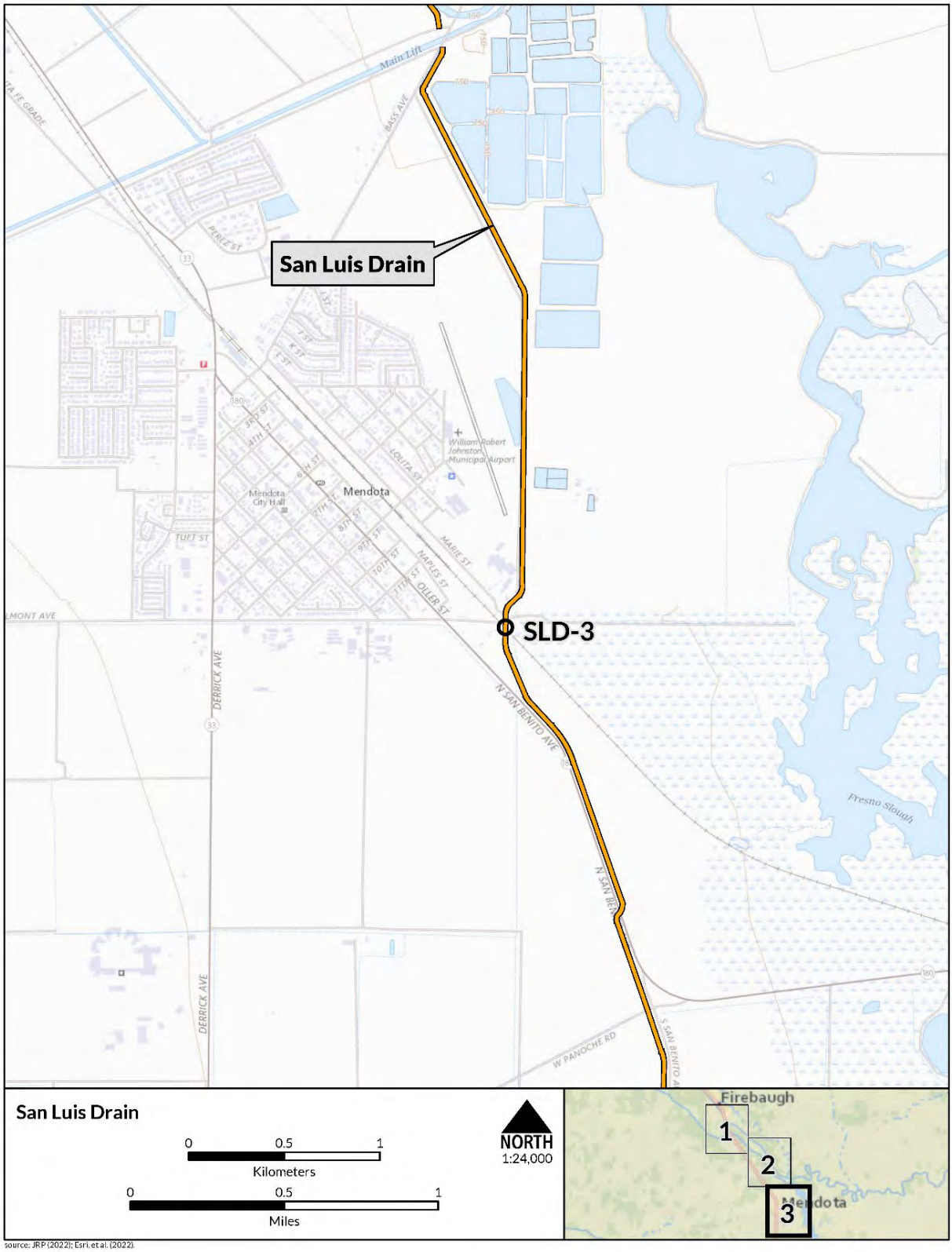


NOTE: Include bar scale and north arrow.

***Resource Name or #** (Assigned by recorder) San Luis Drain

***Drawn by:** JRP Historical Consulting, LLC

***Date of map:** 2022



State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary # _____
HRI # _____
Trinomial _____
NRHP Status Code 6Z
Other Listings _____
Review Code _____ Reviewer _____ Date _____

***Resource Name or #** (Assigned by recorder) Drain U-121.2

P1. Other Identifier: Drain U-121.2

***P2. Location:** ☐ **Not for Publication** ☒ **Unrestricted** ***a. County** Fresno

and (P2b and P2c or P2d. Attach a Location Map as necessary.)

***b. USGS 7.5' Quad** Firebaugh **Date** 2021 **T** 13S; **R** 14E; __ ¼ **of Sec** ; Mount Diablo **B.M.**

c. Address NA City Firebaugh (vic.) Zip _____

d. UTM: (give more than one for large and/or linear resources) Zone _____; _____mE/ _____mN

Segment recorded from Zone 10S, 728390.36mE / 4079117.19mN at the north, to Zone 10S, 732684.75mE / 4074696.30mN at the south.

e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate)

Assessor Parcel Numbers: 012-031-21ST; 012-030-33S; 012-060-59S; 012-070-25S

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries)

This form records Drain U-121.2, a component of the Firebaugh Canal Water District in western Fresno County, between Firebaugh and Mendota (**Photograph 1**). The entire drainage canal is located in and adjacent to the area of potential effects (APE) for the project cited in *P11. See the attached Linear Feature Record for a description of the resource.

***P3b. Resource Attributes:** (List attributes and codes) HP20 – Canal / Aqueduct

***P4. Resources Present:** ☐ Building ☒ Structure ☐ Object ☐ Site ☐ District ☐ Element of District ☐ Other (Isolates, etc.)

P5a. Photo or Drawing (Photo required for buildings, structures, and objects.)



P5b. Description of Photo: (View, date, accession #) **Photograph 1.** Upstream view of Drain U-121.2; camera facing southeast, July 20, 2022.

***P6. Date Constructed/Age and Sources:**
☒ Historic ☐ Prehistoric ☐ Both
ca. 1951; 1973 (Aero Exploration Co.; HistoricAerials.com; U.S. Bureau of Reclamation)

***P7. Owner and Address:**
Firebaugh Canal Water District
2412 Dos Palos Road / Highway 33
Mendota, CA 93640

***P8. Recorded by:** (Name, affiliation, address)
Samuel Skow & Danielle Baza
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

***P9. Date Recorded:** July 20, 2022

***P10. Survey Type:** (Describe) Intensive

***P11. Report Citation:** (Cite survey report and other sources, or enter "none.") JRP Historical Consulting, LLC, "Finding of Eligibility Delta-Mendota Canal Subsidence Correction Project," 2022, prepared for US Bureau of Reclamation and San Luis & Delta-Mendota Water Authority.

***Attachments:** ☐ None ☐ Location Map ☒ Sketch Map ☒ Continuation Sheet ☒ Building, Structure, and Object Record ☐ Archaeological Record ☐ District Record ☒ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐Other (list) _____

***NRHP Status Code** 6Z

***Resource Name or #** (Assigned by recorder) Drain U-121.2

B1. Historic Name: Firebaugh Canal Company Drain

B2. Common Name: Drain U-121.2

B3. Original Use: Drainage B4. Present Use: Drainage

***B5. Architectural Style:** Utilitarian

***B6. Construction History:** (Construction date, alteration, and date of alterations) Drain built ca. 1951; replacement drain constructed in parallel alignment 1973; drainage pipes, pumps, replacement trash screens added at unknown dates.

***B7. Moved?** ☒ **No** ☐ **Yes** ☐ **Unknown** **Date:** _____ **Original Location:** _____

***B8. Related Features:** None

B9. Architect / Engineer: U.S. Department of Interior (USDI), Reclamation, Central Valley Project, Delta-Mendota Canal / West San Joaquin Division – San Luis Unit

b. Builder: United Concrete Pipe Corp. and Vinnell Co., Inc.; Ball, Ball & Brosamer Co.

***B10. Significance: Theme** n/a **Area** n/a

Period of Significance n/a **Property Type** n/a **Applicable Criteria** n/a

(Discuss importance in terms of historical or architectural context as defined by theme, period, and geographic scope. Also address integrity.)

Drain U-121.2 does not meet the criteria for listing in the National Register of Historic Places (NRHP) or the California Register of Historical Resources (CRHR) because it is not historically significant within the context of the Central Valley Project (CVP) or the development of regional agriculture. It is not an historic property under Section 106 of the National Historic Preservation Act nor is it an historical resource for the purposes of the California Environmental Quality Act (CEQA). This resource has been evaluated in accordance with Section 106 of the National Historic Preservation Act of 1966 (as amended) (54 U.S.C. 306108) and its implementing regulations (36 CFR Part 800), and Section 15064.5(a)(2)-(3) of the CEQA Guidelines, using the criteria outlined in Section 5024.1 of the California Public Resources Code (see Continuation Sheet).

B11. Additional Resource Attributes: (List attributes and codes) _____

***B12. References:** U.S. Department of Interior, Reclamation, Central Valley Project, "Delta-Mendota Canal – Sta. 5200+00: Drain Siphon Crossing – Plan, Profile, and Sections," dwg. no. 214-D-16411, August 22, 1949, Specifications No. DC-2857, Reclamation Design & Construction Library, Sacramento, California; Declaration of Taking, United States of America vs. Redfern Ranches, No. F-232, October 4, 1968, 5629 O.R. 444, Fresno County Recorder, Fresno, California; see footnotes.

B13. Remarks:

***B14. Evaluator:** Samuel Skow, JRP Historical Consulting, LLC

***Date of Evaluation:** August 2022

(This space reserved for official comments.)

Sketch map with north arrow required

See Continuation Sheet.

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____

***Resource Name or #** (Assigned by recorder): Drain U-121.2

***Recorded by:** S. Skow and D. Baza

***Date:** July 20, 2022

L1. Historic and/or Common Name: Drain U-121.2

L2a. Portion Described: ☒ Entire Resource ☐ Segment ☐ Point Observation **Designation:** Drain U-121.2

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) Segment recorded from Zone 10S, 728390.36mE / 4079117.19mN at the north, to Zone 10S, 732684.75mE / 4074696.30mN at the south.

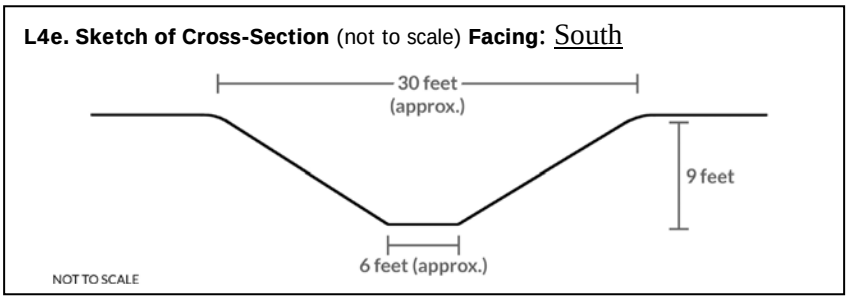
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)

Drain U-121.2 is an earth-lined drainage canal that extends roughly five miles from a point in the Northeast ¼, Section 24, Township 13 South, Range 14 East, Mount Diablo Base Meridian (NE ¼ Sec. 24, T13S / R14E, MDBM), northwesterly downstream in a parallel alignment to the adjacent San Luis Drain and Delta Mendota Canal (recorded and evaluated on separate DPR 523 forms appended to the report cited in *P11) to its northern terminus in the NW ¼, Sec. 3, T13S / R14E (**Photograph 2** and **Photograph 3**). Here, the drain is siphoned below the two canals named above into a discharge outlet on the northeast side of the Delta Mendota Canal adjacent to the Firebaugh Wasteway, into which Drain U-121.2 empties via corrugated metal pipe (**Photograph 3** – **Photograph 6**) (see Continuation Sheet). The Firebaugh Wasteway sends water into the San Joaquin River (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width:** 30 feet (approx.)
b. **Bottom Width:** 6 feet
c. **Height or Depth:** 9 feet (approx.)
d. **Length of Segment:** 5 miles (approx.)

L4e. Sketch of Cross-Section (not to scale) **Facing:** South



L8a. Photograph, Map, or Drawing.



L11. Date: July 20, 2022

L5. Associated Resources: Firebaugh Canal Water District canals, drains, and water control features

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This resource is located in a rural agricultural area in Fresno County. The terrain is generally flat.

L7. Integrity Considerations: Canal rerouted in 1973

L8b. Description of Photo, Map, or Drawing:
Photograph 2: Upstream view of Drain U-121-2 San Luis Drain operating and maintenance road (left bank); camera facing southeast, July 20, 2022.

L9. Remarks:

L10. Form prepared by:
Samuel Skow
JRP Historical Consulting, LLC
2850 Spafford St., Davis, CA 95618

L3. Description (continued):

The earth-lined, trapezoidal drainage canal has a slightly elevated right bank and a lower left bank, both with 1 ½: 1 slope. Vegetative overgrowth is prominent in various sections of the canal bed and walls. Parallel dirt and gravel roads extend along the levee crests, with a 14-foot-wide O&M road on the right bank and private farm roads extending the left bank (**Photograph 2**). The drain is conveyed beneath the San Luis Drain and Delta-Mendota Canal via concrete pipe, with a metal trash screen and pump at the inlet, a round concrete manhole tube extending from the siphon through the right bank of the San Luis Drain, and a concrete outlet with wingwalls (**Photograph 3, Photograph 4,** and **Photograph 7**). Other appurtenant structures include a concrete pipe culvert at Sierra Avenue, an assortment of different metal and plastic subsurface inlet drains from the adjoining agricultural lands, and modern pumping equipment (**Photograph 8** – **Photograph 12**).

B10. Significance (continued):

Historic Context

The oldest components of Drain U-121.2 recorded on this form were constructed circa 1951, around the same time that construction was completed on the adjacent Delta-Mendota Canal (DMC) for the Central Valley Project (CVP), with the remainder of the linear resource rerouted to accommodate the 1973 construction of the San Luis Drain, a key component of the San Luis Unit expansion of the CVP. For a discussion of the original CVP, the Delta-Mendota Canal, the San Luis Unit, and the San Luis Drain, see the DPR 523 form sets prepared for the Delta-Mendota Canal and the San Luis Drain appended to the report cited in *P11.

Drain U-121.2

The discharge outlet of the drainage canal recorded on this form was originally constructed sometime between 1950 and 1955, likely around the same time that construction of the DMC was completed in 1951. As originally constructed, the drain occupied the same general alignment as the present-day San Luis Drain, the construction of which enlarged and concreted the formerly earth-lined structure in this section (**Figure 1**). Reclamation drafted plans as early as 1949 for a drain siphon crossing at the location of the underground structure recorded on this form, indicating that the Firebaugh Canal Company—the drain's original owner—may have planned the structure at the location sometime even earlier, but likely after 1939. That year, four subsidiaries of the Miller & Lux Corporation—the Firebaugh Canal Company, the San Joaquin & Kings River Canal & Irrigation Company, Inc., the Columbia Canal Company, and the San Luis Canal Company—all entered into a contract with the federal government to receive CVP water in exchange for relinquishing access to San Joaquin River water, which Reclamation ultimately stored in Friant Reservoir for diversion south to Kern County. These four entities were collectively referred to as the "Exchange Contractors," and they remain active in the region at present as the San Joaquin River Exchange Contractors Water Authority.[1]

The Firebaugh Canal Water District appears to retain ownership of Drain U-121.2. This district was originally formed in 1914 as the Panoche Canal Company, a subsidiary of Miller & Lux, Inc., the single largest cattle, land, and irrigation operation in the western United States, at one time owning or holding leases to over one million acres throughout California, Oregon, and

[1] Aero Exploration Co., Flight ABI, Frame ABI-18G-51, February 13, 1950 (1:20,000), flown for U.S. Department of Agriculture, Production and Marketing, , available at http://malt.lib.csufresno.edu/MALT/ (Fresno State; accessed July 2022); HistoricAerials.com, "Firebaugh, California," 1955, https://historicaerials.com/viewer (accessed July 2022); U.S. Department of Interior, Reclamation, Central Valley Project, "Delta-Mendota Canal – Sta. 5200+00: Drain Siphon Crossing – Plan, Profile, and Sections," dwg. no. 214-D-16411, August 22, 1949, Specifications No. DC-2857, Reclamation Design & Construction Library, Sacramento, California; Declaration of Taking, United States of America vs. Redfern Ranches, No. F-232, October 4, 1968, 5629 O.R. 444, Fresno County Recorder, Fresno, California; Decision No. 31861: Before the Railroad Commission of the State of California – Application No. 22391, March 20, 1939, University of California (UC) at Merced, UC Cooperative Extension Archive, available at https://calisphere.org/item/ark:/86071/d2mh9f/ (August 2022); San Joaquin River Exchange Contractors Water Authority (SJRECWA), "Exchange Contractors: History of SJRECWA," http://www.sjrecwa.net/about/history/ (accessed August 2022); Ebasco Services, Inc., "Agricultural Drainwater Management Organizations in the Drainage Problem Area of the Grasslands Area of the San Joaquin Valley," prepared for the San Joaquin Valley Drainage Program, March 1989, 3-3.

Nevada. In 1920, the Panoche company changed its name to the Firebaugh Canal Company and developed an irrigation system of one, 3.5-mile main canal and three approximately 10-mile lateral canals for distributing diversions from the San Joaquin River, the company's primary water source. By 1930, the company had irrigated some 18,354 acres, where farmers mainly grew cotton but also grain, alfalfa, grapes, and beans (**Figure 2**). By the early 1950s, the service area had grown to encompass 22,640 acres in Fresno County near the towns of Firebaugh and Mendota, where farmers produced cotton, rice, alfalfa, sugar beets, vegetables, and grain. By the late 1980s, the Firebaugh Canal Company distributed water through 47 miles of main and lateral canals and disposed of irrigation drainage water in 58 miles of surface drains—nine miles of which drained into the Firebaugh Wasteway (including the drain recorded on this form), with most emptying into the Firebaugh Main Drain, which transported wastewater beyond the service area into the Agatha Drain in Merced County. The company was reincorporated in 1988 as the Firebaugh Canal Water District, and it now distributes water to over 30 farms and provides financial assistance for agricultural water conservation projects.[2]



Figure 1: Excerpt of 1957 aerial photograph, with Firebaugh Canal Company drain (identified with arrows) in same alignment as San Luis Drain, adjacent to Delta Mendota Canal.[3]

[2] California Department of Public Works, *Bulletin No. 36: Cost of Irrigation Water in California, Reports on State Water Plan Prepared Pursuant to Chapter 832, Statutes of 1929* (Sacramento: California State Printing Office, 1930), 82; "Order to Show Cause on Application for Change of Name of Corporation," San Francisco *Recorder* (September 23, 1920): 5; "Third of Lift Canals Completed on West Side," *The Fresno Bee* (March 8, 1929): 2B; Thomas G. Mapel and Thomas H. Means, "Appraisal: Market Value Mutual Water Company Stock Appurtenant to Bureau Lands Fresno County," prepared for United States Department of the Interior, Bureau of Reclamation, April 26, 1951, 4-6, University of California, Riverside, Library, Water Resources Collections and Archives, available at https://calisphere.org/item/ark:/86086/n2zc81q9/ (accessed August 2022); Ebasco, "Agricultural Drainwater Management Organizations in the Drainage Problem Area of the Grasslands Area of the San Joaquin Valley," 4-5 – 4-6; U.S. Department of Agriculture, Soil Conservation Service, *Mendota-Gustine Study: Fresno and Merced Counties, California* (September 1972), 8; SJRECWA, "Member Districts: Firebaugh Canal Water District," 2022, http://www.sjrecwa.net/member-districts/firebaugh-canal-water-district/ (accessed August 2022).

[3] Cartwright and Company, Frame ABI-29T-138, 1957, UCSB.

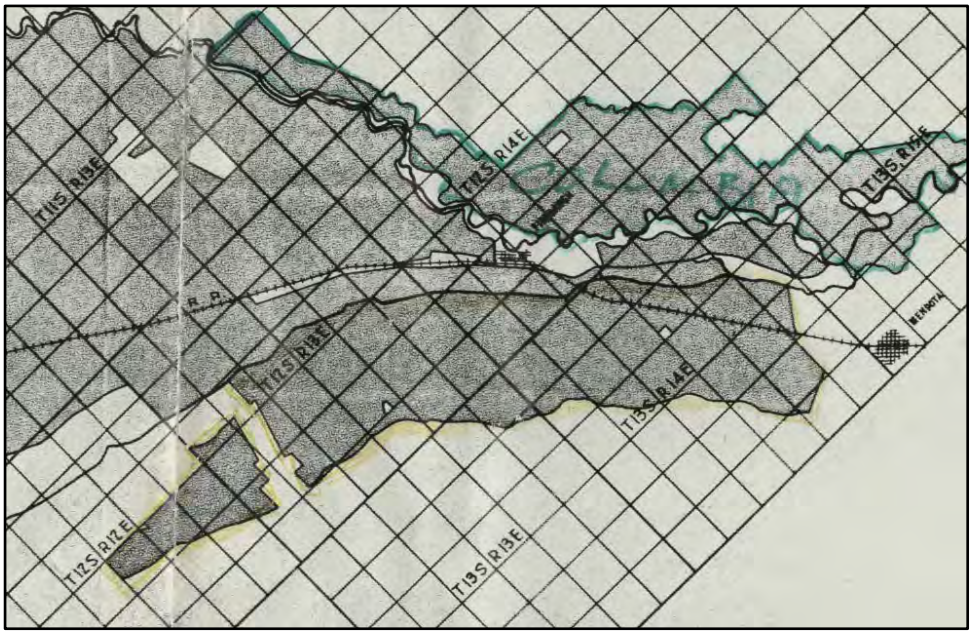


Figure 2: Excerpt of 1939 map showing service areas of San Joaquin River Exchange Contractors; Firebaugh Canal Company (outlined in yellow).[4]

One such farming enterprise serviced by what is now the Firebaugh Canal Water District is Redfern Ranches, Inc., the present and historic owner of 116.18 acres (APN 012-030-33S) containing part of Drain U-121.2 recorded on this form. Redfern Ranches was founded by prominent local farmer, Floyd E. Redfern sometime prior to 1947, the same year that he conveyed that acreage outside of Firebaugh containing a portion of the drain recorded on this form to his business. Born in Nebraska and raised on his family's farm in Dos Palos (about 16 miles north of Drain U-121.2), Floyd Redfern struck out on his own in 1926, initially leasing croplands before purchasing his home ranch south of Dos Palos, where he remained for the duration of his life. By 1942, Redfern was one of the largest rice cultivators in the San Joaquin Valley, expanding up to 1,500 acres by the end of the decade, and reportedly introducing several new practices, like aerial planting and mechanized thresher-and-Caterpillar harvesting. Redfern grew other crops, including alfalfa—which, then as now, was grown at the Firebaugh property near the DMC. Redfern also grew cotton, sugar beets, wheat, and various species of grass, in addition to raising Hereford beef cattle on 13,000 acres outside of Gilroy in Santa Clara County and sheep for wool on 4,000 acres in the western San Joaquin Valley. Redfern was likewise active among various agriculture-related groups. In the 1930s, he was a founding member and vice president of the Merced Production Credit Association, which lent short-term agricultural loans to small farmers in Merced, Mariposa, and western Fresno counties on behalf of the U.S. Farm Credit Administration. The following decade, he also helped found and serve as president of the West Side Alfalfa Pest Control Association. In the 1950s, Redfern was an active participant and booster of the U.S. Department of Agriculture's soil bank reserve program, whereby the federal government subsidized underplanting to discourage overproduction; he was active with the Poso, Panoche, Loma Prieta, and Firebaugh soil conservation districts. Redfern was also an advocate for water efficiency, installing an extensive tailwater return system at his home ranch near Dos Palos that comprised of two holding reservoirs with 15- and 30-horsepower pumps that redistributed the water via concrete pipes. Floyd Redfern had amassed some 26,000 acres throughout the region by the time he died in 1993. His daughter, Suzanne Compte nee Redfern currently owns and operates Redfern Ranches.[5] Research did not

[4] "Exhibit 'A': Map Showing The Service Areas of The San Joaquin & Kings River Canal & Irrigation Company, Incorporated, Columbia Canal Company, San Luis Canal Company, Firebaugh Canal Company," ca. 1939, appended to Decision No. 31861, March 20, 1939.

[5] Fresno County Assessor, property information for APN 012-031-33S, accessed via ParcelQuest.com; Deed, Floyd E. and Gladys W. Redfern to Redfern Ranches, Inc., May 21, 1947 (recorded August 13, 1947), 2543 O.R. 368, Fresno County Recorder, Fresno, California; A. W. Emerson, "Floyd E. Redfern of California—A Profile," *Soil Conservation* 24, no. 12 (July 1959): 281; U.S. Census Bureau, Manuscript Population Schedule: 1900, California, Fresno County, First Township, Enumeration District No. 1, sheet 13A, accessed via Ancestry.com; U.S. Census Bureau, Manuscript Population Schedule: 1910, California, Fresno County, Township 1, Dos Palos Colony (unincorporated), Enumeration District No. 26, sheet 2A (Ancestry.com); "Dos Palos Farmer was a Visionary: Floyd Redfern Dies After

identify other historic-period landowners adjacent to Drain U-121.2; however, aerial satellite imaging and Google Street View appear to indicate that the majority acreage was not planted in orchards until circa 2014.

As it had while building the DMC 18 years earlier, the federal government filed a Declaration of Taking against Redfern Ranches in 1968 for the construction of the San Luis Drain. As part of the project, the original earth-lined drainage canal was enlarged and lined with concrete, and another earth-lined drain was planned along with the "non-exclusive right to discharge drainage water through culverts to be installed by the United States into and to convey drainage water through Drain U-121.2, to be constructed by the United States as a replacement for the Firebaugh Canal Company drain, and in a 24-inch concrete pipe crossing of the San Luis Drain … as a part of said replacement drain."[6] In June 1972, Ball, Ball & Brosamer of Danville won construction contracts for an approximately 18-mile stretch of earthwork, concrete lining, and structures on San Luis Drain comprising that section that traverses the APE for the project cited in *P11, along with the southernmost drain segment where it terminates near Five Points in Fresno County. Included in the design specifications were also plans for Drain U-121.2. Ball, Ball and Brosamer completed all work the following year, when construction on the San Luis Drain was halted altogether (**Figure 3**).[7]

Ball, Ball & Brosamer was formed as joint venture between Gordon H. Ball's two sons, Gordon N. Ball and Dennis W. Ball, and Robert G. Brosamer. In addition to its work on the San Luis Drain, other CVP work included rehabilitation of a portion of the Friant-Kern Canal, with other works for Reclamation including installation of the Gallegos Canyon Siphons as part of the Navajo Indian Irrigation Project in New Mexico and the Sonoqui Dike in Arizona. As with Gordon H. Ball, Inc., Ball, Ball & Brosamer was most actively involved in heavy highway construction. Gordon N. Ball went on to form Gordon N. Ball, Inc., and Robert Brosamer formed R & L Brosamer, Inc, both active firms based in the San Francisco Bay Area.[8]

Helping Set Course for Agriculture," *Merced Sun-Star* (August 21, 1993): A3; "Dos Palos Starts Harvesting of Rice," *Oakland Tribune* (October 11, 1929): 35D; "Rice Being Harvested South of Dos Palos," *The Fresno Bee* (October 7, 1934): 8D; "Largest West Side Rice Crop Being Harvested," *The Fresno Bee* (November 15, 1942): 4D; "Lemoore Now San Joaquin Wool Capital," *Hanford Sentinel* (May 26, 1944): 4; "KMJ Will Broadcast Rice Grower's Talk," *The Fresno Bee* (July 24, 1949): n.p.; "Fresno County Hay Growers Call Lahontan Good Stopgap to Aphid," *The Fresno Bee* (October 27, 1957): 19D; "Loan Group at Merced Named," *The Modesto Bee* (November 30, 1933): 2; "Butterfly War will be Waged on West Side," *The Fresno Bee* (August 4, 1946): n.p.; "67 Producers Paid $5,261,000 in Soil Bank Reserve Program," The San Bernadino County *Daily Sun* (December 24, 1957): B9; Larry D. Adams, "West Side Farms Use Unclaimed Tailwaters," *The Fresno Bee* (April 19, 1970): 3F;

[6] Declaration of Taking, United States of America vs. Redfern Ranches, No. F-232, October 4, 1968, 5629 O.R. 444, Fresno County Recorder, Fresno, California;

[7] Memo Re: Field Inspection for Transfer from Construction to O&M Status for: Stage 1 Kesterson Reservoir and the Three Completed Reaches of the San Luis Drain—Specification Nos. DC-6611, DC-6681, DC-6703, DC-6823—San Luis Unit, CVP, California (December 17, 1973), ff. San Luis Drain (Spec. No. DC-6611), on file at USBR Library, Sacramento, California; ff. San Luis Drain (Spec. No. DC-6948), on file at USBR Library, Sacramento, California; "San Luis Drain Takes Shape in Fresno County," *The Fresno Bee* (September 16, 1973): C1.

[8] "Irrigation Trickles," *Irrigation Journal* 27, no. 3 (May-June 1977): 34; "Contractors," *Western Construction* 50, no. 7 (July 1975): 127; U.S. Department of Interior, *Decisions of the United States Department of the Interior Vol. 93, January-December 1986* (Washington, D.C.: U.S. Government Printing Office, 1987), 144; "County Repays FAA $480,000 for False Billing," Los Angeles Times (June 29, 2000): B1; "Gordon N. Ball, Inc.," NewBayBridge.org, n.d. https://www.newbaybridge.org/the_builders/gordon_ball/ (accessed August 2022); "Featured Projects," Gordon N. Ball Inc., 2017, http://ballconco.com/featured-projects/ (accessed August 2022); Robert L. "Bob" Brosamer, "Message from Bob Brosamer," R & L. Brosamer, Inc. [newsletter] (Spring 2001): 2, available at https://www.thenewsletterguy.com/samples/CustomerNewsletters/RLBrosamer.pdf (accessed August 2022).



Figure 3: Excerpt of 1977 aerial photograph, with Drain U-121.2 (identified with arrows) adjacent to segments of San Luis Drain and Delta-Mendota Canal.[9]

NRHP / CRHR Evaluation

Criteria for Evaluation

The eligibility criteria for designating historic properties under federal and state criteria are essentially the same. The criteria for listing properties in the National Register of Historic Places (NRHP) are codified in 36 CFR 60 and expanded upon in numerous guidelines published by the National Park Service. Buildings, structures, objects, sites, and districts listed in, eligible for listing in, or that appear eligible for listing in the NRHP are considered historic properties under the regulations for Section 106 of the National Historic Preservation Act (NHPA). Eligibility for listing buildings, structures, objects, sites, and districts (i.e., historic properties) in the NRHP rests on twin factors of *historic significance* and *integrity*. A resource must have both significance and integrity to be considered eligible. Loss of integrity, if sufficiently great, will overwhelm the historic significance a property may possess and render it ineligible. Likewise, a property can have complete integrity, but if it lacks significance, it must also be considered ineligible. Historic significance is judged by applying the NRHP criteria, identified as Criteria A through D. The NRHP guidelines state that a historic property's "quality of significance in American history, architecture, archeology, engineering, and culture" must be determined by meeting at least one of the four main criteria. Properties may be significant at the local, state, or national level. The NRHP criteria are:

Criterion A: association with "events that have made a significant contribution to the broad patterns of our history;"

Criterion B: association with "the lives of persons significant in our past;"

Criterion C: resources "that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values;"

[9] Flight 1977 FRE, Frame 1977 FRE CO 6-26R, June 26, 1977, flown for U.S. Department of Agriculture – Agricultural Adjustment Administration, Western Division Laboratory, Fresno State.

Criterion D: resources "that have yielded, or may be likely to yield, information important to history or prehistory."[10]

Integrity is determined through applying seven factors to the historic resource: location, setting, design, workmanship, materials, feeling, and association. These seven can be roughly grouped into three types of integrity considerations. Location and setting relate to the relationship between the property and its environment. Design, materials, and workmanship, as they apply to historic buildings, relate to construction methods and architectural details. Feeling and association are the least objective of the seven criteria and pertain to the overall ability of the property to convey a sense of the historical time and place in which it was constructed.

Central Valley Project Draft Multiple Property Listing

In 2009, Reclamation prepared a *Draft National Register of Historic Places Multiple Property Documentation Form: Central Valley Project* (CVP MPL).[11] The CVP MPL identifies the period of significance for the CVP as 1935 when the project received its first authorizations to 1956 when the last of the major project components was completed. However, as stated, "This MPL is also designed to be easily amended as more project engineering features become historic."[12] The document provides registration criteria regarding NRHP significance and integrity. The subsections of the registration requirements relied upon for this evaluation of Drain U-121.2 for individual eligibility for listing in the NRHP are the subsections for "Drains" as quoted below. The NRHP and CRHR evaluation of Drain U-121.2 contained in this report utilizes in part the framework provided in the CVP MPL.

The following is excerpted from the CVP MPL:

Drains

Drains are water conveyance structures (either open channels or buried pipes) that carry excess water away from irrigated agricultural fields to prevent rising water tables. A drain classification was instituted by Reclamation in 1920 that categorized drains into three classes according to their size and relative importance. Class I or "deep drains" are the largest and most significant, with Class III being the smallest and least significant.[13]

Significance

In conjunction with the storage and diversion dams, canals form the CVP's backbone. They provide the means to transfer, transport, and deliver water through the system and ultimately to the water users. Traversing across hundreds of miles, the canals form a significant feature of the physical landscape and define the geographical limits of the project. In keeping with the original CVP plan of large-scale water transfers, canals are the primary means behind the geographical redistribution of fresh water from the valley's wetter northern reaches to the drier southern stretches.[14]

The need for continual maintenance and repairs to canals requires special consideration of integrity. Irrigation systems are constantly evolving as features are upgraded, repaired, or replaced. Alterations made to canals during the period of significance and even subsequent to that may not nullify eligibility if a canal retains certain basics. Most important are integrity of location, association, and overall design configuration of the prism (i.e. depth and width). A canal which has retained its original form and associated appurtenant features has a high degree of integrity. It is not uncommon for a canal lining to be replaced, or for previously unlined segments to be lined. Such changes may not preclude a canal's eligibility if they do not significantly damage the canal's historic association or its overall design. If in addition to integrity of association, location, and overall design, the historical setting and feeling of a canal are maintained, then the likelihood is even higher that an altered canal would be eligible.

[10] USDI, National Park Service, *Guidelines for Applying the National Register Criteria for Evaluation, National Register Bulletin 15* (Washington, D.C.: USDI, National Park Service, 1990, rev. 1997).
[11] Jim Bailey, "National Register of Historic Places Multiple Property Documentation Form, Central Valley Project: Planning and Construction of the First Four Divisions, 1935-1956," draft prepared for Reclamation, 2009, updated 2018.
[12] Bailey, draft CVP MPL (2009, updated 2018), 100-105, 107.
[13] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 124.
[14] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 125.

On the other hand, if an entire canal is piped, it would no longer convey any of its original design, workmanship, materials, or historical association and would not be contributing. Conversely, partial piping of a significant canal may not preclude eligibility if a majority of a canal is still open and intact.[15]

Secondary to the canals in distributing water are the thousands of laterals and their appurtenant features. As with canals, many appurtenant features are upgraded, altered, or even replaced over time due to the constant ongoing maintenance needs. For laterals to be considered contributing, they must exhibit a high level of integrity, and serve as principal laterals or incorporate a larger number of contributing appurtenant features. Because of the vast number of appurtenant features and the many miles of laterals, it may only be appropriate to identify representative samples of contributing elements. In unusual cases, laterals and appurtenant features may have individual significance if they are: surviving examples of a rare type of design or construction; of innovative engineering design that impacted subsequent designs; or were specifically designed to meet an unusual engineering challenge.[16]

Sub-lateral canals and their branches are not considered as contributing resources to the CVP. The small size of sub-laterals does not make a significant contribution to the function or design of the CVP and are not individually eligible. Sub-laterals could, however, be eligible if they are associated with a historic farm or district where the impact the lateral has in combination with the other resources is substantial.[17]

The evaluation of the significance of drains is similar to that of laterals. The principal, or Class I drains, are contributing features if they retain a high level of integrity and fall within the period of significance. Class II and III drains are not considered contributing resources. In unusual cases, drains may have individual significance if they fall within the period of significance and are rare, surviving examples of a type of design or construction, of innovative engineering design that impacted subsequent designs, or were specifically designed to meet an unusual engineering challenge. Like laterals and sub-laterals, drains are considered as ineligible components of the CVP.[18]

Registration Requirements

The period of significance for historic water conveyance structures begins in 1937 with the initial construction of the first CVP canal, the Contra Costa Canal, and ends in 1952 with the completion of the Friant-Kern, Delta-Mendota, and Delta Cross Channel canals. Like the dams, these canals are part of the initial CVP authorizations.[19]

Water conveyance structures with adequate integrity are considered eligible as part of the multiple property listing for the National Register for the following reasons:

Criterion A: They have had a significant impact on the settlement, agricultural economy, or development patterns of the project area; they have been defining elements in the evolution of the cultural landscape; they are directly associated with important events.

Criterion B: They are the result of the direct efforts of a prominent individual associated with the CVP and are the most prominent feature associated with that individual.

Criterion C: They represent the distinctive characteristics of Reclamation canal design and/or methods of construction used on the CVP; they involved challenging engineering design problems due to topography, grade, length, natural obstacles, and resulted in complex or innovative solutions; they are among the best or a rare surviving example of a distinctive type of water conveyance structure; they represent the evolving technology in design of water conveyance structures; they were identified during the construction period as an individually significant feature; or they embody the work of a significant engineer or builder.

[15] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 126-127.
[16] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 127.
[17] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 127.
[18] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 128.
[19] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 129.

Criterion D: They have the ability to yield information important to understanding the history of the CVP. None of the CVP water conveyance structures are eligible under this criterion.[20]

Evaluation

The following evaluates Drain U-121.2 in its entirety for individual eligibility for listing in the NRHP and CRHR under the themes and within the framework presented above.

Criteria A and 1

Drain U-121.2, which encompasses the entire length of the drainage canal, does not have direct associations with significant historic events, trends, or patterns of development at the local, state, or national level, and thus is not eligible for listing under NRHP Criterion A or CRHR Criterion 1. The drainage canal recorded on this form was built around the same time as the Delta-Mendota Canal as a minor irrigation drainage discharge structure. As a minor component of the CVP, this basic earth-lined wastewater conveyance lacks meaningful associations to the larger themes and points of significance discussed above. The drain is likewise not significant for its associations with the Firebaugh Canal Company, a subsidiary of Miller & Lux. The drain recorded on this form was constructed circa 1951, well after Miller & Lux and their agent entities began construction of the earliest irrigation works to provide water to the western San Joaquin Valley and therefore it is not associated with the pioneering period of irrigated agriculture in the region. The drain is a common mid-twentieth-century wastewater conveyance structure, a common addition to the region as it began to receive increasing quantities of imported CVP surface water, and as such is not eligible for listing in the NRHP or the CRHR under these criteria.

Criteria B and 2

The canal is not eligible for listing under NRHP Criterion B or CRHR Criterion 2 for meaningful associations with the lives of individuals important to history. Floyd E. Redfern may have played a prominent role in the regional agricultural economy, both as a productive farmer and as a financial organizer and governmental program booster, but he does not appear to have fundamentally changed the industry. On the whole, while his regional contributions to rice cultivation, farm finance, and efficient water use are notable, they do not elevate him to the status of historically significant under these criteria.

Criteria C and 3

Drain U-121.2 is not eligible for listing under NRHP Criterion C or CRHR Criterion 3 for design, method of construction, or representation of the work of a master engineer or builder. There is no indication that the canal applied anything other than standard methods in widespread use in the San Joaquin Valley in the twentieth century. Indeed, basic earthen canals date back thousands of years across a broad swath of global civilizations, and their construction has continued to follow the same general principles as demonstrated by the canal recorded on this form. Drain U-121.2 is a typical earthen canal, principally comprised of an excavated ditch flanked by compacted earthen banks, with culverts, a siphon, and a network of subsurface metal and plastic drainage pipes.

Drain U-121.2 does not represent the important work of a master engineer or builder. Lead project engineer for the larger San Luis Drain project—of which the Drain U-121.2 reroute was a small part—Edward J. Brannan joined Reclamation in 1937 as a transitman on the Columbia Basin Project before he was promoted to construction engineer on the Spokane Valley Project in Washington in 1965 and ultimately the San Luis Drain in the late 1960s and early 1970s. Brannan does not appear to have developed new designs but rather followed the standardized designs drafted earlier by Reclamation engineer Harry Raymond McBirney.[21] Additionally, Ball, Ball & Brosamer won two construction contracts for San Luis Drain, including the Drain U-121.2 reroute project. A prolific joint venture, Ball, Ball & Brosamer's status as master builders is somewhat debatable. Moreover, both firms appear to have specialized in heavy highway construction. While construction of Drain U-121. was a large undertaking for the companies, it does not best represent their body of work.

Criteria D and 4

[20] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 129.
[21] "Water Project Post is Filled," *Spokane Daily Chronicle* (February 16, 1965): 3.

Drain U-121.2 is not eligible under NRHP Criterion D or CRHR Criterion 4 for information potential because it was designed and built according to well-documented practices, and the project is well documented through drawings, textual records, and photographs.

Integrity

Drain U-121.2 along with its contributing structures retains integrity to its period of reconstruction, 1973. In terms of design and setting, the drain recorded on this form remains in its original location, the setting of which remains defined by flat rural farmland. In terms of design, materials, and workmanship, research did not reveal that any substantial modifications have been made to outside of the 1973 reroute. While some inlet drains appear to have been added at some unknown date, these additions are comparably minor and do not detract from the overall feeling of the drain. Drain U-121.2 continues to function as a drain and thus retains integrity of association. However, the drain recorded on this form lacks significance under all NRHP / CRHR Criteria and is therefore not eligible for listing in either register.

Photographs:



Photograph 3: Downstream view of Drain 121.2 inlet to drain undercrossing; camera facing west, July 20, 2022.



Photograph 4: Upstream view of Drain U-121.2 outlet to drain undercrossing, with Delta-Mendota Canal recorder house (background left); camera facing south, July 20, 2022.



Photograph 5: Upstream view of Drain U-121.2 discharge inlet (bottom left) and view of Delta-Mendota Canal recorder house (background center); camera facing south, July 20, 2022.



Photograph 6: Downstream view of Drain U-121.2 discharge point at Firebaugh Wasteway; camera facing southwest, July 20, 2022.



Photograph 7: Upstream view of Drain U-121.2 (right), San Luis Drain (left), and manhole tube (far left); camera facing southeast, July 20, 2022.



Photograph 8: Upstream view of Drain U-121.2 culvert undercrossing at Sierra Avenue; camera facing southeast, July 20, 2022.



Photograph 9: Downstream view of Drain U-121.2 subsurface inlet drainpipe with valve; camera facing northwest, July 20, 2022.



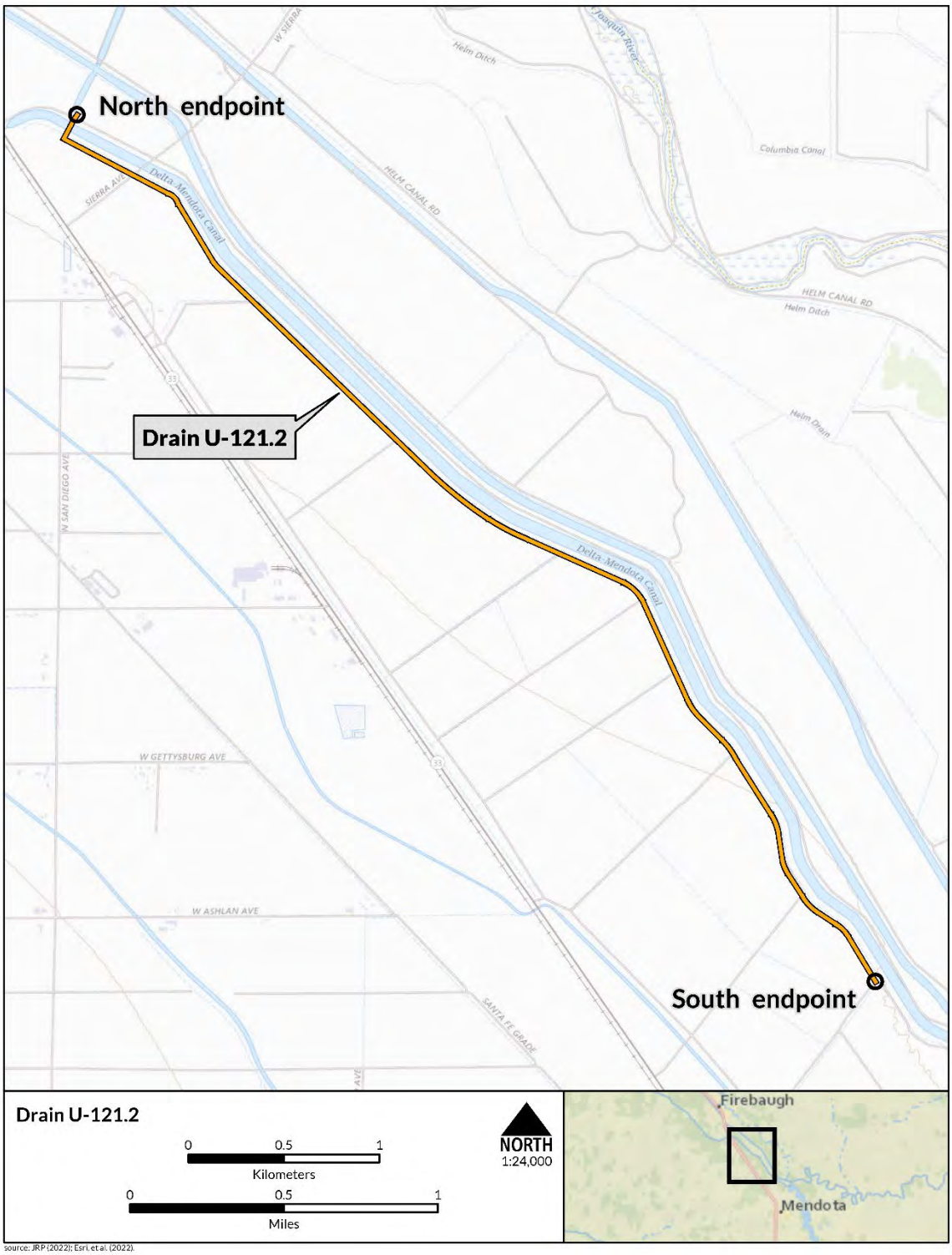
Photograph 10: Upstream view of Drain U-121.2 with extended subsurface inlet drain pipe; camera facing southeast, July 20, 2022.



Photograph 11: Downstream view of Drain U-121.2 corrugated metal and plastic subsurface inlet drainpipes; camera facing southwest, July 20, 2022.



Photograph 12: Downstream view of Drain U-121.2 modern pumping equipment; camera facing northwest, July 20, 2022.


North endpoint
Drain U-121.2
South endpoint
Delta-Mendota Canal
HELM CANAL RD
Helm Ditch
Columbia Canal
Helm Drain
W GETTYSBURG AVE
W ASHLAN AVE
SANTA FE GRADE
N SAN DIEGO AVE
SIERRA AVE
Drain U-121.2
0
0.5
1
Kilometers
0
0.5
1
Miles
NORTH
1:24,000
Firebaugh
Mendota
source: JRP (2022); Esri, et al. (2022).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary # _____
HRI # _____
Trinomial _____
NRHP Status Code 6Z
Other Listings _____
Review Code _____ Reviewer _____ Date _____

***Resource Name or #** (Assigned by recorder) APN: 251-050-120

P1. Other Identifier: _____

***P2. Location:** ☐ **Not for Publication** ☒ **Unrestricted** ***a. County** San Joaquin
and (P2b and P2c or P2d. Attach a Location Map as necessary.)
***b. USGS 7.5' Quad** Tracy, California **Date** 1980 **T** T3S; **R** 4E; NE ¼ **of Sec** 1; M.D. **B.M.**
c. Address 27655 South Lammers Road City Tracy Zip 95377
d. UTM: (give more than one for large and/or linear resources) Zone _____; _____mE/ _____mN
e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate)
Assessor Parcel Number (APN) 251-050-120

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries)

The property at 27655 South Lammers Road lies on a 5.01-acre lot in Tracy, to the north of the Delta-Mendota Canal right of way. It comprises a main house, animal shelter, and prefabricated secondary home (**See Site Map**). The main house is a wood-framed 1,629 square-foot Ranch style single family residence (**Photograph 1**). Constructed in 1972 on a raised foundation with vents, this single-story house features a slightly irregular rectangle footprint. The wood shingle roof is side-gabled, with a wide eave overhang. The façade and north end of the house is of grooved plywood material, and the rest of the house is clad in stucco. There is a shallow recessed porch with brick veneer and supported by two unadorned square columns. The main entrance is an off-set wooden door with a centered glass panel. There is a wooden deck with lattice protruding on the east side of the residence. Fenestration includes a large metal-framed sliding window in the recessed porch, and smaller sliding windows in both directions. There is a two-car garage facing north, with a narrower prow roof line. Vertical board siding extends from the top of the garage doors to the roof line. (See Continuation Sheet.)

***P3b. Resource Attributes:** (List attributes and codes) HP2- Single Family Property

***P4. Resources Present:** ☒ Building ☐ Structure ☐ Object ☐ Site ☐ District ☐ Element of District ☐ Other (Isolates, etc.)

P5a. Photo or Drawing (Photo required for buildings, structures, and objects.)



P5b. Description of Photo: (View, date, accession #) **Photograph 1**: residence (right) and prefabricated building (left background), camera facing southwest, July 18, 2022.

***P6. Date Constructed/Age and Sources:**
☒ Historic ☐ Prehistoric ☐ Both
1972, San Joaquin County Assessor

***P7. Owner and Address:**
Peter A. and Beth M. Swanson
27655 South Lammers Road
Tracy, CA 95377

***P8. Recorded by:** (Name, affiliation, address)
Cheryl Brookshear and D. Baza
JRP Historical Consulting, LLC
2850 Spafford St.
Davis, CA 95618

***P9. Date Recorded:** July 18, 2022

***P10. Survey Type:** (Describe) Intensive

***P11. Report Citation:** (Cite survey report and other sources, or enter "none.") JRP Historical Consulting, LLC, "Finding of Eligibility Delta-Mendota Canal Subsidence Correction Project," 2022, prepared for US Bureau of Reclamation and San Luis & Delta-Mendota Water Authority.

***Attachments:** ☐ None ☐ Location Map ☐ Sketch Map ☒ Continuation Sheet ☒ Building, Structure, and Object Record ☐ Archaeological Record ☐ District Record ☐ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐ Other (list) _____

***NRHP Status Code** 6Z

***Resource Name or #** (Assigned by recorder) [underline TR11]

B1. Historic Name: _____
B2. Common Name: _____
B3. Original Use: Residence B4. Present Use: Residence
***B5. Architectural Style:** Ranch
***B6. Construction History:** (Construction date, alteration, and date of alterations) Residence constructed 1972, animal shelter added 1972-1987; secondary residence added 1987-1993 and replaced 1993-2004

***B7. Moved?** ☒ **No** ☐ **Yes** ☐ **Unknown** **Date:** _____ **Original Location:** _____
***B8. Related Features:** _____

B9. Architect: Unknown b. Builder: Unknown
***B10. Significance: Theme** n/a **Area** n/a
Period of Significance n/a **Property Type** n/a **Applicable Criteria** n/a
(Discuss importance in terms of historical or architectural context as defined by theme, period, and geographic scope. Also address integrity.)

The residence and outbuildings at 27655 South Lammers Road do not meet the criteria for listing in the National Register of Historic Places (NRHP) or the California Register of Historical Resources (CRHR), nor do they appear to be a historical resource for the purposes of California Environmental Quality Act (CEQA). These buildings have been evaluated in accordance with Section 106 of the National Historic Preservation Act of 1966 as amended and Section 15064.5(a)(2)-(3) of the CEQA Guidelines, using the criteria outlined in Section 5024.1 of the California Public Resources Code.

Historic Context

This property is located southwest of Tracy, on the dryer west side of the San Joaquin Valley, south of the fertile Sacramento-San Joaquin Delta lands. This area developed small scale agriculture later than other portions of the county and this property was not constructed until the second half of the twentieth century. (See Continuation Sheet.)

B11. Additional Resource Attributes: (List attributes and codes) _____

***B12. References:** Thompson and West, *History of San Joaquin County California with Illustrations*, Berkeley, California: Howell-North Books. 1968 reprint; Tinkham, George H. *History of San Joaquin County.* Los Angeles: Historic Record Company, 1923. Jelinek, Lawrence. *Harvest Empire: A History of California Agriculture.* San Francisco, CA: Boyd & Fraser, 1979. *Tracy Press* (See also footnotes.)

B13. Remarks:

***B14. Evaluator:** Cheryl Brookshear

***Date of Evaluation:** July 2022

(This space reserved for official comments.)

(Sketch Map with north arrow required.)



P3a. Description (continued):

The animal shelter on the property is an enclosed structure of one central square, and two roofs extending from the north and east sides (**Photograph 2).** All roofs are of corrugated metal with exposed eaves and projecting rafter tails. The main portion is wood framed with vertical wood siding. There are two doors on the west side. Off to the north, the structure features a long shed roof on two-by-two wood supports. Here there are open rafters and diagonal bracing between the posts and roof. The western side has a shorter roof and two bays, situated on two-by-one supports. There is a four-by-four enclosure composed of salvage such as a left-over utility pole and miscellaneous posts. Salvage is also used for fencing to create corrals.

South of the main house is a double-wide one-story side-gabled prefabricated home on a raised foundation with vents. The roof is composition shingle, and the walls are covered in grooved plywood. A prominent metal chimney extends from the northeastern side of the roof. There are deep overhangs on the gabled ends, but no overhang on the sides. The door is centered, with its own wooden stoop. It appears that there was previously an overhang above the door, for the gutters stop on either side. Fenestration is asymmetrical; the sliding windows are irregularly placed anodized aluminum. They include a flat trim and decorative panels below each window **(Photograph 3).**

In the southwestern corner of the property, there is a prefabricated end-gabled shed.

B10. Significance (continued):

The land southwest of Tracy was considered of little value through the 1850s as miners traveled through the area to and from the mines to cities around the San Francisco Bay. As the area is in the rain shadow of the Coast Range, dry farming of grain began in the area slightly later than other areas of the valley with grain cultivation starting around 1867. Wheat production through the county grew through the 1850s and 1860s and became a major economic force in the 1870s with most processing occurring in Stockton. While other areas of the county diversified with alfalfa, fruits, vines and orchards, the western portion of the valley remained dominated by grains and cattle grazing.[1]

Arrival of the Central Pacific Railroad in the area in 1869 stabilized settlement in the western part of the San Joaquin County. The railroad initially established Ellis as a coaling station on the route across the Altamont Pass, and in 1878 the Central Pacific Railroad created a second route connecting the San Joaquin line with West Oakland and Martinez. The two routes crossed east of Ellis, and the new location was named Tracy. The community became a railroad hub with additional lines meeting at the junction.[2]

Increased diversification of crops developed in the early twentieth century with irrigation. For the last half of the nineteenth century, hopes for irrigating the western side of the San Joaquin valley rested upon construction of canals from Tulare Lake. While companies were formed, no one succeeded in developing such a project. Instead, in 1910 the Patterson Ranch Company, attempting to profit from extensive land holdings, created the Patterson Water Company to operate an irrigation system on the west side of the San Joaquin Valley. Unlike the east side irrigation districts which were gravitationally fed districts, Patterson developed a pumped system that became a model for the west side of the valley. The area surrounding Tracy formed into the West Side Irrigation District in 1915. Irrigation led to diversified crops with additional fruits and

[1] Thompson and West, *History of San Joaquin County California with Illustrations* (Berkeley, California: Howell-North Books. 1968 reprint) 128-131; George H. Tinkham, *History of San Joaquin County* (Los Angeles: Historic Record Company, 1923) 105-106, 117-118, 120.

[2] Thompson and West, *History of San Joaquin County California*, 130; Raymond W. Hillman and Leonard A. Covello, *Cities & Towns of San Joaquin County Since 1847* (Fresno, CA: Panorama West Books, 1985); "The Important Cities of San Joaquin County," *The Lodi Sentinel*, Sept. 25, 1913; Ralph Lee and Christi Kennedy, "Tracy traces its roots back to railroad company," *Lodi News-Sentinel*, May 20, 2005; *Tracy Diamond Jubilee: 1878 to 1953* (Tracy, CA: Tracy Diamond Jubilee, Inc., 1953); Tracy Historical Society, *Images of America: Tracy* (San Francisco: Arcadia Publishing, 2004); *Tracy Press Centennial Edition*, Sept. 6, 1978.

vegetables. Three crops became dominant: alfalfa cultivation and ensuing dairy operations, sugar beet production, and beans.[3]

The area southwest of Tracy started changing after World War II. Until that time, the area was dominated by field-crops. The war expanded the agricultural economy throughout the state, and during the latter half of the twentieth century various shifts occurred that placed development pressures on farmland near urban areas across California. Agricultural pressures were both internal to the industry and external. Relocation of agricultural production from southern California and the coastal valleys increased farmland values in the San Joaquin Valley. Farming also became more industrialized in the latter half of the twentieth century. In general, this resulted in increasing farm sizes not only in land ownership, but in operational units, which for some farms included leased land from multiple owners to reach efficiencies in size.[4]

Under these pressures two trends developed. The state legislature passed the California Land Conservation Act of 1965 (Williamson Act), which allowed landowners to reduce their property tax by committing to retain their land as open space. The increased size of agricultural operational units caused some owners to lease the farmland and separate it from existing farmsteads and other structures. These trends continued through the late twentieth century and continue today. Combined with the many legal permutations for transferring farm ownership and operation to the next generation, agricultural land was and continues to be, increasingly separated from the historically associated farmsteads.[5]

Land in the vicinity of the Delta-Mendota Canal southwest of Tracy did not begin to divide into smaller parcels until the mid-twentieth century. At that time, the area that includes the subject parcel was owned by Roy F. Tuso and his wife Margaret. The family had purchased a ranch along Lammers Road around 1954 and constructed a home at 27545 South Lammers Road north of the subject property. Roy and his brothers Charles and Sal owned multiple properties around Tracy that they operated together.[6] Margaret Tuso, the administrix of Roy Tuso's estate, split a portion of the former Tuso ranch forming the subject parcel in 1972, four years after his death. Mary Foster, a teacher in the Tracy public schools purchased it and had the house built. The Ranch style house had a construction cost of $22,675. Foster continued teaching, possibly leasing the agricultural land. She sold the house in 1986 and within the next two years it was sold three times in rapid succession until it was purchased by current owners Carolyn and Peter Swanson, and Herbert Swanson. While the animal pen had been constructed prior to their purchase they added a secondary residence to the south between 1987 and 1993. It was replaced by the current prefabricated home between 1993 and 2004.[7]

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[3] History (pattersonid.org) accessed July 2022; Harmon S. Bonte, *Division of Water Resources Bulletin 37 Financial and General Data Irrigation, Reclamation and Other Public Districts in California* (Sacramento: California Division of Water Resources, 1930) 104; Tinkham, *History of San Joaquin County*, 115-116; Works Progress Administration, "History of Stockton and San Joaquin County," Works Progress Administration, 1938, Tracy 3.

[4] Lawrence Jelinek, *Harvest Empire: A History of California Agriculture* (San Francisco, CA: Boyd & Fraser, 1979),89,94; Philip M. Raup, "Disaggregating Farmland Markets," *Government Policy and Farmland Markets: The Maintenance of Farmer Wealth* (Ames, Iowa: Iowa State Press, 2003) 19; John E. Reynolds and Warren Johnston, "Micro-markets for Farmland: The Case of Florida and California," *Government Policy and Farmland Markets: The Maintenance of Farmer Wealth* (Ames, Iowa: Iowa State Press, 2003) 367-390;

[5] Lawrence Jelinek, *Harvest Empire: A History of California Agriculture* (San Francisco, CA: Boyd & Fraser, 1979),89,94; California Department of Conservation, The Land Conservation Act, www.conservation.ca.gov/dlrp/lca/Pages/Index.aspx, accessed June, 2017; Philip M. Raup, "Disaggregating Farmland Markets," *Government Policy and Farmland Markets: The Maintenance of Farmer Wealth* (Ames, Iowa: Iowa State Press, 2003) 19; John E. Reynolds and Warren Johnston, "Micro-markets for Farmland: The Case of Florida and California," *Government Policy and Farmland Markets: The Maintenance of Farmer Wealth* (Ames, Iowa: Iowa State Press, 2003) 367-390;

[6] "John Tuso First Tracy Baby of '59." *Tracy Press*, January 5, 1959, 1; "Roy Tuso," *Stockton Evening and Sunday Record*, March 26, 1968; "Funeral Service for Roy F. Tuso Set for Friday," *Tracy Press*, March 27, 1968; San Joaquin County Recorder, Deed Margaret Tuso and Estate of Roy Francis Tuso to Mary L. Foster, Book 3618, 215, February 9, 1972; San Joaquin County Assessor, Parcel Record for 251-050-240, accessed via parcelquest.com July 2022.

[7] R.L. Polk & Co., *Polk's Tracy City Directory* (Monterey Park, California: R.L. Polk & Co., 1972) 52; San Joaquin County Recorder, Deed Margaret Tuso and Roy Tuso estate to Mary Foster, Book 3618, 215, February 9, 1972; "Permits Issued for Two Homes in Rural Area," *Tracy Press*, March 8, 1972, 15; San Joaquin County Recorder, Deed Mary Foster to James D and Clare Atkins, Document

Evaluation

This property was developed during the post war reorganization of agriculture into a more industrial and corporate model and large lot residential construction began to meld urban and rural development (NRHP Criterion A / CRHR Criterion 1). The residence and associated acreage do not fit well within either trend. Mary Foster's use of the land is not documented. This parcel is larger than most used for rural residential development, but it is not large enough to represent industrial and corporate agriculture. Nor does her development of the property represent any other noted trend of the period.

This property does not have an association with the life of an individual important to history (NRHP Criterion B / CRHR Criterion 2). It does not appear that any specific person associated with this property made demonstrably important contributions to history at the local, state, or national level. This residence and associated buildings were constructed after the Tuso family began to pool their lands to create a more corporate farming system, and the buildings are not associated with the family. Mary Foster was a schoolteacher, and the residence and agricultural land does not represent her productive life. Later occupants have used the property for small scale agriculture and research did not reveal any significant activities.

Under NRHP Criterion C / CRHR Criterion 3 this property is not significant as an important example of a type, period, or method of construction. The main residence has a low long plan typical of the Ranch style developed in the 1930s and 1940s which tried to adopt the affect of early western residences. The houses typically had a long low profile including long porches and mixed materials. The Ranch style became popular in the 1950s and 1960s. By the 1970s new influences were introduced. This example shows the increasing influence of Contemporary style with a more minimalistic façade and the pointed ship-like prow projection of the roof ridge. The residence does not appear to include new materials such as glue laminated beams that came to define the Contemporary style. While a transitional example, this residence does not embody significant innovations to either style. The animal shelter is utilitarian and is a common example of the type of building. The prefabricated secondary residence is a newer addition but shows wear. This example is a double-wide mobile home type developed during the 1970s and has become common place in rural and isolated areas. Easily relocated based upon need, and inexpensive they are frequently largely utilitarian with little stylistic elements. The inclusion of faux panels below the windows does not represent any specific architectural style and does not elevate this building to a level of aesthetic interest. As such, these buildings are not important architectural examples and do not meet these significance criteria.

Under NRHP Criterion D / CRHR Criterion 4, this property is not a significant or likely source of important historical information. The ranch residence, animal shelter, and prefabricated residence on this parcel do not appear to have any likelihood of yielding important information about historic construction materials or technologies. Also, the property's land use and the layout of the extant built environment resources, and the relationship the building with the surrounding parcels is typical of the period and does not provide important information within the broader economic, social, and cultural setting of the area since its construction in 1972. This evaluation does not address non-built environment resources or pre-historic resources.

Visual inspection of the residences does not indicate any significant modifications to the buildings. The animal shelter appears to have been partially accretive, but lacks any indications of particular building campaigns. The property retains integrity of location, materials, design, workmanship, setting, feeling, and association. The expansion of Tracy and the construction, currently in progress, of a new housing development to the east will result in a decline to the integrity of the setting. Despite general integrity, the property does not meet any of the criteria necessary for eligibility for listing in either the NRHP or CRHR.

86037339, May 27, 1986; San Joaquin County Recorder, Deed James D and Clare Atkins to Elizabeth C Fee, Document 87115448, December 23, 1987; San Joaquin County Recorder, Deed Elizabeth C Fee to Carolyn S, Herbert T and Peter A Swanson, Document 87115449, December 23, 1987; USGS, Aerial Photographs San Joaquin County Flight NAPP 515-59, June 29, 1987, Earth Explorer Accessed July 2022; Google, Google Earth Historic imagery 1993 and 2004, accessed July 2022.

Photographs (continued):



Photograph 2. Animal shelter north of residence, camera facing northwest, July 18, 2022.



Photograph 3. Prefabricated secondary residence (center) and prefabricated shed (left) camera facing northwest, July 18, 2022.

Site Map:


APN: 251-050-120
Animal Shelter
Residence
Prefab
Secondary
Residence
S Lammers Rd
Delta-Mendota Canal
NORTH
0
50
Feet

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary # _____
HRI # _____
Trinomial _____
NRHP Status Code 6Z
Other Listings _____
Review Code _____ Reviewer _____ Date _____

***Resource Name or #** (Assigned by recorder) APN: 240-140-260

P1. Other Identifier: _____

***P2. Location:** ☐ **Not for Publication** ☒ **Unrestricted** ***a. County** San Joaquin
and (P2b and P2c or P2d. Attach a Location Map as necessary.)
***b. USGS 7.5' Quad** Tracy, California **Date** 1980 **T** 3S; **R** 5E; SW ¼ **of Sec** 6; M.D. **B.M.**
c. Address 4500 South Lammers Road City Tracy Zip 95377
d. UTM: (give more than one for large and/or linear resources) Zone _____; _____mE/ _____mN
e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate)
Assessor Parcel Number (APN) 240-140-260

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries)

The property at 4500 South Lammers Road sits on a one-acre lot just outside Tracy on the south side of the Delta-Mendota Canal right of way. The property contains a 2,335 square-foot residence, and a 1,500 square-foot out building. The main house is a wood-framed single-family residence that has a generally rectangular footprint with a square addition off the northeast corner (**Photograph 1**). Constructed in 1956 on a concrete slab, this single-story house has a composition shingle complex hip roof that sits atop the stucco and brick veneer walls. The residence has an off-center entry projection north of the attached two bay garage. The projection is clad in brick veneer. Large, anodized metal or vinyl sliding windows are on the façade. A large textured window is on the north side of the entrance projection. The square rear addition has smaller sliding windows with little or no trim. The roof has deep eaves with a narrow fascia trim. Solar panels are a recent addition on the roof. A large brick chimney projects from the east slope of the roof. (See Continuation Sheet.)

***P3b. Resource Attributes:** (List attributes and codes) HP2- Single Family Property
***P4. Resources Present:** ☒ Building ☐ Structure ☐ Object ☐ Site ☐ District ☐ Element of District ☐ Other (Isolates, etc.)

P5a. Photo or Drawing (Photo required for buildings, structures, and objects.)



P5b. Description of Photo: (View, date, accession #) **Photograph 1.** Residence camera facing southeast, July 18, 2022

***P6. Date Constructed/Age and Sources:**
☒ Historic ☐ Prehistoric ☐ Both
1956, San Joaquin County Assessor

***P7. Owner and Address:**
Joseph Cardenas et al
4500 South Lammers Road
Tracy, CA 95377

***P8. Recorded by:** (Name, affiliation, address)
Cheryl Brookshear and D. Baza
JRP Historical Consulting, LLC
2850 Spafford St.
Davis, CA 95618

***P9. Date Recorded:** July 18, 2022

***P10. Survey Type:** (Describe) Intensive

***P11. Report Citation:** (Cite survey report and other sources, or enter "none.") JRP Historical Consulting, LLC, "Finding of Eligibility Delta-Mendota Canal Subsidence Correction Project," 2022, prepared for US Bureau of Reclamation and San Luis & Delta-Mendota Water Authority.

***Attachments:** ☐ None ☐ Location Map ☐ Sketch Map ☒ Continuation Sheet ☒ Building, Structure, and Object Record ☐ Archaeological Record ☐ District Record ☐ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐ Other (list) _____

B1. Historic Name: _____
B2. Common Name: _____
B3. Original Use: Residence B4. Present Use: Residence
***B5. Architectural Style:** Minimal Traditional/ Ranch
***B6. Construction History:** (Construction date, alteration, and date of alterations) Residence constructed 1956; updated 1967, divided from surrounding agricultural land 1997; solar panels added 2020; secondary rear building added 1993-2003

***B7. Moved?** ☒ **No** ☐ **Yes** ☐ **Unknown Date:** _____ **Original Location:** _____
***B8. Related Features:** _____

B9. Architect: Unknown b. Builder: Perry Associates, Builders of Homes, Inc.
***B10. Significance: Theme** n/a **Area** n/a
Period of Significance n/a **Property Type** n/a **Applicable Criteria** n/a
(Discuss importance in terms of historical or architectural context as defined by theme, period, and geographic scope. Also address integrity.)

The residence and outbuilding at 4500 South Lammers Road do not meet the criteria for listing in the National Register of Historic Places (NRHP) or the California Register of Historical Resources (CRHR), nor do they appear to be historical resources for the purposes of California Environmental Quality Act (CEQA). These buildings have been evaluated in accordance with Section 106 of the National Historic Preservation Act of 1966 as amended and Section 15064.5(a)(2)-(3) of the CEQA Guidelines, using the criteria outlined in Section 5024.1 of the California Public Resources Code.

Historic Context

This property is located southwest of Tracy, on the dryer west side of the San Joaquin Valley, south of the fertile Sacramento-San Joaquin Delta lands. This area developed small scale agriculture later than other portions of the county and this property was not constructed until the second half of the twentieth century. (See Continuation Sheet.)

B11. Additional Resource Attributes: (List attributes and codes) _____

***B12. References:** Thompson and West, *History of San Joaquin County California with Illustrations*, Berkeley, California: Howell-North Books. 1968 reprint; Tinkham, George H. *History of San Joaquin County*. Los Angeles: Historic Record Company, 1923. Jelinek, Lawrence. *Harvest Empire: A History of California Agriculture*. San Francisco, CA: Boyd & Fraser, 1979. *Tracy Press* (See also footnotes.)

B13. Remarks:

***B14. Evaluator:** Cheryl Brookshear

***Date of Evaluation:** July 2022

(This space reserved for official comments.)

(Sketch Map with north arrow required.)



P3a. Description (continued):

A large secondary building sits behind the residence mostly obscured by vegetation and the main house (**Photograph 2).** The nearly square building has a side gable roof and is clad in stucco. The western façade is recessed under the roof creating a full-length porch supported on simple, square, wood posts. A pair of French doors on the west façade were the only other discernable features.

B10. Significance (continued):

The land southwest of Tracy was considered of little value through the 1850s as miners traveled through the area to and from the mines to cities around the San Francisco Bay. As the area is in the rain shadow of the Coast Range, dry farming of grain began in the area slightly later than other areas of the valley with grain cultivation starting around 1867. Wheat production through the county grew through the 1850s and 1860s and became a major economic force in the 1870s with most processing occurring in Stockton. While other areas of the county diversified with alfalfa, fruits, vines and orchards, the western portion of the valley remained dominated by grains and cattle grazing.[1]

Arrival of the Central Pacific Railroad (CPRR) in the area in 1869 stabilized settlement in the western part of the San Joaquin County. The railroad initially established Ellis as a coaling station on the route across the Altamont Pass, and in 1878 the CPRR created a second route connecting the San Joaquin line with West Oakland and Martinez. The two routes crossed east of Ellis, and the new location was named Tracy. The community became a railroad hub with additional lines meeting at the junction. When the Western Pacific Railroad (WPRR) sought to challenge CPRR in the early twentieth century it ran tracks largely parallel to the earlier Central Pacific route through the pass. But since Tracy was formed and controlled by CPRR and its successor Southern Pacific Railroad, the WPRR tracks passed south of the city with its own junction at Carbona by 1909.[2]

Increased diversification of crops developed in the early twentieth century with irrigation. For the last half of the nineteenth century, hopes for irrigating the western side of the San Joaquin valley rested upon construction of canals from Tulare Lake. While companies were formed, no one succeeded in developing such a project. Instead, in 1910 the Patterson Ranch Company, attempting to profit from extensive land holdings, created the Patterson Water Company to operate an irrigation system on the west side of the San Joaquin Valley. Unlike the east side irrigation districts which were gravitationally fed districts, Patterson developed a pumped system that became a model for the west side of the valley. The area surrounding Tracy formed into the West Side Irrigation District in 1915. Irrigation led to diversified crops with additional fruits and vegetables. Three crops became dominant: alfalfa cultivation and ensuing dairy operations, sugar beet production, and beans.[3]

The area southwest of Tracy started changing after World War II. Until that time, the area was dominated by field-crops. The war expanded the agricultural economy throughout the state, and during the latter half of the twentieth century various shifts occurred that placed development pressures on farmland near urban areas across California. Agricultural pressures

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[1] Thompson and West, *History of San Joaquin County California with Illustrations* (Berkeley, California: Howell-North Books. 1968 reprint) 128-131; George H. Tinkham, *History of San Joaquin County* (Los Angeles: Historic Record Company, 1923) 105-106, 117-118, 120.

[2] Thompson and West, *History of San Joaquin County California,* 130; Raymond W. Hillman and Leonard A. Covello, *Cities & Towns of San Joaquin County Since 1847* (Fresno, CA: Panorama West Books, 1985); "The Important Cities of San Joaquin County," *The Lodi Sentinel*, Sept. 25, 1913; Ralph Lee and Christi Kennedy, "Tracy traces its roots back to railroad company," *Lodi News-Sentinel*, May 20, 2005; *Tracy Diamond Jubilee: 1878 to 1953* (Tracy, CA: Tracy Diamond Jubilee, Inc., 1953); Tracy Historical Society, *Images of America: Tracy* (San Francisco: Arcadia Publishing, 2004); *Tracy Press Centennial Edition*, Sept. 6, 1978; Arthur L. Lloyd, "Western Pacific Railroad: A Railroader's History," *Classic Trains*, August 2021, Western Pacific Railroad: A railroader's history - Trains; USGS, *Tracy, California Topographic Map* (Washington, D.C.: USGS, 1916).

[3] History (pattersonid.org) accessed July 2022; Harmon S. Bonte, *Division of Water Resources Bulletin 37 Financial and General Data Irrigation, Reclamation and Other Public Districts in California* (Sacramento: California Division of Water Resources, 1930) 104; Tinkham, *History of San Joaquin County*, 115-116; Works Progress Administration, "History of Stockton and San Joaquin County," Works Progress Administration, 1938, Tracy 3.

were both internal to the industry and external. Relocation of agricultural production from southern California and the coastal valleys increased farmland values in the San Joaquin Valley. In the latter half of the twentieth century farming also became more industrialized. In general, this resulted in increasing farm sizes not only in land ownership, but in operational units, which for some farms included leased land from multiple owners to reach efficiencies in size.[4]

Under these pressures two trends developed. The state legislature passed the California Land Conservation Act of 1965 (Williamson Act), which allowed landowners to reduce their property tax by committing to retain their land as open space. The increased size of agricultural operational units caused some owners to lease the farmland and separate it from existing farmsteads and other structures. These trends continued through the late twentieth century and continue today. Combined with the many legal permutations for transferring farm ownership and operation to the next generation, agricultural land was and continues to be increasingly separated from the historically associated farmsteads.[5]

The property in the vicinity of the Delta-Mendota Canal southwest of Tracy did not begin to divide into smaller parcels until the mid-twentieth century. Charles and Josephine Spatafore purchased 22 acres (from which the subject parcel would later be separated) between the WPRR tracks, the Delta-Mendota Canal, and Lammers Road in 1956. The property was for their son Charles Jr. who had just married Margaret McDaniel. The elder Spatafores were apricot farmers on the east side of Tracy along Chrisman Road. Charles Jr. and his wife took up apricot farming on the new land. The elder Spatafores had the home built at 4500 South Lammers Road for the couple by Perry Associates Builders that same year. The house was a simple rectangular building with the slight projecting entryway near the south end. While Charles developed the farm, Margaret was active promoting apricots, literacy, and community social events. In 1960, the younger Spatafores were able to purchase their land from the elder couple. By 1967 the ranch was productive and participated in a field test for mechanical apricot harvesting equipment developed by the University of California, Davis. The financial success resulted in a renovation of the home including the construction of the two garage bays on the south end and the square addition off the northeast corner. As farming continued to industrialize in the San Joaquin Valley, Spatafore joined with his parents and other farmers to create Bella Vista Farms as a joint business venture. The couple also created a pick your own farm, farmstand, bakery, and fishing pond along Patterson Pass Road. As they matured Charles Jr. went on to serve on several water and irrigation district boards. In their later years the couple changed their agricultural pursuits. In 1997, they sold the residence recorded on this form and a single acre to Ronald and Margaret Wiley who are the likely builders of the second building. The residence at 4500 South Lammers Road has sold two additional times and serves as a large parcel rural residence and is no longer associated with the Spatafore family, nor is it associated with agriculture.[6]

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[4] Lawrence Jelinek, *Harvest Empire: A History of California Agriculture* (San Francisco, CA: Boyd & Fraser, 1979),89,94; Philip M. Raup, "Disaggregating Farmland Markets," *Government Policy and Farmland Markets: The Maintenance of Farmer Wealth* (Ames, Iowa: Iowa State Press, 2003) 19; John E. Reynolds and Warren Johnston, "Micro-markets for Farmland: The Case of Florida and California," *Government Policy and Farmland Markets: The Maintenance of Farmer Wealth* (Ames, Iowa: Iowa State Press, 2003) 367-390;

[5] Lawrence Jelinek, *Harvest Empire: A History of California Agriculture* (San Francisco, CA: Boyd & Fraser, 1979),89,94; California Department of Conservation, The Land Conservation Act, www.conservation.ca.gov/dlrp/lca/Pages/Index.aspx, accessed June, 2017; Philip M. Raup, "Disaggregating Farmland Markets," *Government Policy and Farmland Markets: The Maintenance of Farmer Wealth* (Ames, Iowa: Iowa State Press, 2003) 19; John E. Reynolds and Warren Johnston, "Micro-markets for Farmland: The Case of Florida and California," *Government Policy and Farmland Markets: The Maintenance of Farmer Wealth* (Ames, Iowa: Iowa State Press, 2003) 367-390;

[6] San Joaquin County Recorder, Deed Salvatore and Anna Magnasco to Charles and Josephine Spatafore, Book 1841, 391, February 26, 1956; "Margaret McDaniel Becomes Bride of Charles Spatafore," *Stockton Evening Record*, June 20, 1956, 25; San Joaquin County Recorder, Notice of Completion, Book 1906, 247, September 24, 1956; "Mrs. Charles Spatafore Offers Recipes for Elegant 'Do-Ahead' Buffet Dinner," *Tracy Press*, May 27, 1964, 10; "Jo and Marge Spatafore Share Apricot Recipes," *Tracy Press*, July 6, 1966, 12; San Joaquin County Recorder, Deed Charles and Josephine Spatafore to Charles Jr. and Margaret Spatafore, Book 2266, 491, January 21, 1960; "Machine Harvest of Apricots Tested in Central California," *Stockton Evening Record*, July 22, 1967, 21; "Legal Notice," *Tracy Press*, October 18, 1967, 16; "Apricot Growers' Wives Form Auxiliary," *Tracy Press*, June 7, 1972, 13; "Public Notice," *Tracy Press*, June 4, 1976, 21; San Joaquin County Recorder, Deed Charles Jr. and Margaret Spatafore to Ronald and Margaret Wiley, Document 9705747, May 23, 1997; San Joaquin County Assessor, Assessor Parcel Data Parcel 240-140-270, obtained via ParcelQuest, July 2022; "Obituary Charles Spatafore Jr." *The Record*, November 27, 2008; Cartwright and Company, San Joaquin County Aerial Photography,

Evaluation

Under NRHP Criterion A or CRHR Criterion 1, this property does not have significant associations with important historic events or trends. The residence was constructed as part of a family farm. Although the house's residents appear to have shared some aspects of farm management, the property does not appear to contribute to the trend of industrialization and corporation of agriculture. This property does not illustrate the growing industrialization and corporation of California agriculture in the latter half of the twentieth century. The residence was separated from the associated agricultural land in 1997, which is late in the development of large parcel residential properties in the state. The property did not form a model for this type of growth or initiate growth in the rural area around Tracy.

This property does not have an association with the life of an individual important to history (NRHP Criterion B / CRHR Criterion 2). It does not appear that any specific person associated with this property made demonstrably important contributions to history at the local, state, or national level. Charles Spatafore Jr. and his wife were successful agriculturists and businesspeople active in their community. While active their varied pursuits, those accomplishments did not result in or affect significant trends or developments within the community. Later occupants have used the property as a residence and research did not reveal any significant activities.

Under NRHP Criterion C / CRHR Criterion 3 this property is not significant as an important example of a type, period, or method of construction. Based upon floor plan and the general simplicity of the north end (oldest portion) of the house it was likely constructed as a Minimal Traditional residence. The Minimal Traditional style was an attempt to modernize architecture, leaving behind all the stylistic embellishments of the past beginning in the 1930s. Simple clean lines were used with minimal trim and no ornament. The style reached the height of popularity immediately after World War II, by the later 1950s and 1960s the style was replaced with the Ranch style which had developed around the same time as Minimal Traditional. The style attempted to evoke the ranches of mid-nineteenth century western settlement. The long low profile expressed the expanse of the outdoors, and a mix of materials the accretive nature of early development. They often had long porches and deep roofs. Elements of this transition are commonly found in homes of this period. The Minimal Traditional them offered compact, economical floor plans, and the Ranch a bit of stylistic flair. This residence with very plain northern and southern ends and a more elaborate entry is typical. The entry with the brick veneer attempts to evoke a more Ranch like theme. Extending the garage to the south also enhanced the Ranch like appearance. The Minimal Traditional lines are still visible, and the projecting entry rather than a recessed or porch covered entry prevent a full transition to the later style. This example is common and typical to both urban and rural areas throughout California. Perry Associates was not a significant builder of the period, and the residence is not the work of a master or has high artistic merit.

Under NRHP Criterion D / CRHR Criterion 4, this property is not a significant or likely source of important historical information. The residence and secondary building on this parcel do not appear to have any likelihood of yielding important information about historic construction materials or technologies. Also, the property's land use and the layout of the extant built environment resources, and the relationship the buildings have with the surrounding parcels is typical of the period and does not provide important information within the broader economic, social, and cultural setting of the area since its construction in 1956. This evaluation does not address non-built environment resources or pre-historic resources.

The main residence was significantly altered in 1967 adding the two-bay garage and northeastern addition. The façade windows appear to be double glazed replacements likely during the construction of the secondary residence between 1997-2003. The property's integrity of design, materials, workmanship, setting, feeling, and association to the date of original construction, 1956, is thus diminished. The property has more integrity to the 1967 renovation retaining design and most materials and workmanship. The separation of the property from the associated agricultural land however affects the feeling and association of the property. Rapid development of Tracy resulting in construction of a housing development directly north of the residence is beginning to affect the property's integrity of the setting.

Flight ABD-1957, frame 39T-42, July 15, 1957, for USDA, accessed UC Santa Barbara Frame Finder, July 2022; San Joaquin County Recorder, Deed Ronald and Margaret Wiley to Samantha and Alexander O'Connor, Document 2020069346, June 12, 2020; San Joaquin County Recorder, Deed Alexander O'Connor to Joseph Cardenas et al, Document 2021208477, December 14, 2021; Google Earth Historic Imagery, accessed July 2022.

Photographs (continued):



Photograph 2. Second building behind the main residence, camera facing southeast, July 18, 2022.

Appendix C: Tables

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Misc	0.09	4+69.4	Non-Contributing	No Adverse Effect	No Adverse Effect
O&M Road, Left Bank	0.19-116.61		Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	0.19-0.85		Contributing	No Adverse Effect	No Adverse Effect
O&M Road, Right Bank	0.19-116.61		Contributing	No Adverse Effect	No Adverse Effect
Bridge	0.33	17+32	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	0.38	19+95	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	0.38	19+95	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	0.74	19+95	Non-Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	0.87-2.52		Contributing	No Adverse Effect	No Adverse Effect
Drainlet	0.95	50+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	1.05		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	1.33	70.20	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	1.36	72+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Siphon	1.36-3.50	72+37	Contributing	No Adverse Effect	No Adverse Effect
Sign	1.41	74+32	Contributing	No Adverse Effect	No Adverse Effect
Drainlet	1.44	75+67	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	1.63	86+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	1.89	100+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	1.94	102+81	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	1.95	103+37	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	1.96	103+93	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	1.97	104.49	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	1.99	105+61	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Shoulder Drain	2.07	110+09	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	2.08	110+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	2.37	125+20	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	2.47	130+14	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	2.53	133+75	Contributing	No Adverse Effect	No Adverse Effect
Culvert	2.68		Non-Contributing	No Adverse Effect	No Adverse Effect
Misc	3.12	164+64	Contributing	No Adverse Effect	No Adverse Effect
Culvert	3.33		Non-Contributing	No Adverse Effect	No Adverse Effect
Building	3.49	184+01	Contributing	No Adverse Effect	No Adverse Effect
Inlet	3.50		Non-Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	3.50-13.66		Contributing	Adverse Effect	Adverse Effect
Pipe	3.53		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	3.53		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	3.53		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	3.54-4		Non-Contributing	No Adverse Effect	No Adverse Effect
Building	3.65	193+34	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	3.78	199+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	3.96	209+15	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	3.96	209+11	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	4.16	218+02	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	4.17	218+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	4.22		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	4.29	225+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Siphon	4.41-4.63	231+80	Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Shoulder Drain	4.76	250+20	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	4.77	250+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	4.97	260+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	4.98	261+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	4.99	261+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	5.15	270+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	5.30	278+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	5.45		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	5.67	297+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	5.77		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	6.01	316+10	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	6.01	315+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	6.27		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	6.36	334+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	6.59	346+72	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	6.60	347+42	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	6.60	347+07	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	6.74	354.90	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	6.75	355+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	6.95	366+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	7.00		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	7.10		Non-Contributing	No Adverse Effect	No Adverse Effect
Building	7.23		Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	7.25	381+50	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Shoulder Drain	7.29	383+61	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	7.50	395+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	7.66	403+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	7.67	403+92	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	7.67	404+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	7.67		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	7.69	404+98	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	7.81		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	8.01	422+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	8.21	433+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	8.37	441+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	8.49		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	8.51		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	8.52		Contributing	Adverse Effect	Adverse Effect
Turnout	8.71		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	8.80		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	8.91	469+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	8.92	470+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	9.04	476+34	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	9.07	477+95	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	9.26	487+42	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	9.27-9.29	487+94	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	9.27	487+94	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	9.29	489+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	9.29	489+40	Non-	No Adverse	No Adverse

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
			Contributing	Effect	Effect
Turnout	9.29		Contributing	No Adverse Effect	No Adverse Effect
Turnout	9.40		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	9.43	497+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	9.82		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	9.85		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	9.87	574+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	10.09		Contributing	Adverse Effect	Adverse Effect
Bridge	10.28	585+41	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	10.53		Contributing	Adverse Effect	Adverse Effect
Drainlet	10.55	610+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	10.61		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	10.62	613+29	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	10.78	622+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	10.86	626+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	10.87	626+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	11.04	635+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	11.28		Contributing	Adverse Effect	Adverse Effect
Stillwell	11.32	650+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	11.35	652+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 1	11.35	652+65	Contributing	Adverse Effect	Adverse Effect
Drainlet	11.38	635+95	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	11.41	655+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	11.45		Contributing	Adverse Effect	Adverse Effect
Shoulder Drain	11.49	659+40	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Siphon	11.49-11.51	659+72	Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	11.51	660+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	11.53	661+47	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	11.74	673+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	11.77	674+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	11.88	680+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	12.07		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	12.09	691+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	12.31	702+95	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	12.33	704+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	12.37		Contributing	Adverse Effect	Adverse Effect
Inlet	12.37	706+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	12.71		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	12.75	723+80	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	13.00		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	13.25		Contributing	No Adverse Effect	No Adverse Effect
Bridge	13.25	752+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	13.25	752+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	13.25	752+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	13.26		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	13.27		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	13.31		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	13.45	763+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	13.57		Contributing	Adverse Effect	Adverse Effect
Siphon	13.66-13.69	774+66	Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Shoulder Drain	13.69	775+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	13.70-20.62		Contributing	Adverse Effect	Adverse Effect
Shoulder Drain	13.96	789+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	13.96	790+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	13.97		Contributing	No Adverse Effect	No Adverse Effect
Turnout	14.12		Contributing	Adverse Effect	Adverse Effect
Drainlet	14.19	802+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	14.26		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	14.26		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	14.49		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	14.49		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	14.49		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	14.79	833+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	14.79		Contributing	Adverse Effect	Adverse Effect
Bridge	14.80	833+87	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	14.80		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	14.81		Contributing	Adverse Effect	Adverse Effect
Culvert	14.82		Non-Contributing	No Adverse Effect	No Adverse Effect
Misc	15.08		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	15.09	850+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	15.10	850+74	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	15.10		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	15.10		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	15.85	872+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	15.95		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	16.14		Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	16.15	899+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	16.16	899+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 2	16.19	901+05	Contributing	Adverse Effect	Adverse Effect
Building	16.19	901+05	Non-Contributing	No Adverse Effect	No Adverse Effect
Siphon	16.20-16.25	901+65	Contributing	No Adverse Effect	No Adverse Effect
Siphon	16.31-16.34	907+15	Contributing	No Adverse Effect	No Adverse Effect
Stillwell	16.39	911+05	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	16.64		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	16.65	925+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	16.78		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	16.78		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	16.80		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	17.10	949+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	17.22		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	17.23	954+14	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	17.59		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	17.77		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	18.05	996+94	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	18.05		Contributing	Adverse Effect	Adverse Effect
Turnout	18.06		Contributing	Adverse Effect	Adverse Effect
Pipe	18.47		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	18.47		Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	18.59	1025+68	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	18.60		Contributing	Adverse Effect	Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	18.90		Contributing	Adverse Effect	Adverse Effect
Turnout	19.15		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	19.17	1052+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	19.18		Contributing	Adverse Effect	Adverse Effect
Turnout	19.39		Contributing	Adverse Effect	Adverse Effect
Turnout	19.40		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	19.59		Contributing	No Adverse Effect	No Adverse Effect
Drainlet	19.59	10.74+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	19.85	1088+20	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	20.00		Contributing	Adverse Effect	Adverse Effect
Drainlet	20.20	1096+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	20.37	1115.50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	20.42		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	20.43		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	20.59		Contributing	Adverse Effect	Adverse Effect
Stillwell	20.60	1127+55	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	20.63	1128+70	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 3	20.63	1129+35	Contributing	Adverse Effect	Adverse Effect
Canal Lining Section	20.66-34.41		Contributing	Adverse Effect	Adverse Effect
Stillwell	20.69	1132+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	20.70	1133+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	20.71	1133+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	20.85	1141+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	20.96	1146+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	20.97		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	20.97		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	21.00	1154+99	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	21.12		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	21.13		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	21.22	1160+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	21.25		Contributing	Adverse Effect	Adverse Effect
Bridge	21.49	1174+52	Non-Contributing	No Adverse Effect	No Adverse Effect
Sign	21.49	1174+52	Contributing	No Adverse Effect	No Adverse Effect
Turnout	21.65		Contributing	Adverse Effect	Adverse Effect
Inlet	21.86		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	21.87	1195+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	21.91	1197+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	21.95	1199+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	22.20		Contributing	Adverse Effect	Adverse Effect
Drainlet	22.26	1215+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	22.37	1220+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	22.39	1220+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	22.45	1225+12	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	22.48	1226+80	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	22.50		Contributing	No Adverse Effect	No Adverse Effect
Drainlet	22.51	1227+80	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	22.54	1229+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	22.57	1231+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	22.60	1233+15	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	22.67	1237+00	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Shoulder Drain	22.67	1237+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	22.70	1239+37	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	22.72	1240+57	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	22.73	1240+80	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	22.73	1240+57	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	22.75		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	22.77	1242+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	22.78		Contributing	Adverse Effect	Adverse Effect
Shoulder Drain	22.80	1252+80	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	23.09	1259+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	23.26	489+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	23.36	494+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	23.41	497+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	23.41		Contributing	Adverse Effect	Adverse Effect
Drainlet	23.72	513+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	23.76		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	23.81		Contributing	Adverse Effect	Adverse Effect
Turnout	23.94		Contributing	No Adverse Effect	No Adverse Effect
Siphon	23.95-24.01	525+70	Contributing	No Adverse Effect	No Adverse Effect
Inlet	24.38		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	24.38		Contributing	Adverse Effect	Adverse Effect
Drainlet	24.39	548+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	24.40	549+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	24.40	548+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 4	24.42	550+00	Contributing	Adverse Effect	Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Building	24.43	550+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	24.48	553+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	24.48	553+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	24.67	563+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	24.89	575+45	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	25.02		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	25.02		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	25.03		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	25.07	584+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	25.10	585+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	25.18		Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	25.20	591+20	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	25.27	594+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	25.37	600+20	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	25.59	611+80	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	25.61		Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	25.62	613+36	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	25.63		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	25.63		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	25.65		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	25.67	615+70	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	25.75	619+70	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	26.13	640+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	26.18	643+00	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	26.21		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	26.21	644+57	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	26.69	670+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	26.89		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	26.93	682+58	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	26.95		Contributing	Adverse Effect	Adverse Effect
Drainlet	27.21	698+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	27.42		Contributing	Adverse Effect	Adverse Effect
Drainlet	27.59	718+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	27.80		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	27.80	729+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	27.84		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	28.04	742+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	28.19		Contributing	Adverse Effect	Adverse Effect
Shoulder Drain	28.27	754+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	28.27	754+19	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	28.53	768+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	28.78	781+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	28.89		Contributing	Adverse Effect	Adverse Effect
Drainlet	28.96	790+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	29.19	802+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	29.19		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	29.19	802+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	29.19	802+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	29.19	802+55	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	29.19		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	29.56		Contributing	Adverse Effect	Adverse Effect
Drainlet	29.69	828+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	29.79	833+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 5	29.81	835+65	Contributing	Adverse Effect	Adverse Effect
Building	29.82	835+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	29.88	838+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	29.91	840+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	29.93	841+23	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	29.95		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	30.33		Contributing	Adverse Effect	Adverse Effect
Drainlet	30.34	862+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	30.43		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	30.43	867+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	30.43	867+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	30.63		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	30.96		Contributing	Adverse Effect	Adverse Effect
Bridge	31.12	903+91	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	31.31	913+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	31.31		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	31.32	914+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	31.59	928+38	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	31.60	929+20	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	31.60		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	31.60		Contributing	Adverse Effect	Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Drainlet	31.61	929+70	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	31.81	940+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	32.10	955+51	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	32.29	965+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	32.36		Contributing	Adverse Effect	Adverse Effect
Turnout	32.38		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	32.61	982+32	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	32.61		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	32.62		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	32.83	994+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	32.94		Contributing	Adverse Effect	Adverse Effect
Turnout	33.07		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	33.29	1018+27	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	33.53	1031+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	33.71	1040+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	33.71		Contributing	Adverse Effect	Adverse Effect
Drainlet	33.89	1050+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	33.90		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	33.98	1054+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	34.08		Contributing	Adverse Effect	Adverse Effect
Drainlet	34.30	1071+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Westley Wasteway	34.32	1072+55	Contributing	No Adverse Effect	No Adverse Effect
Drainlet	34.35	1074+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	34.39	1076+58	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	34.39	1076+33	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Building	34.42	1078+15	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 6	34.42	1078+15	Contributing	Adverse Effect	Adverse Effect
Canal Lining Section	34.45-54.40		Contributing	Adverse Effect	Adverse Effect
Stillwell	34.47	1081+15	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	34.50	1082+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	34.55		Contributing	Adverse Effect	Adverse Effect
Inlet	34.63	1089+42	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	34.63		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	34.76	1096+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	34.89	1102+78	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	35.04		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	35.05	1111+46	Non-Contributing	No Adverse Effect	No Adverse Effect
Siphon	35.05	1111+46	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	35.10	1114+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	35.18		Contributing	Adverse Effect	Adverse Effect
Drainlet	35.38	1128+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	35.39	1129+24	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	35.71	1146+49	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	35.72	1146+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	35.72	1146+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	35.73	1146+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	35.73	1146+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	35.73		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	35.74	1146+96	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	36.01		Contributing	Adverse Effect	Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Inlet	36.01	1162+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	36.09	1166+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	36.39		Contributing	Adverse Effect	Adverse Effect
Turnout	36.45		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	36.52	1189+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	36.55	1190+20	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	36.68		Contributing	Adverse Effect	Adverse Effect
Inlet	36.80	1200+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	36.81	1204+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	37.10	1204+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Siphon	37.24-37.31	1227+85	Contributing	No Adverse Effect	No Adverse Effect
Bridge	37.28	1229+28	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	37.32	1231+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	37.32		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	37.33		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	37.34	1231+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	37.58	1245+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	37.58		Contributing	Adverse Effect	Adverse Effect
Drainlet	37.70	1251+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	38.11	1273+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Misc	38.11	1273+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Misc	38.11	1273+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	38.14	1274+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	38.14		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	38.15		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	38.15		Contributing	Adverse Effect	Adverse Effect
Drainlet	38.39	1287+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	38.59	1298+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	38.64	1300+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	38.68	1302+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 7	38.68	1302+65	Contributing	Adverse Effect	Adverse Effect
Stillwell	38.74	1305+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Misc	38.76		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	38.80		Contributing	Adverse Effect	Adverse Effect
Drainlet	38.99	1319+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	39.20		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	39.21	1330+56	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	39.22		Contributing	Adverse Effect	Adverse Effect
Wasteway	39.32-39.42	1331-01	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	39.46		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	39.78		Contributing	Adverse Effect	Adverse Effect
Bridge	39.81	1362+42	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	39.86	1365+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	40.00	1365+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	40.37	1391+74	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	40.39		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	40.45		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	40.62	1405+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	40.77	1413+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	41.01	1425+70	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	41.03		Contributing	Adverse Effect	Adverse Effect
Drainlet	41.35	1433+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	41.49	1451+03	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	41.53		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	41.53		Contributing	Adverse Effect	Adverse Effect
Overchute	41.93	1474+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	41.94		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	41.99	1477+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	42.08		Contributing	Adverse Effect	Adverse Effect
Turnout	42.10		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	42.50	1504+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	42.50		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	42.51		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	42.52	1505+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	42.53	1505+86	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	42.53	1505+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	42.68		Contributing	Adverse Effect	Adverse Effect
Misc	42.90	1525+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	43.08	1535+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	43.22		Contributing	Adverse Effect	Adverse Effect
Inlet	43.22	1540+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	43.24	1542+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	43.24	1541+41	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	43.26	1542+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	43.73		Contributing	Adverse Effect	Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Inlet	43.73	1569+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	44.19	1593+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	44.20	1593+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	44.22		Contributing	Adverse Effect	Adverse Effect
Turnout	44.24		Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	44.24	1596+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	44.26	1597+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 8	44.26	1597+65	Contributing	Adverse Effect	Adverse Effect
Stillwell	44.32	1600+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	44.53	1610+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	44.56	1613+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	44.73	1622+01	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	45.20		Contributing	Adverse Effect	Adverse Effect
Drainlet	45.25	1647+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	45.26	1648+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	45.35		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	45.38		Contributing	Adverse Effect	Adverse Effect
Drainlet	45.43	1657+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	45.75		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	45.77	1675+17	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	45.78		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	45.79		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	45.92	1683+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	46.02		Contributing	Adverse Effect	Adverse Effect
Pipe	46.17		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	46.19		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	46.35	1705+80	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	46.36		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	46.36	1706+06	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	46.62	1720+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	46.83		Contributing	Adverse Effect	Adverse Effect
Bridge	46.84	1731+79	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	47.09	1745+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	47.37		Contributing	No Adverse Effect	No Adverse Effect
Turnout	47.37		Contributing	Adverse Effect	Adverse Effect
Bridge	47.38	1759+88	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	47.53	1768+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	47.87		Contributing	Adverse Effect	Adverse Effect
Bridge	47.88	1786+38	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	47.88	1786+15	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	47.88	1786+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	47.89		Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	48.13	1799+62	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	48.14		Contributing	Adverse Effect	Adverse Effect
Drainlet	48.37	1812+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	48.38	1812+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	48.59	1824+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	48.60		Contributing	Adverse Effect	Adverse Effect
Building	48.62	1825+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 9	48.62	1825+65	Contributing	Adverse Effect	Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Stillwell	48.69	1829+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	48.70	1829+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	48.80		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	48.96		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	48.97	1843+48	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	48.97	1843+48	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	49.20	1856+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	49.43	1868+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	49.43		Contributing	Adverse Effect	Adverse Effect
Inlet	49.54	1874+20	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	49.55	1874+64	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	49.56		Contributing	No Adverse Effect	No Adverse Effect
Drainlet	49.58	1876+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	49.71	1883+32	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	49.82	1889+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	49.84		Contributing	Adverse Effect	Adverse Effect
Shoulder Drain	50.00		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	50.20	1911+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	50.46		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	50.49	1927+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	50.49		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	50.53	1929+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	50.53	1929+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	50.66		Contributing	Adverse Effect	Adverse Effect
Turnout	50.70		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Siphon	51.18-51.27	1964+55	Contributing	No Adverse Effect	No Adverse Effect
Culvert	51.31		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	51.40	1975+64	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	51.41		Contributing	Adverse Effect	Adverse Effect
Turnout	51.65		Contributing	Adverse Effect	Adverse Effect
Inlet	51.66	1988+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	52.01	2007+68	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	52.02		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	52.18	2016+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	52.40	2028+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	52.40		Contributing	Adverse Effect	Adverse Effect
Drainlet	52.72	2057+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	52.85	2073+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	53.15	2083+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	53.39	2094+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	53.41		Contributing	Adverse Effect	Adverse Effect
Bridge	53.43	2096+86	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	53.63	2107+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	53.63	2107+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	53.64		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	53.98	2126+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	53.98	2126+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	54.01	2127+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	54.01		Contributing	Adverse Effect	Adverse Effect
Drainlet	54.36	2146+00	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Newman Wasteway	54.38	2147+00	Contributing	No Adverse Effect	No Adverse Effect
Stillwell	54.39	2147+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	54.41	2148+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 10	54.41	2148+65	Contributing	Adverse Effect	Adverse Effect
Canal Lining Section	54.44-69.00		Contributing	No Adverse Effect	No Adverse Effect
Stillwell	54.49	2152+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	54.67	2162+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	54.70		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	55.07	2183+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	55.19		Contributing	Adverse Effect	Adverse Effect
Culvert	55.23		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	55.34		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	55.85		Contributing	Adverse Effect	Adverse Effect
Drainlet	55.92	2247+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	55.95		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	56.02	2253+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	56.18		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	56.18	2261+55	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	56.60	2283+62	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	56.78		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	56.80		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	56.82		Contributing	Adverse Effect	Adverse Effect
Turnout	56.83		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	56.85		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	57.46	2340+00	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	57.46		Contributing	Adverse Effect	Adverse Effect
Drainlet	57.73	2354+18	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	57.95		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	57.95	2366+10	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	57.95	2366+10	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	58.25	2381+32	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	58.26		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	58.27		Contributing	Adverse Effect	Adverse Effect
Check No. 11	58.28	2382+00	Contributing	Adverse Effect	Adverse Effect
Building	58.28	2382+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Siphon	58.29-58.35	2384+25	Contributing	No Adverse Effect	No Adverse Effect
Stillwell	58.40	2389+70	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	58.46	2392+79	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	58.73	2392+79	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	58.90		Contributing	Adverse Effect	Adverse Effect
Turnout	59.50		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	59.50		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	59.53		Contributing	Adverse Effect	Adverse Effect
Bridge	60.06	2477+17	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	60.54		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	60.65		Contributing	Adverse Effect	Adverse Effect
Turnout	61.05		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	61.06	2530+22	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	61.37		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	61.84		Contributing	Adverse Effect	Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	62.08		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	62.09	2588+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	62.67		Contributing	Adverse Effect	Adverse Effect
Stillwell	63.95	2691+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	63.96		Contributing	Adverse Effect	Adverse Effect
Check No. 12	63.99	2693+00	Contributing	No Adverse Effect	No Adverse Effect
Building	63.99	2693+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	64.06	2697+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	64.28	2709+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	64.30	2710+33	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	64.32		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	64.32		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	64.85		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	65.35		Contributing	Adverse Effect	Adverse Effect
Turnout	65.37		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	65.38		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	65.52		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	65.89	2802+98	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	65.91	2802+98	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	66.06		Contributing	Adverse Effect	Adverse Effect
Turnout	66.20		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	66.68		Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	66.70	2844+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	66.73		Contributing	Adverse Effect	Adverse Effect
Turnout	67.16		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	67.16		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	67.16	2869+53	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	67.55		Contributing	No Adverse Effect	No Adverse Effect
Bridge	68.03	2922+13	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	68.03		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	68.03		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	68.58		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	68.58		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	68.59		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	68.83		Non-Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	69.00-69.25		Contributing	No Adverse Effect	No Adverse Effect
Turnout	69.21		Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	69.25-69.99		Contributing	No Adverse Effect	No Adverse Effect
O'Neill Forebay Inlet Canal	69.30	2985+99	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	69.62		Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	69.85		Non-Contributing	No Adverse Effect	No Adverse Effect
Volta Wasteway	69.98	3022+00	Contributing	No Adverse Effect	No Adverse Effect
Stillwell	69.99	3022+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 13	70.01	3023+65	Contributing	No Adverse Effect	No Adverse Effect
Building	70.01	3023+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	70.01	3023+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	70.04-85.08		Contributing	No Adverse Effect	No Adverse Effect
Stillwell	70.09	3027+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	70.13		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	70.62		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	71.31		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	71.31	3091+44	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	71.32		Contributing	Adverse Effect	Adverse Effect
Turnout	71.34		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	71.59		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	71.66		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	71.69		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	72.25		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	72.33	3145+53	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	72.33		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	72.34		Contributing	Adverse Effect	Adverse Effect
Bridge	72.80	3167+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	72.80		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	72.82	3167+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	73.06		Contributing	No Adverse Effect	No Adverse Effect
Turnout	73.38		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	73.43		Contributing	Adverse Effect	Adverse Effect
Culvert	73.81		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	73.87		Contributing	Adverse Effect	Adverse Effect
Turnout	74.35		Contributing	Adverse Effect	Adverse Effect
Stillwell	74.36	3253+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 14	74.40	3256+50	Contributing	Adverse Effect	Adverse Effect
Building	74.40	3256+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	74.45	3257+37	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Bridge	74.77	3275+58	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	74.84		Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	75.38	3307+80	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	75.43		Contributing	Adverse Effect	Adverse Effect
Bridge	75.84	3332+41	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	75.86	3256+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	76.03		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	76.03		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	76.05		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	76.77		Contributing	Adverse Effect	Adverse Effect
Turnout	77.19		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	77.20	3403+89	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	77.20		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	77.24		Contributing	Adverse Effect	Adverse Effect
Bridge	77.63	3426+93	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	77.98		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	78.56		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	78.57		Contributing	Adverse Effect	Adverse Effect
Overchute	78.59	3477+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	79.12	3506+26	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	79.12		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	79.13		Contributing	Adverse Effect	Adverse Effect
Stillwell	79.63	3533+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 15	79.64	3533+90	Contributing	Adverse Effect	Adverse Effect
Siphon	79.64-79.72	3534+50	Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Building	79.64	3534+58	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	80.00	3537+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	80.01	3537+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	80.03		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	80.34		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	80.34	3570+19	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	80.93		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	80.99		Contributing	No Adverse Effect	No Adverse Effect
Turnout	81.08		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	81.69	3641+23	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	81.79	3646+89	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	81.80		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	82.31		Contributing	No Adverse Effect	No Adverse Effect
Pipe	82.52		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	82.52	3685+64	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	82.79		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	82.79		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	83.07	3714+64	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	83.08		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	83.08		Contributing	No Adverse Effect	No Adverse Effect
Pipe	83.36		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	83.57		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	83.62		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	83.63		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Pipe	83.88		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	83.88	3757+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	84.38	3783+58	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	84.39		Contributing	Adverse Effect	Adverse Effect
Pipe	84.65		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	84.65		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	84.82	3806+72	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	84.82		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	85.04		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	85.05		Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	85.07	3819+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	85.08		Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 16	85.09	3821+50	Contributing	Adverse Effect	Adverse Effect
Building	85.09	3821+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	85.10-98.62		Contributing	No Adverse Effect	No Adverse Effect
Stillwell	85.14	3825+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	85.47		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	85.47	3841+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	85.68		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	86.17		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	86.17		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	86.19		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	86.19	3879+11	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	86.70		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	86.71		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	86.72		Contributing	Adverse Effect	Adverse Effect
Turnout	87.35		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	87.48		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	87.97		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	88.13	3981+67	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	88.24		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	88.62	4007+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	88.65		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	88.91		Contributing	No Adverse Effect	No Adverse Effect
Pipe	89.23		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	89.56		Contributing	No Adverse Effect	No Adverse Effect
Turnout	90.27		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	90.53		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	90.53		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	90.53		Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	90.53	4108+18	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	90.54	4108+70	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 17	90.54	4108+70	Contributing	Adverse Effect	Adverse Effect
Bridge	90.56	4110+17	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	90.56		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	90.57		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	90.57		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	90.57		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	90.57		Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	90.61	4110+64	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Bridge	90.91	4128+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Pip	90.91		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	91.71		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	92.23		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	92.73	4224+36	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	92.73		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	93.23		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	93.24	4251+55	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	93.25		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	93.27		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	94.26		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	94.27	4305+93	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	94.57		Contributing	Adverse Effect	Adverse Effect
Pipe	95.45		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	95.45	4368+05	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	95.45		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	95.50		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	95.50		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	95.95		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	96.61		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	96.61	4429+57	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	96.62		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	96.70		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	96.70		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	96.70		Non-	No Adverse	No Adverse

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
			Contributing	Effect	Effect
Turnout	96.70		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	96.70		Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	96.79	4432+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	96.81	4440+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 18	96.82	4440+00	Contributing	No Adverse Effect	No Adverse Effect
Stillwell	96.88	4441+37	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	97.68	4482+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	97.69		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	97.70		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	97.70		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	97.70		Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	98.64-111.55		Contributing	Adverse Effect	Adverse Effect
Bridge	98.74	4540+12	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	98.74		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	98.74		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	99.82	4597+05	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	99.82		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	100.23		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	100.80		Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	100.85		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	100.85	4652+15	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	100.85		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	101.27		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	102.03	4713+89	Non-	No Adverse	No Adverse

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
			Contributing	Effect	Effect
Turnout	102.04		Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	102.38		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	102.54		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	102.93		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	102.93		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	102.93	4761+81	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	102.95		Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	103.56		Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	104.74		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	105.03		Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	105.03		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	105.03	4873+29	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	105.04		Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	105.05	4875+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	105.05		Non-Contributing	No Adverse Effect	No Adverse Effect
Building	105.06	4875+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 19	105.06	4875+00	Contributing	Adverse Effect	Adverse Effect
Stillwell	105.09	4876+17	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	105.55	4901+06	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	105.55		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	105.56		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	106.48		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	106.58	4955+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	106.59		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Bridge	107.42	5000+14	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	107.85		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	109.45		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	110.12	5142+79	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	110.27		Non-Contributing	No Adverse Effect	No Adverse Effect
Siphon	110.96-111.02	5186+97	Contributing	No Adverse Effect	No Adverse Effect
Culvert	111.07		Non-Contributing	No Adverse Effect	No Adverse Effect
Firebaugh Wasteway	111.22	5190+03	Contributing	No Adverse Effect	No Adverse Effect
Stillwell	111.24	5201+70	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	111.24		Non-Contributing	No Adverse Effect	No Adverse Effect
Building	111.26	5201+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 20	111.26	5202+30	Contributing	Adverse Effect	Adverse Effect
Stillwell	111.28	5203+07	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	111.51	5216+16	Non-Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	111.55-114.05		Contributing	Adverse Effect	Adverse Effect
Canal Lining Section	114.05-116.61		Contributing	Adverse Effect	Adverse Effect
Siphon	115.57-115.59	5430+15	Contributing	No Adverse Effect	No Adverse Effect
Stillwell	116.45	5476+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	116.48	5477+10	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	116.48	5477+22	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 21	116.48	5477+37	Contributing	No Adverse Effect	No Adverse Effect
Building	116.50	5478+54	Non-Contributing	No Adverse Effect	No Adverse Effect

Delta-Mendota Canal Subsidence Correction Project Environmental Assessment/Initial Study

Appendix A: Supplemental Materials

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Appendix A Supplemental Materials

A.1 List of Preparers

This Environmental Assessment/Initial Study (EA/IS) was prepared by San Luis & Delta-Mendota Water Authority (SLDMWA) and the Bureau of Reclamation (Reclamation). A list of persons who prepared various sections of the EA/IS, prepared significant background materials, or participated to a significant degree in preparing this EA/IS is presented below in Table A-1 through Table A-3.

Table A-1. CEQA Lead

Preparers	Agency	Role In Preparation
Jacob Bejarano	SLDMWA	Project objective identification, alternative formulation, EA/IS development and review
Jaime McNeil	SLDMWA	Project objective identification, alternative formulation, EA/IS development and review
Rebecca Akroyd	SLDMWA	Project objective identification, alternative formulation, EA/IS development and review
Pablo Arroyave	SLDMWA	Project objective identification, alternative formulation, EA/IS development and review
Cindy Meyer	SLDMWA	Project objective identification, alternative formulation, EA/IS development and review
Scott Petersen	SLDMWA	Project objective identification, alternative formulation, EA/IS development and review

Key: CEQA = California Environmental Quality Act; SLDMWA = San Luis & Delta-Mendota Water Authority; EA/IS = Environmental Assessment/Initial Study

Table A-2. NEPA Lead

Preparers	Agency	Role In Preparation
Aniruddha (Babi) Bhattacharya	Reclamation	Project objective identification, alternative formulation, EA/IS development and review
Numan Mizyed	Reclamation	Project objective identification, alternative formulation, EA/IS development and review
Brandee Bruce	Reclamation	Project objective identification, alternative formulation, EA/IS development and review
Rain Emerson	Reclamation	Project objective identification, alternative formulation, EA/IS development and review
Jeremy Foin	Reclamation	EA/IS development and review
Vince Barbara	Reclamation	Project objective identification, alternative formulation, EA/IS development and review
Derya Sumer	Reclamation	Project objective identification, alternative formulation, EA/IS development and review
Shauna McDonald	Reclamation	EA/IS development and review

Preparers	Agency	Role In Preparation
Amanda Becker	Reclamation	Project objective identification, alternative formulation, EA/IS development and review

Key: NEPA = National Environmental Policy Act; EA/IS = Environmental Assessment/Initial Study

Table A-3. Consultants

Preparers	Degree(s)/Years of Experience	Experience and Expertise	Role In Preparation
CDM Smith			
Christopher Park, AICP, PMP	M.S. City and Regional Planning 15 years' experience	Water Resources Planner	Project Manager, Technical Review
Anusha Kashyap	M.S. Environmental Engineering 10 years' experience	Environmental Engineer	Project Management, Document Review and Revision, Introduction, Project Description
Laura Lawson	B.S. Environmental Studies 5 years' experience	Environmental Planner	Document Review and Revision, Project Description, Noise and Vibration, Air Quality, Greenhouse Gases
Abbie Woodruff, AICP	M.S. Urban and Environmental Planning B.S. Geography B.S. Environmental Studies 6 years' experience	Water Resources Planner	Water Quality, Water Supply, Geology and Soils, Recreation
Jenna Quan	B.S. Ecology, Evolution & Biodiversity <1 years' experience	Environmental Planner	Document Review and Revision, Affected Environment, Geology and Soils, Public Utilities and Power, Hazards and Hazardous Materials
Greta Gledhill	B.S. Environmental Policy Analysis and Planning <1 years' experience	Environmental Planner	Document Review and Revision
Jeremy Gilbride	B.S. Chemical Engineering 7 years' experience	Chemical Engineer	Air Quality and Greenhouse Gas Emissions
John Pehrson, MBA	B.S. Chemical Engineering 40 years' experience	Chemical Engineer	Technical Review- Air Quality and Greenhouse Gas Emissions
Yonnel Gardes	M.S. Transportation Engineering B.S. Civil Engineering 19 years' experience	Transportation Planner	Technical Review

Preparers	Degree(s)/Years of Experience	Experience and Expertise	Role In Preparation
Szu-han Chen	M.S. Civil and Environmental Engineering B.S. Urban Planning 9 years' experience	Transportation Planner	Traffic and Transportation
Danielle Tran	B.S. Environmental Science 3 years' experience	Environmental Scientist	Regulatory Settings
John Wondolleck	M.S. Zoology B.S. Biology 49 years' experience	Environmental Management	Technical Review
Samuel Bankston	B.S. Aquatic Biology 9 years' experience	Biologist	Biological Resources
Jennifer Jones	M.S. Environmental Science 20 years' experience	Environmental Scientist	Technical Review-Biological Resources
Brian Heywood, PMP	M.S. Civil Engineering B.S. Civil Engineering 25 years' experience	Water Resources Engineer	Technical Review- Water Quality, Water Supply
Brian Shepard	B.S. Geography and Environmental Resources A.A. Science 4 years' experience	Environmental Planner	GIS Specialist
Pacific Legacy			
John Holson, RPA	M.A. Anthropology, CRM 43 years' experience	Archaeology/Cultural Resources Management	Project Manager, Principal Investigator
Christopher Peske	B.A. Anthropology, M.A. in progress 9 years' experience	Archaeology	Field Director
Denise Duffy & Associates			
Josh Harwayne	M.S. Ecology and Systematic Biology 25 years' experience	Natural Resources Division Manager	Project Manager, Technical Review
John Wandke	M.S. Environmental Science 14 years' experience	Associate Scientist	Field Surveys, Document Preparation and Review, GIS Preparation
Rikki Lougee	B.A. Environmental Studies 3 years' experience	Assistant Environmental Scientist	Field Surveys, Document Preparation and Review

Preparers	Degree(s)/Years of Experience	Experience and Expertise	Role In Preparation
California Biordi	M.S. Environmental Science 4 years' experience	Assistant Environmental Scientist	GIS Preparation, Spatial Analyses
MBK Engineers			
Walter Bourez	M.S. Civil Engineering, 26 years' experience	Hydrological Modeling	Alternatives Development, CalSim Modeling
Wesley Walker	M.S. Civil Engineering, 4 years' experience	Hydrological Modeling	Alternatives Development, CalSim Modeling
Shankar Parvathinathan	Ph.D. Environmental Engineering 15 years' experience	Environmental Engineer	Alternatives Development, CalSim Modeling
JRP Historical			
Christopher McMorris	M.S. Historic Preservation 24 years' experience	Historic Architectural/Built Environment Resources	Project Manager for Historic Architectural/Built Environment Studies, Technical Review
Heather Norby	M.A. History 14 years' experience	Historic Architectural/Built Environment Resources	Lead Historian/Architectural Historian, Author Technical Studies
Destiny Beltran	B.S. Wildlife Biology 7 years' experience	Biologist II	Document Preparation

Key: AICP = Association of Certified Planners, ASQ = American Society of Quality, B.A. = Bachelor of Arts, B.S. = Bachelor of Science, CA = Certified Arborist, CERP = Certified Ecological Restoration Practitioner, CHMM = Certified Hazardous Materials Manager, CQA = Certified Quality Auditor, CWB = Certified Wildlife Biologist, MBA = Master of Business Administration, M.S. = Masters of Science, Ph.D. = Doctor of Philosophy, RCA = Registered Consulting Arborist, RPA = Register of Professional Archaeologists

A.2 Acronyms

AB	Assembly Bill
ACHP	Advisory Council on Historic Preservation
AF	acre-feet
APE	Area of Potential Effects
ARPA	Archaeological Resources Protection Act
B	beneficial
BAAQMD	Bay Area Air Quality Management District
BMP	best management practice
BP	before present
BRMMP	Biological Resources Management and Monitoring Plan

BSR	biological survey report
CAAQS	California Ambient Air Quality Standards
CalSim II	California Simulation Model II
Caltrans	California Department of Transportation
CARB	California Air Resources Board
CCIC	Central California Information Center
CCID	Central California Irrigation District
CDFW	California Department of Fish and Wildlife
CDPR	California Department of Parks and Recreation
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CHRIS	California Historical Resources Information System
CH_4	methane
CO_2	carbon dioxide
CRHR	California Register of Historical Resources
CTS	California Tiger Salamander
CVP	Central Valley Project
CVRWQCB	Central Valley Regional Water Quality Control Board
CY	cubic yard
dBA	A- weighted decibels
Delta	Sacramento-San Joaquin River Delta
DMC	Delta-Mendota Canal
DPM	diesel particulate matter
DPR	Department of Parks and Recreation
DWR	California Department of Water Resources
EA	Environmental Assessment
ESA	Endangered Species Act
GHG	Greenhouse Gas
Intertie Pumping Plant	Delta-Mendota Canal – California Aqueduct Intertie Pumping Plant
I	Interstate
IS	Initial Study
ITA	Indian Trust Assets
ITP	Incidental Take Permit
Jones Pumping Plant	C.W. Bill Jones Pumping Plant (formerly the Tracy Pumping Plant)
LOS	level of service
LTS	less than significant

M&I	municipal and industrial
MAF	million acre-feet
MM	mitigation measure
MP	mile post
$MTCO_2e$	metric tons CO_{2e}
MWSEL	maximum water surface elevation when canal is operated at design flow
NAAQS	national ambient air quality standards
NAHC	Native American Heritage Commission
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NI	no impact
NMFS	National Marine Fisheries Service
N_2O	nitrous oxide
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NWIC	Northwest Information Center
OM&R	operation, maintenance, and replacement
O_3	ozone
OHP	Office of Historic Preservation
PA	Programmatic Agreement
PM	particulate matter
PPV	peak particle velocity
PRC	Public Resources Code
Project	Delta-Mendota Canal Subsidence Correction Project
Reclamation	Bureau of Reclamation
ROC on LTO	Reinitiation of Consultation on the Coordinated Long-Term Operations of CVP and SWP
ROD	Record of Decision
ROW	right-of-way
RWQCB	Regional Water Quality Control Board
S	significant
SCAQMD	South Coast Air Quality Management District
SFBAAB	San Francisco Bay Area Air Basin
SGMA	Sustainable Groundwater Management Act
SHPO	California State Historic Preservation Office
SJKF	San Joaquin Kit Fox
SJVAB	San Joaquin Valley Air Basin
SJVAPCD	San Joaquin Valley Air Pollution Control District

SLDMWA	San Luis and Delta-Mendota Water Authority
SMS	Scenery Management System
SR	state road
SRA	state responsibility areas
SSH	state scenic highway
SSJVIC	Southern San Joaquin Valley Information Center
SWP	State Water Project
SWPPP	Stormwater Pollution Prevention Plan
TAC	toxic air contaminant
TAF	thousand acre-feet
USACE	United States Army Corps of Engineers
USC	United States Code
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VMT	vehicle miles traveled
WEAT	Worker Environmental Awareness Training
WIIN	Water Infrastructure Improvements for the Nation Act of 2016

A.3 References

A.3.1 Chapter 1 – Introduction

Bureau of Reclamation (Reclamation). 1959. *Delta-Mendota Canal: Technical Record of Design and Construction*. Technical Record of Design and Construction, Denver, Colorado. Accessed on September 26, 2022. Available at: https://books.google.com/books?id=b7HRAAAAMAAJ&pg=PP9#v=onepage&q&f=false

A.3.2 Chapter 2 – Project Description

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A.3.4 Chapter 4 – Environmental Impacts

A.3.4.1 Surface Water Supply

No References

A.3.4.2 Water Quality

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Delta-Mendota Canal Subsidence Correction Project Environmental Assessment/Initial Study

Appendix B: Plan Formulation Technical Memorandum

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Delta-Mendota Canal Subsidence Correction Project
Plan Formulation Technical Memorandum

Prepared by
United States Department of the Interior
Bureau of Reclamation
California-Great Basin

San Luis & Delta-Mendota Water Authority
Los Banos, CA

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Abbreviations and Acronyms

CEQA	California Environmental Quality Act
cfs	cubic foot per second
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
D&S	Directive and Standards
Delta	Sacramento-San Joaquin Delta
DMC	Delta-Mendota Canal
DWR	California Department of Water Resources
EA/IS	Environmental Assessment/Initial Study
ESA	Endangered Species Act
FONSI	Finding of No Significant Impact
JPOD	Joint Point of Diversion
MP	Mile Post
MWSEL	Maximum Water Surface Elevation when canal is operated at design flow
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
OM&R	Operation, Maintenance and Replacement
PR&G	Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies
Project	Delta-Mendota Canal Subsidence Correction Project
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
ROC on LTO	Reinitiation of Consultation on the Coordinated Long-Term Operation of Central Valley Project and State Water Project
ROD	Record of Decision
ROW	Right-of-way
SGMA	Sustainable Groundwater Management Act
SLDMWA	San Luis & Delta-Mendota Water Authority
SWP	State Water Project
TAF	thousand acre-feet
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
VP Study	Value Planning Study, conducted by Reclamation in 2021
WIIN Act	Water Infrastructure Improvements for the Nation Act of 2016. Public Law 114-322

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Chapter 1 Introduction

This report describes the alternatives identification, evaluation and selection process, and selected alternative identified for evaluation in the Delta-Mendota Canal (DMC) Subsidence Correction Project Feasibility Report and Environmental Assessment (EA)/Initial Study (IS).

1.1 Project Background and History

The DMC is a 116-mile-long canal which conveys water from the Sacramento-San Joaquin Delta (Delta) region near Tracy, California to the Mendota Pool near Mendota, California (Figure 1). This canal is one of the major components of the Delta Division of the U.S. Department of the Interior, Bureau of Reclamation's (Reclamation) Central Valley Project (CVP) and is considered critical infrastructure. The San Luis & Delta-Mendota Water Authority (SLDMWA) operates and maintains the DMC on Reclamation's behalf pursuant to Transfer Agreement Contract No. 8-07-20-X0354-X (January 14, 2020).

The DMC delivers water to agricultural, refuge, and municipal and industrial contractors; a significant portion of the water is used to irrigate agricultural lands in the Central Valley and Santa Clara and San Benito Counties. The main crops in the DMC's service area are tree fruit, melons, grapes, vegetables, and deciduous nuts, making the DMC an important contributor to the success of California's agricultural economy (Water Education Foundation 2022).

The DMC was designed by Reclamation in the late 1940's, in compliance with then-current Design Standards and standard industry practices, and construction was completed in 1951. The upper segment of the DMC is lined with four-inch unreinforced concrete. At Mile Post (MP) 98.64 (Station Number 5201+00), the concrete lining is replaced by earthen lining, which continues for the lower 18 miles of the DMC. During design, Reclamation found that the expansive properties of the clay soil surrounding the lower segment of the canal would be detrimental to a concrete lining. Additionally, high groundwater in areas of the lower 18-mile segment would require an elaborate drainage system to be installed underneath any potential concrete lining. Therefore, Reclamation decided to use suitable clay soil from canal excavation to form an earthen lining for the lower 18-mile segment of the DMC (Reclamation 1959).

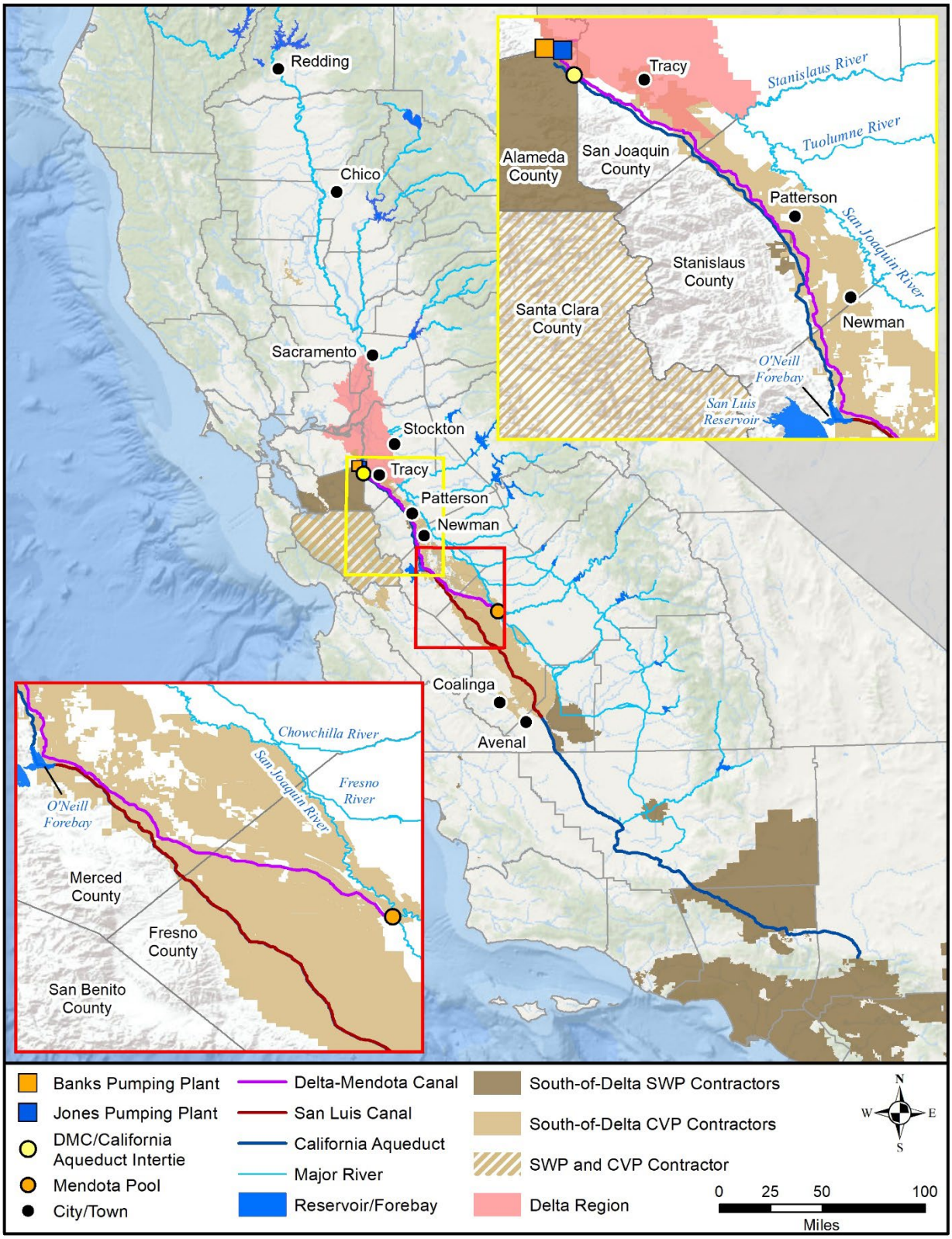


Figure 1. Project Location Map

The DMC was originally designed to convey a variable flow rate, the maximum being 4,600 cubic feet per second (cfs) at its origin (the C.W. "Bill" Jones Pumping Plant near Tracy, CA), reducing to the minimum of 3,210 cfs at its terminal point at Mendota Pool near Mendota, CA. The water is lifted from the Delta into the DMC via large pumps at the C.W. "Bill" Jones Pumping Plant (Jones Pumping Plant; formerly the Tracy Pumping Plant). This pumping plant lifts the water 200 feet to allow for gravity flow through the remaining 113 miles of the DMC, with one major diversion at the San Luis Reservoir/O'Neill Forebay. The DMC has numerous turnouts and delivery locations along its length to service water demands, and a series of check structures and wasteways to monitor, control, and release the flows as needed for operational demands and safety needs. The 700 cfs capacity DMC/California Aqueduct Intertie Pumping Plant (Intertie Pumping Plant) was added to the DMC delivery system in 2012 and is a key component for compensating for diminished capacity in the upper DMC. The Intertie Pumping Plant accomplishes this by pumping water from the DMC into the California Aqueduct for conveyance to O'Neill Forebay where it can be pumped into and stored as CVP supply in San Luis Reservoir, released to the San Luis Canal and the Dos Amigos pumping plant for delivery as CVP supply, or released through the O'Neill Pumping Plant to the lower DMC for delivery as CVP supply. In the short term, the Intertie Pumping Plant allows the subsidence-caused bottleneck in the upper reach of the DMC to be bypassed. Water can also be conveyed from the California Aqueduct to the DMC through the Intertie Pumping Plant; up to 900 cfs can be conveyed from the California Aqueduct to the DMC via gravity flow (Reclamation 2022).

Since its original construction, the DMC has been affected by subsidence generated by groundwater pumping. Reclamation performed construction on the canal to remediate subsidence issues in 1969 and 1977, with work consisting of raising miles of concrete liner and multiple structures. However, subsidence has continued, and the DMC is no longer able to convey the original design flows while operating in accordance with Reclamation Safety Standards and Guidelines. These limits on conveyance capacity have introduced operational constraints that can affect deliveries to south-of-Delta CVP water users. To fully optimize CVP storage and support Reclamation's contract deliveries to south-of-Delta CVP water users, the capacity of the DMC must be restored. The DMC Subsidence Correction Project (Project) is proposed to restore conveyance capacity and avoid constraints on the operation of the CVP, as well as address operational safety concerns generated by subsidence.

The Omnibus Public Land Management Act of 2009 (Public Law 111-11) provides Reclamation with the authority to complete or fund work on a project such as the CVP, where the O&M responsibilities have been transferred to a local entity, subject to a repayment contract. This Project meets the definition of extraordinary maintenance, as defined in Public Law 111-11, Section 9603, which includes "major nonrecurring maintenance to Reclamation-owned or operated facilities, or facility components." The Feasibility Report currently underway has been authorized and funded through the Water Infrastructure Improvements for the Nation (WIIN) Act of 2016 (Public Law 114-322) storage projects eligible under Section 4007. Consistent with WIIN and Reclamation's Directive and Standards CMP-09-02, Reclamation has signed a 50-50 cost sharing agreement with SLDMWA, who is the O&M entity of the facility and the nonfederal partner for the Project. Reclamation and SLDMWA are in initial stages of discussion on developing a funding strategy to support final design and construction using federal and other funding.

1.1.1 Groundwater Extraction and Land Subsidence in the San Joaquin Valley

Land subsidence, described as the gradual sinking of a land area, is typically the result of declining groundwater levels due to pumping at a rate higher than that of the aquifer's recharge. Because water

in aquifers (especially aquifers composed of fine-grained sediments, which are common in the Central Valley) is somewhat responsible for supporting the structure of the land above it, removing large amounts of water from an aquifer can cause the sediments to compact and the land above to sink (United States Geological Survey [USGS] 2018a). This deformation of aquifers composed of fine-grained sediments is sometimes inelastic, resulting in permanent land subsidence (USGS 2018b). In addition, a portion of the compaction can be residual compaction that occurs over a longer period of time as a result of the delayed drainage of low-permeability fine-grained sediments (USGS 2018b). The San Joaquin Valley has a history of significant regional land subsidence—between 1926 and 1970 land subsidence exceeding 27 feet (8.5 meters) was recorded in the most affected regions of the valley (Poland et al. 1975).

The Sustainable Groundwater Management Act (SGMA) was passed in 2014 with the purpose of regulating groundwater extraction to protect California's groundwater resources over the long term and reduce the occurrence of unsustainable groundwater overdraft. SGMA requires local groundwater sustainability agencies to develop groundwater sustainability plans to mitigate groundwater overdraft within the next 20 years, prioritizing groundwater basins with the greatest problems. These basins are classified as high- and medium-priority basins (California Department of Water Resources [DWR] 2022a).

The DMC is located over the Tracy and Delta-Mendota subbasins, which lie within the San Joaquin Valley groundwater basin. These subbasins are differentially impacted by groundwater overdraft; in the SGMA prioritization categories, the Tracy subbasin is ranked as medium priority whereas the Delta-Mendota subbasin is ranked as high priority/critically overdrafted (DWR 2022b). Because SGMA's regulation of groundwater extraction is focused on medium and high priority basins, groundwater extraction in these areas is expected to be conducted in a more sustainable way following the implementation of SGMA. Once the actions outlined in SGMA are fully implemented, the occurrence and severity of land subsidence is expected to decrease. The contribution of regional groundwater use to subsidence in the Central Valley is anticipated to continue through full SGMA implementation in 2040, with residual subsidence forecast to continue through the year 2070, the design life of the DMC.

1.1.2 Effects of Land Subsidence on the Delta-Mendota Canal: Loss of Available Freeboard and Other Structural Issues

Land subsidence in the most impacted areas along the length of the canal has caused major structural issues that affect the canal's ability to safely carry the capacity of water that it was designed to (its design capacity). The main structural issues caused by land subsidence are the sinking of the canal's lining and embankments, which cause the canal's shape to change in a way that reduces the volume of water that it can carry and therefore reduces the amount available freeboard as the water level rises. Freeboard is the vertical clearance, or additional lining/bank height, above the maximum-designed water surface that acts as an important safety feature to prevent embankment erosion caused by wind waves, protect against flooding in the event of higher-than normal water flows, and more (Reclamation 2018). Reclamation Safety Standards require that available freeboard space should range between 2.21 to 2.36 feet for the concrete-lined segment of the DMC, 1.43 to 1.44 feet for the earth-lined segment, and 4.58 to 4.9 feet for the bank. The rise of the water level in some areas of the canal in response to land subsidence impedes on the available freeboard, meaning that the capacity of the canal must be reduced if it is to operate in accordance with Reclamation Safety Standards and Guidelines. Another safety consequence of land subsidence on the canal is that the clearance space between the water level and some bridges is reduced. Currently, 30 bridges out of

the existing 115 along the DMC are considered deficient because they have less than one foot of clearance above the maximum water surface elevation (MWSEL), resulting in deficient bridges being partially submerged when the canal is operated at design capacity. Therefore, if these deficiencies are not rectified, the flow in the canal needs to be restricted further below its current flows so that the canal can be operated in accordance with Reclamation's Safety guidelines as mentioned above.

Because land subsidence varies in severity along the DMC, the loss of available freeboard is not uniform and therefore the reduction in capacity throughout the canal is not uniform. Generally, the northern section of the canal is less impacted by subsidence than the southern section (current capacity reduction in the northern section hovers between eight to 18 percent [368–781 cfs] below design capacity whereas current capacity reduction increases to around 12 to 31 percent [434–1,036 cfs] below design capacity in the southern section), excluding Mile Post (MP) 70 to 85 (station 3023+00 to between stations 3806+72 and 3819+00), where current capacity is reduced by zero to nine percent (0 to 344 cfs). If no action is taken to adjust the capacity of the DMC, the flow in the canal is forecasted to be reduced by up to 44 percent (1,457 cfs) of design capacity by 2070 (design life of the canal) at MP 105 (between stations 4865+00 and 4871+95) when operating in accordance with Reclamation Safety Standards. The least affected region, from MP 70 to 85 (station 3023+00 to between stations 3806+72 and 3819+00), is expected to undergo a capacity reduction of around six to 12 percent (205 to 436 cfs) of design capacity by 2070.

After the DMC capacity reduction issues were initially identified, a separate project was designed in the late 2000s, the Intertie Pumping Plant, which functions by conveying water through the California Aqueduct to O'Neill Forebay for use in the DMC. In the short-term, the Intertie Pumping Plant allows the subsidence-caused bottleneck in the upper reach of the DMC to be bypassed.

1.2 Plan Formulation Process

Consistent with the National Environmental Policy Act (NEPA), the plan formulation process for federal water resources studies is identified in the U.S. Department of the Interior's *Agency Specific Procedures For Implementing the Council on Environmental Quality's Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies* (PR&G) and consists of the following deliberative and iterative steps:

- Identifying water resources problems, needs, and opportunities, and developing planning objectives, constraints, and criteria.
- Inventorying and forecasting conditions likely to occur in the study area.
- Evaluating and comparing alternative plans.
- Selecting a plan for recommendation to decision makers for implementation or no action.

For the Project, this iterative process was separated into multiple phases, as described below:

- **2020 Appraisal Study** – An Appraisal Level study was conducted to identify the sufficient and deficient lengths of canal lining, canal embankment, and associated structures present along the full length of the DMC. This study determined that only 24.82 miles of the 116.51 miles of the canal are sufficient to convey the design flows, whereas 91.69 miles are deficient.
- **2021 Value Planning Report –** The Value Planning Study (hereafter referred to as VP Study) identified a broad range of ideas and options that best meet the goals of the Project. The main goal of the Project identified in the VP Study was to modify or replace existing facilities and construct new facilities to restore the capacity of the DMC and deliver water to satisfy Reclamation's contractual obligations and all other stakeholders. The VP Study also required that the selected solution must include a prioritization of the investment, maintenance of the system's reliability, and protection of the public.
- **2021 Feasibility Study of the Structural Alternatives** – The *Delta-Mendota Canal Subsidence Project — Feasibility Study of the Structural Alternatives* (Feasibility Study of the Structural Alternatives) was conducted by Reclamation in 2021 to further analyze, develop, and combine four alternatives identified in the VP study as solutions to the subsidence problem of the DMC. The study also included a technical evaluation of the alternatives identified and their ability to restore the DMC to its original capacity while satisfying current Reclamation, State, and local design standards. Possible impacts on future canal operations were also presented if the canal is not corrected at this time.

1.3 Planning Objectives, Constraints, and Criteria

1.3.1 National Planning Objective

The Federal Objective, which is defined in the PR&G by the *Water Resources Development Act of 2007* (Public Law 110-114, Section 2031), specifies that federal water resources investments should reflect national priorities, encourage economic development, and protect the environment by doing the following:

- Seek to maximize sustainable economic development.
- Seek to avoid the unwise use of floodplains and flood-prone areas and minimize adverse impacts and vulnerabilities in any case where a floodplain or flood-prone area must be used.
- Protect and restore the functions of natural systems and mitigate any unavoidable damage to natural systems.

Two key concepts in the PR&G are "federal investment" and "public benefit." The PR&G states that total level of a given investment shall be determined on a present value basis over the life of the federal investment. In consideration of the many complex water management challenges and competing demands for limited federal resources, federal agencies investing in water resources should strive to maximize public benefits, particularly compared to costs. Public benefits encompass environmental, economic, and social goals, include monetary and nonmonetary effects and allow for the inclusion of quantified and unquantified measures (U.S. Department of the Interior 2015). Stakeholders and decision makers expect the formulation and evaluation of a diverse range of alternative solutions, which may produce varying degrees of benefits and/or impacts. As a result, the trade-offs among potential solutions need to be assessed and properly communicated during the decision-making process.

1.3.2 Planning Constraints and Other Considerations

1.3.2.1 Partnership and Funding Framework

The Omnibus Public Land Management Act of 2009 (Public Law 111-11) provides Reclamation with the authority to complete or fund work on a project such as the CVP, where the operations and maintenance (O&M) responsibilities have been transferred to a local entity, subject to a repayment contract. This Project meets the definition of extraordinary maintenance, as defined in Public Law 111-11, Section 9603, which includes "major nonrecurring maintenance to Reclamation-owned or operated facilities, or facility components." The Feasibility Report currently underway has been authorized and funded through the Water Infrastructure Improvements for the Nation (WIIN) Act of 2016 (Public law 114-322). Consistent with WIIN and Reclamation's Directive and Standards (D&S) CMP 09-02, Reclamation executed a 50-50 cost sharing agreement with SLDMWA which is the operation, maintenance, and replacement (OM&R) entity for the facility and the Non-Federal partner for the Project. Reclamation and SLDMWA are in the initial stages of discussion on developing a proposed repayment contract to support Final Design and Construction using Federal funding.

1.3.2.2 Laws, Regulations, and Policies

Numerous laws, regulations, executive orders, and policies need to be considered, such as: the PR&G, NEPA, Clean Air Act, Clean Water Act, National Historic Preservation Act, California Public Resources Code, Federal Endangered Species Act (ESA) and California ESA, California Environmental Quality Act (CEQA), and the Central Valley Project Improvement Act (CVPIA). The CVPIA of 1992 (Public Law 102-575) is pertinent because of its influence on water supply deliveries and related environmental conditions in the study area.

1.3.3 Criteria

The federal planning process in the PR&G includes four specific criteria for consideration in formulating and evaluating alternatives: completeness, effectiveness, efficiency, and acceptability (U.S. Department of the Interior 2015).

- Completeness is the extent to which an alternative provides and accounts for all features, investments, and/or other actions necessary to realize the planned effects, including any necessary actions by others. It does not necessarily mean that alternative actions need to be large in scope or scale.
- Effectiveness is the extent to which an alternative alleviates the specified problems and achieves the specified opportunities.
- Efficiency is the extent to which an alternative alleviates the specified problems and realizes the specified opportunities at the least cost; and
- Acceptability is the viability and appropriateness of an alternative from the perspective of the Nation's general public and consistency with existing federal laws, authorities, and public policies. It does not include local or regional preferences for particular solutions or political expediency.

These criteria, and how they apply in helping to compare alternative plans, are described in Chapter 3.

1.4 Problems and Needs

Land subsidence has already caused substantial reductions in the amount of water the DMC can safely convey by causing the canal lining and embankments to sink, resulting in reduced available freeboard and clearances between maximum water surface elevations and structures crossing the DMC. This regional land subsidence is forecasted to continue until at least full implementation of SGMA in 2040 and residually beyond 2040, further impacting the capacity of the DMC through the design life of the canal continuing to limit the amount of water that can be safely delivered to south-of-Delta CVP water users unless action is taken to address this issue (see Figure C-1 in Appendix C).

The Project is critical for the continued operation of the DMC, a vital component of the CVP, as it will restore the conveyance capacity, and ensure the DMC's structural integrity and operational safety are protected and restored. Restoring the conveyance capacity would return the diminished yields and improve water supply reliability to south-of-Delta CVP contractors, meeting the objective to maximize net public benefits.

1.5 Project Objective/Purpose and Need

1.5.1 Project Purpose and Need

As a result of subsidence, the available freeboard for the canal lining and the canal embankment, and clearances between maximum water surface elevations and many structures crossing the DMC, no longer meet Reclamation standards. The combination of reduced freeboard and impacted structures requires that SLDMWA operate the DMC at lower water surface elevations, which reduces its capacity to convey water supply deliveries to south-of-Delta CVP water users dependent on that supply. The continued, safe, and reliable operation of the DMC is critical to the users it serves, and the economies it supports. The purpose and need of Reclamation's Proposed Action is to restore the originally authorized conveyance capacity of the DMC (the design capacity conveys a variable flow rate decreasing from 4,600 cfs at the upstream end to 3,210 cfs at the downstream end).

In compliance with the Council on Environmental Quality's *Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies* (PR&G) and Reclamation's D&S CMP 09-02 *Water and Related Resources Feasibility Studies*, Reclamation and SLDMWA are evaluating the feasibility of alternatives that would restore the lost conveyance capacity in the DMC caused by regional subsidence. This plan formulation was developed to detail the process of identifying potential alternatives, the evaluation and selection process, and selecting an alternative to be evaluated in the Delta-Mendota Canal (DMC) Subsidence Correction Project Feasibility Report and EA/IS.

1.5.2 CEQA Primary Goals and Objectives

Under CEQA, a lead agency must identify the objectives sought by the proposed project when that project requires an Environmental Impact Report (CEQA Guidelines Section 15124(b)). Although a statement of project objectives is not required under CEQA for an Initial Study (IS), the additional information provided in this section is consistent with CEQA Guidelines. The primary goal for the Project is to restore or replace conveyance capacity in the DMC lost to regional subsidence. The objectives of the Project are as follows:

1. To restore the long-term reliability and quantity of CVP supplies delivered to south-of-Delta contractors dependent on the DMC currently affected by reduced deliveries limited by the canal's reduced conveyance capacity.
2. To support the safe long-term operation of the DMC consistent with its design for freeboard and clearances between maximum water surface elevations and structures crossing the canal.

1.5.2.1 Additional Goals and Objectives

The Project is being designed and implemented to achieve the primary goals and objectives listed above. CEQA Guideline 15124(b) states that the goals and objectives may also outline Project benefits. The additional benefits of the Project are as follows:

- Restore capacity of the DMC for the short-term conveyance of non-CVP water[1] to provide increased water supply reliability and operational flexibility to south-of-Delta CVP contractors and potentially convey surface water supplies for other water users.
- Design and maintain the restored capacity of the DMC for a service life of at least 50 years to avoid potential future reductions in conveyance capacity resulting from continued subsidence forecast following Project implementation.

1.6 Purpose of the Memorandum

This Plan Formulation Technical Memorandum documents the process used to develop the alternatives for the DMC Subsidence Correction Project. The Lead Agencies are using this structured planning process to delineate a reasonable range of alternatives for evaluation in the Feasibility Report and the EA/IS in compliance with CEQA and NEPA.

[1] Environmental compliance for transfer actions including sellers making water available and the conveyance of transferred water to south-of-Delta CVP contractors is analyzed outside this EA/IS in separate environmental compliance documents, including but not limited to the Long-Term Water Transfers environmental document, available here: https://www.usbr.gov/mp/nepa/nepa_project_details.php?Project_ID=18361.

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Chapter 2 Pre-Screening of Alternatives

This section summarizes the initial evaluation completed by Reclamation and SLDMWA of existing subsidence generated limits on the operation of the DMC and the identification of potential options to restore that impacted capacity as part of the Appraisal and Feasibility Level Studies and Value Planning Study. In 2020, Reclamation completed an Appraisal Study to identify the sufficient and deficient lengths of canal lining, embankment, and associated structures present along the full length of the DMC. This study determined that only 24.82 miles of the 116.51 miles of the canal are sufficient to convey the design flows, whereas 91.69 miles are deficient.

Following the completion of the Appraisal Study, Reclamation developed a Value Planning Study in 2021 with the purpose of identifying a broad range of ideas or options that best meet the goals of the Project. The main goal of the Project identified in the VP Study was to modify or replace existing facilities and construct new facilities to restore the conveyance capacity of the DMC and deliver water to satisfy Reclamation's contractual obligations and all other stakeholders. The VP Study also required that the selected solution must include a prioritization of the investment, maintenance of the system's reliability, and protection of the public.

2.1 Measures and Alternatives

To begin the process of finding a solution that meets the Project goals, the Reclamation VP Study Team (Team), which included members from Reclamation and SLDMWA, drafted a broad list of 29 measures (referred to in the VP Study as "ideas") that were aimed at solving the problem of the reduced capacity of the DMC. These initial measures are presented in Table 1.

Table 1. Initial Measures

	Measure Description	Disposition
1	Raise canal lining and embankment and associated structures utilizing the existing prism (a) modify impacted bridges (b) siphon at appropriate bridges	Alternative.
2	Raise canal lining and embankment and associated structures utilizing the existing prism siphon at appropriate bridges	Design Consideration/Constraint.
3	Lower/modify the canal invert to reduce impacted structures	Alternative.
4	Widen the canal (a) add culverts at the bridges to reduce impacts (b) change the prism geometry below the top width	Alternative.
5	Replace existing conveyance system to pressurized pipeline (a) one pipe, full flow capacity, within embankment (b) two pipes, half flow capacity each, within embankments	Alternative.
6	Canal lining stays existing and use a pressurized pipeline(s) sized to equal the deficiency within the canal construction (a) within embankment (b) outside of ROW (c) within canal prism including divider wall	Alternative.

	Measure Description	Disposition
7	Canal lining stays existing and use a culvert(s) (gravity flow) sized to equal the deficiency within the canal construction (a) within embankment (b) outside ROW (c) within canal prism including divider wall	Alternative.
8	Rebuild new canal (a) at full flow capacity (b) at deficient flow capacity	Alternative.
9	Do nothing	Alternative, for comparison only.
10	Optimize Water Distribution by reducing canal flows through water exchange and/or point of delivery and/or reverse flow and/or treat and reuse recycled water	Alternative.
11	Add mixtures to limit/eliminate algae growth	Design Consideration/Constraint.
12	Cover canal with "tarp"	Design Consideration/Constraint.
13	Cover canal with solar panel	Design Consideration/Constraint.
14	Erosion protection in unlined sections of the canal, do this first	Included in all Alternatives with relining.
15	Funding and Phasing (start with "easy" end with long-lead items) for the project	Design Consideration/Constraint.
16	Alternative water source for Mendota Pool temporarily, coordination with Friant Water Authority to release water into the San Joaquin River, low flow times only	Design Consideration/Constraint.
17	Temporarily utilize San Luis Drain to convey flows up to 200 cfs	Design Consideration/Constraint.
18	Temporarily supply some users with alternative source water, San Luis Water District can take water out of the San Luis Canal	Design Consideration/Constraint.
19	Permanently supply users with alternative source water, water exchange scenario	Alternative.
20	Exchange contract with California Aqueduct, by enhancing existing agreement	Alternative.
21	Change the point of delivery to districts	Likely more expensive and complex than other Alternatives.
22	Enlarge the point of deliveries to supply more water upstream from canal reducing the required flow within the canal (likely works well on the Lower DMC)	Alternative.
23	Include the ability to reverse the direction of the flow in the canal (reverse flow)	Part of Alternative.
24	Utilize solar panels over the canal to power pumping from Measure 23	Design Consideration.
25	Siphon under highway section or other major road crossing	Part of Alternative.
26	Siphons on the Lower DMC	Included above.
27	Consider various options for structural component modifications	Included above.

	Measure Description	Disposition
28	Use trenchless technology to put pipeline crossings under the canal	Included above.
29	Treat and reuse recycled water to reduce downstream canal demands	Likely too expensive without enough benefit (flow reduction).

Key: White boxes represent measure that were identified as infeasible; Gray boxes represent measures that were identified as feasible. cfs = cubic feet per second; DMC = Delta-Mendota Canal

The Team considered each of the measures and screened out any (represented by white boxes in Table 1) that were identified as being infeasible due to high cost or having major design constraints. For example, use of siphons under Measure 2 would only be possible at one bridge and that bridge currently has freeboard and is not in an area of subsidence. The remaining measures (represented by gray boxes in Table 1) were identified as having potential to be feasible and meet the Project's goals when employed either alone or in tandem with other measures. These measures were further refined and combined by the Team to create 11 alternatives that were evaluated in more depth via a scoring process in the remainder of the VP Study. The 11 alternatives that were born from the refinement and combination of these initial measures are detailed in Table 2.

Table 2. Alternatives Evaluated in Value Planning Study

Alternative	Title	Description
1	Raise Deficient Lining, Embankment, and Impacted Bridges	Raise canal lining & embankment to satisfy freeboard requirements at deficient locations along the canal and modify other impacted structures.
2	Lower the Canal Invert (includes divider wall in portions of the canal)	Lower canal invert at non-subsided locations to restore the hydraulic slope of the canal and reduce the number of impacted structures anticipated to be raised.
3	Widen Canal and Add Culverts at Bridges	Widen canal at top portion on one or both side(s), adding culverts at the outside of bridge abutments.
4	Change Canal Prism Below Top Width (includes divider wall)	Modify canal prism below the top width of the canal to increase capacity and freeboard in accordance with regulations without widening the canal. Currently deficient structures would not need to be replaced.
5	Pressurized Pipeline(s) for Deficient Flow Within Embankment	Create new, buried pipeline(s) within the canal embankment to divert deficient flows of approximately 500-600 cfs.
6	Pressurized Pipeline(s) for Deficient Flow Within Canal Prism (includes divider wall)	Create new pipeline(s) within the canal prism that would be larger than that in Alternative 5.
7	Culvert(s) for Deficient Flow Within Embankment	Construct parallel culvert(s) along the canal embankment at segments that constrict flow to restore canal flow to design capacity.
8	Culvert(s) for Deficient Flow Within Canal Prism (includes divider wall)	Install culvert(s) within the canal prism. Similar to Alternative 7.

Alternative	Title	Description
9	Build New Parallel Canal at Deficient Flow Capacity	Construct a new parallel canal within the existing ROW that would convey flow capacity in excess of the existing canal capacity, meeting safety requirements.
10	Baseline Condition (not considered a solution, included for comparison only)	No action. Current deficient lining lengths (91.7 miles) includes both concrete- and earthen-lined segments of the canal. Given predicted subsidence, approximately 63 vehicular bridge crossings and other utilities would become fully/partially submerged in the future.
11	Optimize Water Distribution	Optimize the use of existing water conveyance systems within the DMC service area, such as the California Aqueduct, district interconnected facilities, and more to reduce DMC flows.

2.2 Pre-Screening Criteria and Process

To further evaluate the potential feasibility and function of Alternatives 1 through 11 and identify the most promising alternatives, the Team developed a set of seven criteria and a scoring system. The seven criteria are consistent with the definition of feasibility as defined under CEQA Guidelines Section 15364. The criteria were weighted differentially in the scoring process based on each criterion's importance in achieving the project goal of restoring the capacity of the DMC while prioritizing long-term investment, reliability, and public safety. These criteria, their weighting, and the scoring system used to evaluate the alternatives are detailed in Table 3.

Alternatives 1 through 11 were evaluated based on the criteria detailed in Table 3 and given a score ranging from one (representing the least favorable outcome) to five (representing the most favorable outcome). These scores were multiplied by the criteria weights, and scores were summed for each alternative.

Table 3. Screening Criteria, Scoring, and Weighting

	Criterion	Evaluation Question	Scoring	Weight (%)
A	OM&R Cost	What is the cost of OM&R? How complicated or difficult is the OM&R compared to the service life and longevity?	5: Low/Favorable 1: High/Unfavorable	9
B	Capital Cost[1]	What is the capital cost?	5: Low 1: High	9
C	Sequencing/Seasonality	How flexible are the sequences of construction?	5: Highly Flexible 1: No Flexibility	9
D	Future Flexibility and Fringe Benefits	Does the solution create future benefits/opportunities?	5: Many 1: None	5
E	Permit Requirements	How complex is the permitting compared to other alternatives?	5: Low Complexity 1: High Complexity	16
F	Delivery Impacts	What is the impact of the solution on the delivery of water (including pipeline crossing deliveries)?	5: Minimal Impact 1: Maximum Impact	41
G	Project Phasing	How easily is the solution phased considering schedule, funding, and user impact?	5: Favorable 1: Unfavorable	11

Notes:
[1] Capital cost is defined as the sum of the construction costs and interest during construction.
Key: OM&R = operation, maintenance, and replacement; % = percent

2.3 Pre-Screening Results

The relative scores and rankings of the 11 alternatives as evaluated against the criteria are detailed in Table 4. Scores highlighted in green correspond to alternatives that scored high enough to be considered further, either individually or in tandem with one another. Scores highlighted in blue correspond to alternatives that will no longer be considered as a solution for the Project. The No Action Alternative (Alternative 10) is highlighted in red.

Table 4. Scoring of No Action Alternative and Five Highest-Scoring Action Alternatives

	Score									
Criteria (Weight %)	OM&R Costs (9)	Capital Costs (9)	Sequencing and Seasonality (9)	Future Flexibility & Fringe Benefits (5)	Permit Requirements (16)	Delivery Impacts (41)	Project Phasing (11)	Raw Score	Weighted Score	Ranking
Alternative 1 - Raise Deficient Lining, Embankment, and Impacted Bridges	5	2	5	3	4	5	5	29	447.7	1
Alternative 2 - Lower the Canal Invert (includes divider wall in portions of the canal)	5	3	2	4	5	3	3	25	345.5	4
Alternative 3 - Widen Canal and Add Culverts at Bridges	4	2	3	3	3	3	2	20	288.6	8
Alternative 4 - Change Canal Prism Below Top Width (includes divider wall)	4	2	3	5	3	3	2	22	297.7	7
Alternative 5 - Pressurized Pipeline(s) for Deficient Flow Within Embankment	1	2	4	4	3	3	2	19	275	10
Alternative 6 - Pressurized Pipeline(s) for Deficient Flow Within Canal Prism (includes divider wall)	1	1	3	5	4	3	2	19	277.3	9

	Score									
Criteria (Weight %)	**OM&R Costs (9)**	**Capital Costs (9)**	**Sequencing and Seasonality (9)**	**Future Flexibility & Fringe Benefits (5)**	**Permit Requirements (16)**	**Delivery Impacts (41)**	**Project Phasing (11)**	**Raw Score**	**Weighted Score**	**Ranking**
Alternative 7 - Culvert(s) for Deficient Flow Within Embankment	3	3	4	4	3	4	2	23	343.2	6
Alternative 8 - Culvert(s) for Deficient Flow Within Canal Prism (includes divider wall)	3	2	3	5	4	4	2	23	345.5	4
Alternative 9 - Build New Parallel Canal at Deficient Flow Capacity	4	3	5	4	2	4	3	25	356.8	3
Alternative 10 - Baseline Condition (not considered a solution, included for comparison only)	3	5	5	1	5	1	1	21	254.5	11
Alternative 11 - Optimize Water Distribution	2	4	4	3	3	5	5	26	413.6	2

Alternatives 1 and 11 ranked the highest among the 11 alternatives analyzed in the VP Study overall. These two alternatives both earned scores of fives in the most heavily weighted criterion, Delivery Impacts, in addition to scoring highly in other criteria. Scoring well in the Delivery Impacts criterion indicates that both alternatives would have minimal impacts on water delivery. The lowest-scoring alternative in the Delivery Impacts criterion was the No Action Alternative (Alternative 10) since this alternative would impact water delivery because it does not address the DMC capacity issue, resulting in ongoing and increasing reduced water delivery.

Alternatives 2 and 10 earned scores of fives in the second-most important criterion, Permitting Requirements. Scoring highly in this criterion indicates that both alternatives would require few, if any, permits. Because Alternative 10 is the No Action Alternative, it would not require any permits to complete. The lowest-scoring alternative in this criterion was Alternative 9, which would build a new canal. This effort would require acquiring additional right of way to support construction of the new canal alignment, which is assumed to generate the highest level of permitting complexity in comparison to the other alternatives.

Project Phasing was the third-most important criterion, and Alternatives 1 and 11 scored the highest in this criterion. High scores were identified for both these solutions given that they would not require complex scheduling, funding, or water user impacts. The No Action Alternative (Alternative 10) received the lowest score in this criterion, as taking no action would result in large impacts on canal users that are expected to increase in the future.

Alternatives 1 and 2 scored the highest in the OM&R Cost criterion, indicating that these alternatives would not generate complex or expensive additional OM&R throughout the service life of the DMC. Alternative 6, which involves constructing pressurized pipelines within the canal prism, would require the construction of a new pump station that would create increased energy needs and therefore increased OM&R costs. Alternative 11 also scored poorly in this criterion due to the more complicated and expensive operation efforts that would be required as compared to the life and longevity of this alternative.

The No Action Alternative (Alternative 10) scored the highest in the Capital Cost criterion, reflecting the fact that taking no action is the least expensive alternative. Because Alternative 11 involves optimizing the use of existing water conveyance systems, this alternative also scored highly in this criterion. The lowest-scoring, and therefore most expensive, alternative was Alternative 6. Multiple other alternatives, including Alternative 1 and Alternative 8, also received low scores in this criterion, given their high potential cost to execute.

Alternatives 1, 9, and 10 scored highest in the Sequencing/Seasonality criterion, indicating that the required construction work (or lack thereof) associated with these alternatives is flexible and not hindered by sequence or seasonality concerns. Alternative 2 scored the lowest in this criterion, reflective of the fact that work on the earthen segment of the canal would require the canal to undergo a partial outage and that would be limited to the winter months.

The criterion Future Flexibility and Fringe Benefits reflects whether alternatives create future benefits or opportunities for the canal. Alternatives 4, 6, and 8 were identified as being the most successful in creating future benefits/opportunities by allowing for more flexible future operations. The No Action Alternative (Alternative 10) scored the lowest in this criterion, as taking no action to address the capacity issues of the DMC would result in a reduction of future benefits/opportunities for the canal.

Based on the results of this scoring process, Reclamation identified three action alternatives and one non-structural alternative for further evaluation. Although the No Action Alternative was the least favorable alternative as it does not allow meeting Project goals, it was retained for comparison purposes consistent with D&S and NEPA requirements.

2.4 Alternatives Selected for Further Evaluation

2.4.1 Raise Deficient Structures (Alternative 1)

In this alternative, derived from Alternative 1, deficient lining and embankment segments of the canal and associated impacted structures would be raised to allow for the safe operation of the canal at its design capacity. Specific actions would include raising the concrete lining segments and bank segments, installing riprap for erosion protection to stabilize the banks along the earthen segment, repairing concrete lining, replacing impacted bridges and pipeline crossings, raising the gates of check structures and wasteways, and modifying turnouts and existing drainage structures for safe passage of stormwater.

2.4.2 Adjust Canal Invert and Raise Deficient Structures (Alternative 2)

This alternative was created by combining Alternatives 1, 2, and 11. This alternative aims to lower the canal invert at non-subsided locations to restore the hydraulic slope of the canal and therefore its design capacity. This action, although it would reduce the number of deficient structures along the canal, would not be sufficient to restore the canal's capacity along the whole length of the canal; thus, remaining deficient structures would be raised in the same manner prescribed for Alternative 1. Hydraulic analysis for lowering the invert of non-subsided locations in the concrete lined segment of the DMC showed limited benefits; however, lowering the invert of the earthen segment of the DMC and restoring this segment to its original shape resulted in significant reduction in the number of impacted structures. Thus, this alternative was modified to rebuild the earthen segment, raising deficient lining and embankment, in addition to raising impacted structures.

2.4.3 Optimize Water Distribution (Non-Structural Alternative/Alternative 3)

This alternative, derived from Alternative 11, requires optimizing water distribution to South-of-Delta CVP water users using existing State Water Project (SWP) water conveyance systems including the Banks Pumping Plant, Intertie Pumping Plant, the California Aqueduct, and the San Luis wasteway, owned and operated by Central California Irrigation District, to restore diminished water deliveries. Alternative 11 in the VP study also considered modifying existing water conveyance infrastructure to allow deliveries through alternate delivery points. However, this action would require physical changes to the facilities and would not meet Reclamation D&S CMP 09-04 (Reclamation 2018) requirements for a non-structural alternative. Therefore, this alternative would not include the physical changes under Alternative 11 and only optimize use of existing facilities.

The non-structural alternatives for the upper DMC (Jones Pumping Plant to O'Neill Forebay) and lower DMC (O'Neill Forebay to Mendota Pool) are evaluated separately because the upper DMC is physically connected with the California Aqueduct through the Intertie Pumping Plant, and addressing diminished capacity in the upper DMC requires evaluating use of existing SWP facilities to convey water from the Delta. The lower DMC does not have any existing conveyance features that could be relied on to augment the DMC without structural modification. Under this alternative, Reclamation would need to negotiate and execute a permanent Conveyance and Use Agreement

with California Department of Water Resources (DWR) to utilize available pumping capacity at the Banks Pumping Plant for Joint Point of Diversion (JPOD) and maximize pumping at the Intertie Pumping Plant.

2.4.4 Build New Parallel Canal at Point of Deficient Flow Capacity (Alternative 4)

This alternative, derived from Alternative 9, involves constructing a new canal parallel to the DMC that would span 47 miles from MP 16.34 to MP 70.01. This proposed canal would have a bottom width of 18 feet and water depth of 9 feet. New pipe crossings would have to be installed over the new parallel canal and additional work to modify wasteways and drainage structures would be required where the DMC and the new parallel canal would merge. Culverts under existing roads would be utilized for the parallel canal (modification of alternative 8 in the VP study).

In addition to constructing a new canal, sections of the DMC would require raising the canal lining and embankment as proposed in Alternatives 1 and 2, though the lining and embankments would not have to be raised as high under this alternative. This alternative would also require other repairs to the DMC, including rebuilding the earthen-lined segment (since the new canal would terminate at MP 70), replacing impacted bridges and pipeline crossings, modifying check structures and wasteways, and modifying drainage structures Additionally, agricultural lands outside Reclamation RWO would need to be purchased for this alternative.

Chapter 3 Screening Evaluation and Alternative Development

This chapter describes the screening process used to evaluate the alternatives identified in Chapter 2.

Following the VP Study, three action alternatives and one non-structural alternative were selected for further analysis in Reclamation's 2021 Feasibility Study of the Structural Alternatives: Alternative 1 (derived from Alternative 1 in the VP Study), Alternative 2 (a combination of Alternatives 1, 2, and 8 from the VP Study), Alternative 3 (a non-structural alternative derived from Alternative 11 in the VP Study), and Alternative 4 (derived from Alternative 9 in the VP Study). The four alternatives considered in the Screening Evaluation, their names, and their corresponding alternative numbers from the VP Study are detailed in Table 5.

Table 5. Screening Evaluation Alternatives

Screening Evaluation Alternative	Alternative Name	Corresponding Alternative from VP Study
1	Raise Deficient Structures	1
2	Adjust Canal Invert and Raise Deficient Structures	1, 2, and 8
3	Non-Structural; Optimize Water Distribution	11
4	Build New Parallel Canal	9

The screening evaluation considered two levels of screening.

3.1 Level 1 Screening Evaluation

The criteria to evaluate the alternatives include (1) the ability of the alternative to address the Project's objectives (restore original authorized design capacity of the DMC while continuing to meet Reclamation Safety Standards) and (2) the ability of the alternative to address the Project purpose and need (restore the originally authorized conveyance capacity of the DMC). Alternatives were scored for each of the screening criteria using the following metrics:

- High (3) score means the alternative fully meets Project objectives/Project purpose and need
- Medium (2) score means the alternative partially meets the Project objectives/Project purpose and need
- Low (1) score means the alternative does not meet the Project objectives/Project purpose need

3.1.1 Level 1 Screening Results and Discussion

Each of the alternatives were given a score that represents the degree to which it accomplishes the Project objectives/Project purpose and need. Table 6 presents the results of the screening process.

Table 6. Project Objective/Purpose and Need Screening Results

Alternative	Project Purpose and Need	Project Objectives		Overall Score
	Restore DMC Conveyance Capacity or Otherwise Deliver the CVP Supply Through Other Means	Meet Reclamation's Freeboard Requirements on the DMC	Increase Long-term Reliability and Quantity of CVP Supplies to South-of-Delta Contractors	
Alternative 1 (Raise Deficient Structures)	3	3	3	3
Alternative 2 (Adjust Canal Invert and Raise Deficient Structures)	3	3	3	3
Alternative 3 (Non-Structural)	1	3	1	2
Alternative 4 (Build New Parallel Canal)	3	3	3	3

Key: 3 – High, 2 – Medium, 1 – Low

Alternatives 1 and 2 scored high when scored against the Project objective/Project purpose and need, whereas Alternative 3 scored the lowest. Alternatives 1 and 2 both fulfill the Project purpose and need, which is to restore the originally authorized conveyance capacity of the DMC, as well as the Project objectives of increasing freeboard space and making it possible to increase the long-term reliability and quantity of CVP supplies delivered to South-of-Delta contractors dependent on the DMC. Under both alternatives, the DMC would be modified to satisfy current Reclamation safety standards, including freeboard requirements for the canal lining and embankment, to convey the design capacity of water.

Alternative 3 is the non-structural alternative and involves optimizing the use of existing south-of-Delta SWP and CVP water infrastructure (such as the Banks Pumping Plant, Intertie Pumping Plant, California Aqueduct, district interconnected facilities, etc.). Modeling of the non-structural alternative, which is presented in more detail in Section 3.2.1.2, has indicated that this alternative is inadequate to address loss of conveyance capacity. As such, this alternative fails to meet the Project purpose and need of restoring the DMC's originally authorized conveyance capacity or otherwise deliver the CVP supply through other means. Under this alternative, the DMC would be operated consistent with Reclamation's safety standards and would therefore meet the required freeboard requirements. However, even with fully optimized operation of existing south-of-Delta SWP and CVP water infrastructure, the long-term reliability and quantity of CVP supplies delivered to south-of-Delta contractors dependent on the DMC is not expected to substantially increase. Consequently, Alternative 3 would not fully meet the Project Purpose and Need nor Project objective.

Similar to Alternatives 1 and 2, Alternative 4 scored high when scored against the Project objective/Project purpose and need. Under Alternative 4, the new parallel canal capacity would allow the portion of existing canal to operate at reduced capacity without freeboard deficiencies. Additional improvements, similar to those under Alternative 1 and 2, would satisfy current Reclamation safety standards and restore the originally authorized conveyance capacity of the remaining segments of the DMC that are not parallel to the new canal. While Alternative 4 would

only partially restore the original capacity of the DMC, the new canal would make it possible to deliver the CVP supply through other means and increase the long-term reliability and quantity of CVP supplies delivered to south-of-Delta contractors dependent on the DMC. Therefore, Alternative 4 would meet the Project purpose and need and the Project objectives.

3.1.2 Alternatives Carried Forward for the Level 2 Screening Evaluation

Alternatives 1, 2, and 4 fully meet the Project objectives/purpose and need and will be carried forward as action alternatives for evaluation in the Level 2 Screening. Alternative 3 did not meet the Project purpose and need but partially met the Project objectives, so it will also be carried forward for evaluation in the Level 2 Screening.

3.2 Level 2 Screening Evaluation

Consistent with the standards for formulating and evaluating alternatives for planning and water resource-related projects outlined in the Council of Environmental Quality's *Principles, Requirements and Guidelines for Water and Land Related Resources Implementation Studies*, the Level 2 screening evaluation and comparison of alternatives rely on the federal planning criteria of completeness, effectiveness, acceptability, and efficiency. This evaluation, developed by Reclamation and SLDMWA, presents the relative performance of the alternatives as they are defined in this stage of the study process. The federal criteria and their application in the evaluation and comparison process is as follows:

- Completeness: The completeness criterion addresses whether the alternative would account for all investments or other actions necessary to realize the planned effects. This criterion was measured by the operational ability to implement of the alternatives to characterize the degree to which each alternative would provide for the realization of the Project's purpose and need.
- Effectiveness: The effectiveness criterion addresses how well an alternative would alleviate problems and achieve opportunities. This criterion was measured by the improved water supply yield reliability to south-of-Delta CVP contractors provided by the alternatives.
- Acceptability: The acceptability criterion addresses the viability of an alternative from the perspective of the nation's general public and consistently with existing Federal laws, authorities and public policies. The performance measures for the acceptability criterion focus on potential environmental effects and compatibility with existing laws.
- Efficiency: This evaluation criterion is a measure of how efficiently an alternative alleviates identified problems while realizing specified objectives. Possible approaches to evaluating efficiency include (1) dollars per unit of economic benefit, (2) least cost of attaining an objective, (3) and reduced opportunity costs relative to accomplishments of other alternatives. In this analysis, efficiency of the alternatives was evaluated using an estimated overall Project benefit.

Similar to scoring process used for Level 1 screening, the alternatives were scored for each of the screening criteria using the following metrics:

- High score indicates the alternative fully meets the federal planning criteria of completeness, effectiveness, acceptability, and efficiency.

- Medium score indicates the alternative somewhat meets the federal planning criteria of completeness, effectiveness, acceptability, and efficiency.
- Low score indicates the alternative does not meet the federal planning criteria of completeness, effectiveness, acceptability, and efficiency.

The Plan Formulation Report considers a qualitative approach to the federal planning criteria discussed above. A more detailed and quantitative evaluation of these criteria will be completed in the Feasibility Report and the EA/IS being completed for the selected alternatives.

3.2.1 Completeness

The completeness criterion addresses whether the alternative would account for all investments or other actions necessary to realize the planned effects. This criterion considers how well the alternative plan would achieve the planning objectives. Three performance measures (Authorization and Funding, Full Spectrum of Objectives, and Operational Ability to Implement) were developed for the completeness criterion to characterize the degree to which each alternative would provide for the realization of the project's purpose and need.

3.2.1.1 Authorization and Funding

Public Law 111-11 provides Reclamation with the authority to complete or fund work on a project such as the CVP, where the O&M responsibilities have been transferred to a local entity, subject to a repayment contract. Alternatives 1 and 2 would meet the definition of extraordinary maintenance, as defined in Public Law 111-11. Therefore, Alternatives 1 and 2 scored high under this criterion.

Alternative 3 would not require construction or additional maintenance and would be authorized under Public Law 111-11. Therefore, Alternative 3 scored high under this criterion.

Alternative 4 may not qualify as a project that can be completed or funded under Public Law 111-11 because it may not meet the definition of extraordinary maintenance, which is defined in Public Law 111-11, Section 9603 as "major nonrecurring maintenance to Reclamation-owned or operated facilities or facility components." Therefore, this alternative scored low under this criterion.

3.2.1.2 CEQA Primary Objectives

This performance measure indicates each alternative's capacity to satisfy the two primary planning objectives by the degree to which implementation of each alternative would:

- Restore the long-term reliability and quantity of CVP supplies delivered to south-of-Delta contractors dependent on the DMC currently affected by reduced deliveries limited by the canal's reduced conveyance capacity.
- Support the safe long-term operation of the DMC consistent with its design for freeboard and clearances between maximum water surface elevations and structures crossing the canal.

The ratings identified for each alternative correspond to the number of study objectives that it would meet, and to what extent those objectives would be met. Alternatives 1, 2, and 4 would all meet the project objectives, as discussed in Section 3.1.1, and therefore score high. While Alternative 3 would increase the quantity of CVP supplies delivered to south-of-Delta contractors, it would be to a lower extent than under Alternatives 1, 2 and 4. Therefore, Alternative 3 scores as medium.

3.2.1.3 Operational Ability to Implement

This performance measure indicates the relative complexity associated with operating each alternative with alternatives that would require substantial modification to current operational guidelines/protocols scoring low and alternatives following current guidelines/protocols scoring high.

Alternative 1

Alternative 1 scores high under the operational ability to implement criterion. Under this alternative, the deficient lining, embankment, and impacted structures of the canal would be raised to restore the canal capacity to its originally authorized design flow capacity. The DMC's operations after construction are expected to continue as they were executed following the original construction of the canal under Alternative 1. The canal would be modified to satisfy current Reclamation safety standards, including freeboard requirements for the canal lining and embankment, and would be able to safely operate to deliver the designed capacity of water (variable flow capacity starting at 4,600 cfs at the upstream end and reducing to 3,210 cfs at the downstream end) to contractors.

Alternative 2

Alternative 2 scores low under the operational ability to implement criterion. Although this alternative would be similar to Alternative 1 in that it would raise the deficient lining, embankment, and impacted structures of the canal, it would also require more intensive work in the lower 18-mile earthen-lined segment of the canal. This intensive work to adjust the canal invert would require the shutdown of the lower 18-mile portion of the canal for three months per year of construction, limiting water distribution to contractors within the service area of the affected canal portion. Implementation of this Alternative would require extensive coordination with other water conveyance facilities to ensure that water deliveries would be made pursuant to contract demands in the southern reaches of the DMC and Mendota Pool and would be difficult to implement.

Alternative 3

The non-structural Alternative (Alternative 3) scores low under the operational ability to implement criterion. Alternative 3 would not restore the canal capacity to its originally authorized design flow capacity, as stated in Section 3.1.1. Operations modeling results show that subsidence in the lower DMC contributes more to the water supply shortages to south-of-Delta CVP contractors than other parts of the DMC. Further analysis indicates that the shortages to contractors served by the lower DMC cannot be mitigated through any alternative other than restoring the conveyance capacity in the lower reach of the DMC. The operational ability to implement the non-structural alternative was evaluated separately for the upper DMC (Jones Pumping Plant to O'Neill Forebay) and lower DMC (O'Neill Forebay to Mendota Pool); these evaluations are presented below.

Lower DMC

Diminished capacity in the lower DMC limits the ability to meet full CVP contract demands in southern reaches of the lower DMC and Mendota Pool. Existing capacity in the lower DMC has been reduced compared to design capacity, just upstream from Mendota Pool (MP 95 to MP 105), by approximately 1,000 cfs and is expected to be reduced further in the future for a total reduction of 1,460 cfs. Alternative 3 would not address this capacity restriction in the lower DMC. Figure 2, Figure 3, and Figure 4 contain charts showing the shortage in CVP water delivery to the lower DMC and Mendota Pool for existing, 2035, and 2035 conditions with 2070 DMC capacity. Annual average shortages for existing, 2035, and 2070 conditions are 60 TAF, 86 TAF, and 125 TAF. Diminished

capacity in the lower DMC is a significant contributor to the overall inability to satisfy full CVP contract demands south of Delta.

Analyses show that the shortage to contractors served by lower DMC cannot be solved with a non-structural alternative. Restriction in the lower DMC affects deliveries of water to CVP south-of-Delta contractors and limits Reclamation's ability to balance north-of-Delta storage with south-of-Delta storage and CVP water deliveries.

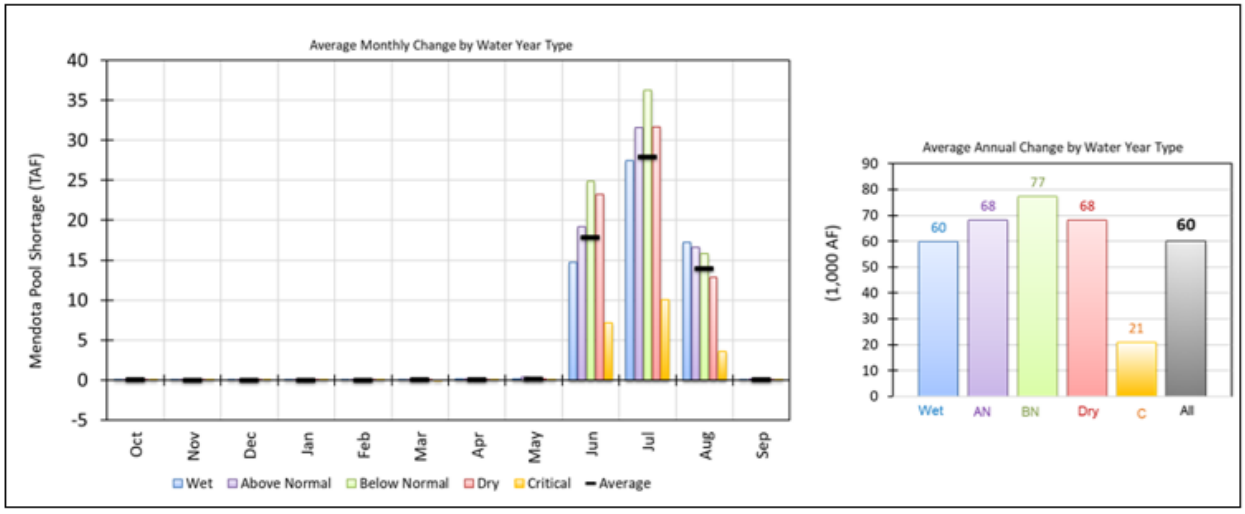


Figure 2. Shortage in CVP Mendota Pool Deliveries – Historically Based Hydrology and Existing DMC Capacity

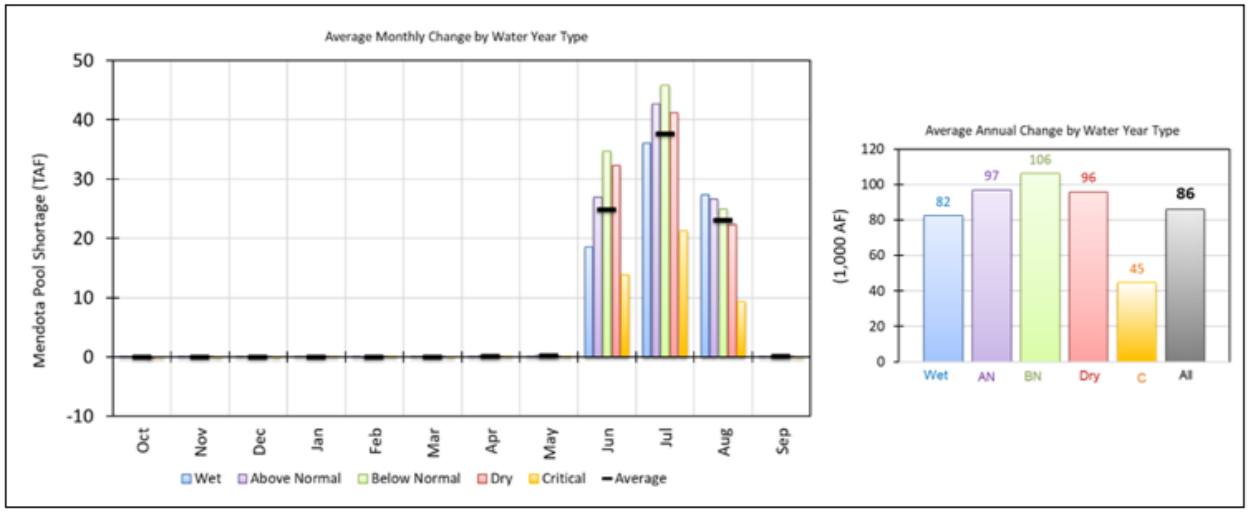


Figure 3. Shortage in CVP Mendota Pool Deliveries – 2035 Hydrology and 2035 DMC Capacity

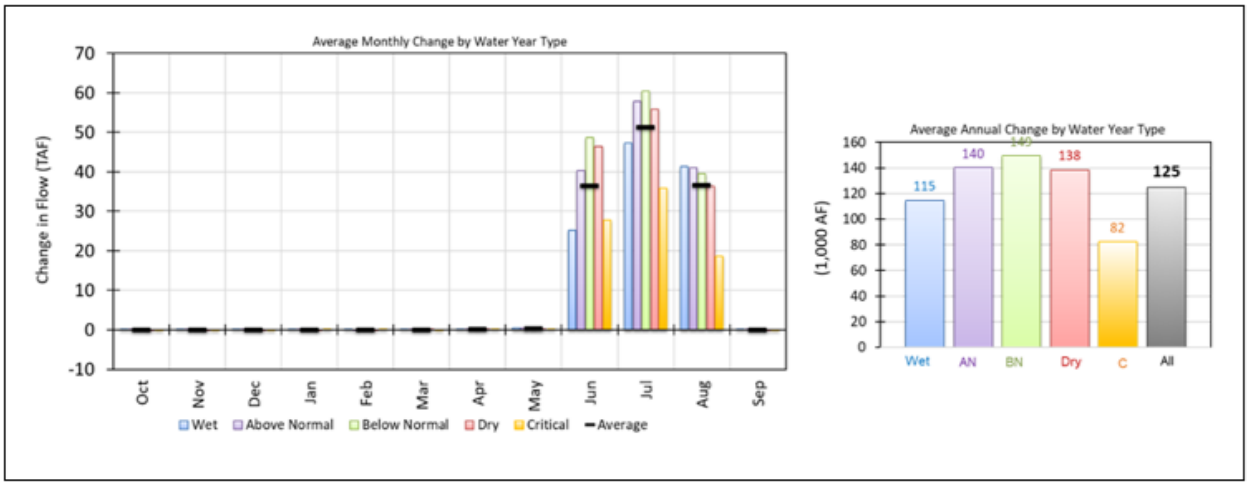


Figure 4. Shortage in CVP Mendota Pool Deliveries – 2035 Hydrology and 2070 DMC Capacity

Upper DMC

For the upper DMC, Alternative 3 considers maximizing the use of the Intertie Pumping Plant and use of SWP facilities, specifically the SWP Banks Pumping Plant, for JPOD from the Delta. The Intertie Pumping Plant conveys approximately 100 TAF more annually under the No Action Alternative with existing capacity compared to design capacity. Although the Intertie Pumping Plant compensates for a portion of the diminished DMC capacity, it has insufficient capacity to meet full CVP contract demands, as demonstrated in modeling of With-Project alternatives.

As noted in Section 2.4.3, Reclamation would need to negotiate and execute a permanent Conveyance and Use Agreement with DWR to utilize available pumping capacity at the Banks Pumping Plant for JPOD and maximize pumping at the Intertie Pumping Plant. With execution of a permanent Conveyance and Use Agreement with DWR, Reclamation could use the SWP facilities when there is unused capacity at the SWP Banks Pumping Plant and there is excess water in the Delta available for diversion that the SWP cannot otherwise divert for its own use due to a lack of available storage capacity.

Evaluation of JPOD was performed by analyzing CalSim II output for the Project No Action Alternative and assessing the potential for using SWP facilities for conveying CVP water. The first step in evaluating CalSim II output is to identify times when there is unused capacity at the SWP Banks Pumping Plant while there is excess water in the Delta. Figure 5 contains a chart showing annual available Banks Pumping Plant capacity while the Delta is in excess condition. The ability to use Banks Pumping Plant occurs with low frequency and the volume needed to compensate for diminished DMC capacity occurs less than 5 percent of years. In addition, at times when there is available capacity at Banks Pumping Plant and Delta Excess the CVP has no ability to use or store this water due to the CVP portion of San Luis Reservoir being full and CVP allocations being 100 percent.

Figure 6 contains a chart of the annual high storage in CVP San Luis Reservoir and CVP south-of-Delta agriculture water supply allocation, all occurrences when Banks Pumping Plant may be used (Figure 5) can be compared to full CVP San Luis Reservoir with full allocation (Figure 6).

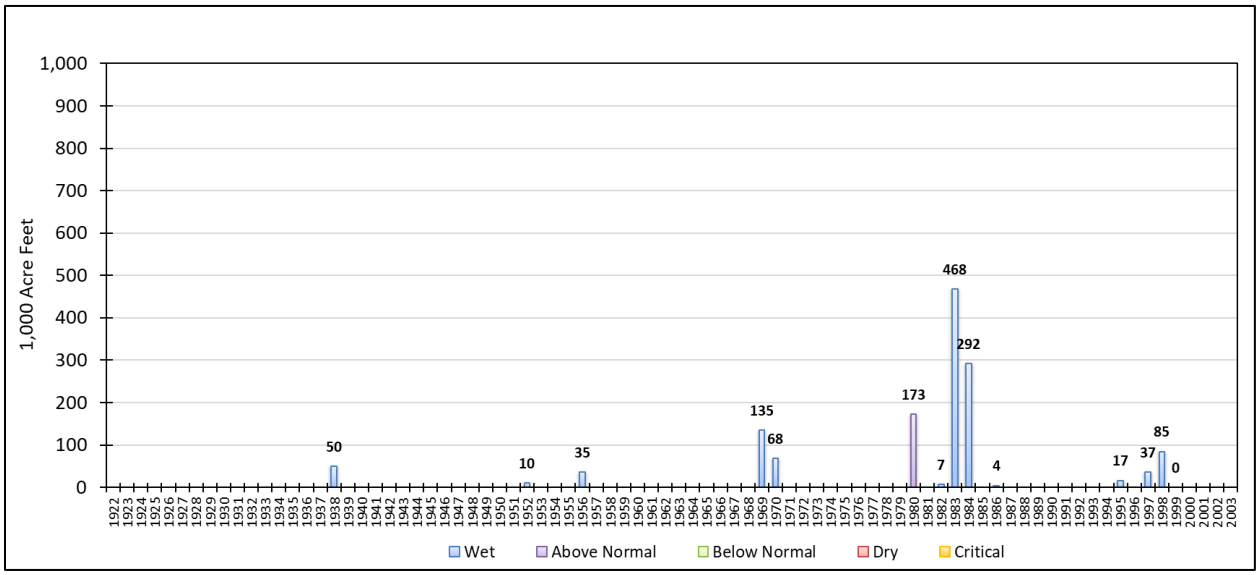


Figure 5. Available Banks Capacity While the Delta is in Excess Condition

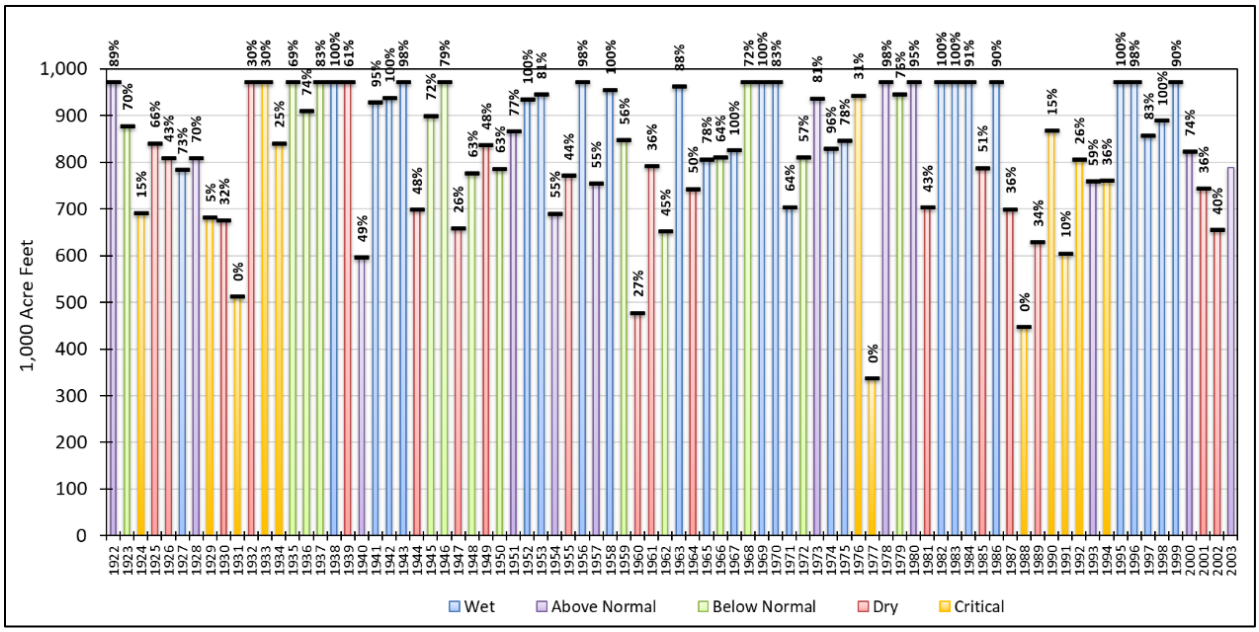


Figure 6. CVP San Luis Reservoir Annual High Storage and CVP SOD Ag Allocation

Use of JPOD during summer months to convey water stored in upstream CVP reservoirs was evaluated by comparing available Banks Pumping Plant capacity to available upstream CVP storage from the No Action Alternative CalSim II simulations. There are frequently times when upstream storage is insufficient to operate Jones Pumping Plant and DMC at capacity, during the times when the CVP is not fully utilizing its own facilities, additional capacity made possible through JPOD is not useful. During most times when upstream reservoirs CVP have additional storage and CVP exports are at capacity, Banks Pumping Plant is also operating at capacity to convey SWP supplies

and JPOD is not available. The times when JPOD may be used to fully compensate for diminished DMC capacity occurs with low frequency.

Alternative 4
Alternative 4 scores medium under the operational ability to implement criteria. Raising the canal lining and embankment in deficient areas not parallel to the new canal, similar to Alternatives 1 and 2, would partially restore the canal capacity to its originally authorized design flow capacity. Those portions of the DMC could continue to operate as they were executed following the original construction of the canal. Capacity of the DMC segment parallel to the new canal would remain deficient and would need to be adjusted to operate the new canal. New operations would need to be implemented for this segment of the DMC and new canal.

3.2.1.4 Overall Completeness Ranking
Table 7 summarizes how each of the alternatives were scored for overall completeness. Alternative 1 scored high, given the increases in water supply and continued typical operation of the DMC that would occur under its implementation. Alternative 2 scored medium, as it would qualify for funding and would meet the project objectives but would be difficult to implement. Alternative 3 scored medium in effectiveness because of its limited ability to increase water supply and its reliance on changes to operations. Alternative 4 scored medium due to its increases in water supply and partial reliance on changes to operations.

Table 7. Overall Completeness Ranking for Final Alternatives

Completeness Criteria	Alternative 1 (Raise Deficient Structures)	Alternative 2 (Adjust Canal Invert and Raise Deficient Structures)	Alternative 3 (Non-Structural)	Alternative 4 (Build New Parallel Canal)
Authorization and Funding	High	High	High	Low
Full Spectrum of Objectives	High	High	Medium	High
Operational Ability to Implement	High	Low	Low	Medium
Overall Ranking	High	Medium	Medium	Medium

3.2.2 Effectiveness
The effectiveness criterion addresses how well an alternative would alleviate problems and achieve opportunities. This criterion was measured by the improved water supply reliability to south-of-Delta CVP contractors provided by the alternative.

3.2.2.1 Water Supply Reliability
Alternatives 1, 2, and 4 would fully return the diminished yields to south-of-Delta CVP water users impacted by reduced capacity in the DMC in the long term. The conveyance capacity restored by Alternatives 1 and 2 and constructed by Alternative 4 would support their future operation

consistent with the existing operating rules identified in the 2019 U.S. Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS) Biological Opinions (2019 USFWS and NMFS Biological Opinions) for the Reinitiation of Consultation on the Coordinated Operations of the CVP and SWP (ROC on LTO), 2020 ROC on LTO Record of Decision (ROD), and the 2018 Addendum to the Coordinated Operation Agreement CVP/SWP Finding of No Significant Impact (FONSI)/ROD, and/or any future regulatory requirements and the terms and conditions specified in the relevant Biological Opinions.[2] Alternatives 1, 2, and 4 would restore south-of-Delta CVP agricultural and municipal and industrial (M&I) deliveries.

During construction, Alternatives 1 and 4 would have high water supply reliability; Alternative 1 would not require any partial or full shutdowns of the canal, allowing for a high level of reliability of water supply for DMC contractors. Similarly, during the construction of Alternative 4, the DMC would remain fully functional and would be able to reliably supply water to DMC contractors. For this and the above reasons, Alternatives 1 and 4 score high under the water supply reliability criterion.

As discussed above, Alternative 2 would have high water supply reliability during long-term operation. However, Alternative 2 would require a shutdown of the lower 18-mile segment of the canal for three months every year of construction. This required shutdown would impair water supply reliability for contractors receiving deliveries from the lower DMC and Mendota Pool during construction of this alternative. Therefore, Alternative 2 scores medium under the water supply reliability criterion.

Alternative 3 scores low under the effectiveness criteria. As noted previously, the non-structural alternative would not restore the canal capacity to its original design flow capacity and would not meet the Project purpose and need. As detailed in Section 3.2.1.2, existing capacity in the lower DMC has reduced compared to design capacity, just upstream from Mendota Pool (MP 95 to MP 105), by approximately 1,000 cfs and is expected to be reduced further in the future to 1,460 cfs (see Figure 2 and Figure 3). Diminished capacity in the lower DMC is a significant contributor to the overall inability to satisfy full CVP contract demand south of the Delta, and Alternative 3 would not address this capacity restriction in the lower DMC. Diminished capacity in the lower DMC limits the ability to meet full CVP contract demands in southern reaches of the lower DMC and Mendota Pool.

3.2.2.2 Overall Effectiveness Ranking

Table 8 summarizes how each alternative was ranked for relative effectiveness. Alternatives 1, 2, and 4 scored high in effectiveness because of their ability to restore DMC conveyance capacity to service south-of-Delta CVP contractors and refuge water supply to south-of-Delta CVP refuges. Alternative 3 scored low, given its limited increases in water supplies. Alternative 2 scored medium, given that it would restore water supply reliability during operation but would reduce water supply reliability during construction.

[2] 2020 Reinitiation of Consultation on the Coordinated Long-Term Operations of CVP and SWP (ROC on LTO) ROD and the 2018 Addendum to the Coordinated Operation Agreement CVP/SWP were both consulted for the original design capacity of the DMC and not the current operation capacity of the DMC.

Table 8. Overall Effectiveness Ranking for Final Alternatives

Effectiveness Criteria	Alternative 1 (Raise Deficient Structures)	Alternative 2 (Adjust Canal Invert and Raise Deficient Structures)	Alternative 3 (Non-Structural)	Alternative 4 (Build New Parallel Canal)
Restore Agricultural Water Supply Reliability	High	Medium	Low	High
Restore Refuge Supply Reliability	High	Medium	Low	High
Overall Ranking	High	Medium	Low	High

3.2.3 Acceptability

The federal acceptability criterion addresses the viability of an alternative with respect to acceptance by state and local entities and compatibility with existing laws. The performance measures for this criterion consider the alternatives' potential environmental impacts to biological, physical, and social resources in the study area.

3.2.3.1 Biological Resource Effects

Biological resources of the study area include aquatic and terrestrial resources. Construction of Alternative 1 could affect sensitive natural communities, including wetland and riparian vegetation communities, disturb terrestrial wildlife, nesting birds, and special status plant species. However, mitigation measures including preconstruction surveys, establishment of buffers, and construction monitoring are expected to be employed to reduce potential impacts, and refuges would continue to receive water supply (Section 3.2.2). Therefore, Alternative 1 scores medium under the biological resource effects criterion.

Construction of Alternative 2 would affect the same biological resources as Alternative 1,but would affect fewer acres of habitat because the extents of lining and embankment raises and the number of bridges and pipeline crossing requiring replacement are reduced under this alternative. However, as discussed in Section 3.2.2, Alternative 2 would require a three-month shutdown of the lower 18-mile segment of the canal during each year of construction. Under current operations of the DMC, refuges primarily receive deliveries from the lower DMC/Mendota Pool. Shutdown of the lower DMC during construction of Alternative 2 could impact these refuge deliveries. Therefore, Alternative 2 scores low under the biological resource effects criterion.

Alternative 3 would include no construction and would have no impact to aquatic or terrestrial resources. Therefore, Alternative 3 scores high under this criterion.

Because Alternative 4 would include building a new canal, it is assumed that the impacts to biological resources would be similar to Alternatives 1 and 2 but on a greater scale and have potential impacts that may not be mitigated to a less than significant level. Therefore, Alternative 4 scores low under this criterion.

3.2.3.2 Physical Resource Effects

Construction of Alternative 1 could impact physical resources such as air quality, geology and soils, water quality, noise, and visual resources. Air quality impacts would likely be the result of operating

construction equipment and operating vehicles to transport waste from the construction site to landfills. Construction activities involving ground disturbance could affect geology and soils as well as water quality. Noise and visual resources impacts would be the result of operating construction equipment. However, mitigation measures are expected to be implemented to reduce any potential impacts. Therefore, Alternative 1 scores as medium under the physical resource effects criterion.

Construction of Alternative 2 would impact the same resources as Alternative 1; however, additional excavation of the earthen-lined segment under Alternative 2 would require more truck trips to dispose of excavated waste, which would have a greater impact on air quality than Alternative 1 would. Additionally, the work required by Alternative 2 would require more construction equipment that would create higher levels of noise and would require additional mitigation measures. Therefore, Alternative 2 scores low under the physical resource effects criterion.

Alternative 3 would include no construction and would have no impact to physical resources. Therefore, Alternative 3 scores high under this criterion.

Because of the new construction associated with Alternative 4, impacts related to air quality, geology and soils, water quality, noise, and visual resources would occur on a larger scale compared to Alternatives 1 and 2. Some impacts related to air quality and noise may be significant yet unavoidable during construction activities. In addition, acquisition of additional land would be required to build the parallel canal. Therefore, Alternative 4 scores low under this criterion.

3.2.3.3 Social Resource Effects

Construction of Alternative 1 could affect social resources such as traffic, hazardous materials, water supply, and cultural resources. However, these effects are expected to be minor. As such, Alternative 1 scores high under the social resource effects criterion.

As discussed in Section 3.2.2, construction of Alternative 2 would require a shutdown of the lower 18-mile segment of the canal for three months during every year of construction. This shutdown would restrict water supply reliability for contractors that rely on water from the lower 18-mile segment of the DMC, which could result in social effects. Additionally, construction of Alternative 2 could affect other social resources such as traffic, hazardous materials, and cultural resources. Therefore, Alternative 2 scores as medium under the social resource effects criterion.

Alternative 3 would include no construction and would have no impact on social resources. Therefore, Alternative 3 scores high under this criterion.

Because of the new construction associated with Alternative 4, impacts related to social resources would occur on a larger scale compared to Alternatives 1 and 2. Some impacts may be significant yet unavoidable during construction activities. Therefore, Alternative 4 scores low under this criterion.

3.2.3.4 Compatibility with Existing Laws

Alternatives 1 and 4 score high under the compatibility with existing laws criteria. As noted previously, the restored conveyance capacity after construction of the alternatives would conform to the existing operating rules identified in the 2020 ROC on LTO ROD, 2019 USFWS and NMFS Biological Opinions, the 2018 Addendum to the Coordinated Operation Agreement CVP/SWP FONSI/ROD, and/or any future regulatory requirements and the terms and conditions specified in the relevant Biological Opinions. Both alternatives require compliance with NEPA and CEQA, as well as consultations under Section 7 of the Endangered Species Act, Section 106 of the National Historic Preservation Act (NHPA), and Section 401 and 404 of the Clean Water Act.

Although Alternative 2 would comply with most of the existing laws, the three-month shutdown of the lower 18-mile segment of the DMC would result in changes in water supply reliability for Exchange Contractors and refuges that rely on the affected canal segment to convey water deliveries. Because Reclamation is required by law to deliver water to Exchange Contractors and refuges, this canal shutdown would likely result in Reclamation being unable to meet the established contract amounts for Settlement/Exchange Contractors and refuges that rely on the southern reaches of the DMC. Therefore, Alternative 2 scores low under this criterion.

Alternative 3 scored low under the compatibility with existing laws criteria. As noted previously, the non-structural alternative would not address this capacity restriction in the lower DMC. Consequently, under Alternative 3, the DMC cannot be operated to successfully fulfill Reclamation's contracts to deliver water to those who rely on the DMC.

3.2.3.5 Overall Acceptability Ranking

Table 9 summarizes how each alternative was ranked for relative acceptability.

Table 9. Overall Acceptability Ranking for Final Alternatives

Acceptability Criteria	Alternative 1 (Raise Deficient Structures)	Alternative 2 (Adjust Canal Invert and Raise Deficient Structures)	Alternative 3 (Non-Structural)	Alternative 4 (Build New Parallel Canal)
Biological Resource Impacts	Medium	Medium	High	Low
Physical Resource Impacts	Medium	Low	High	Low
Social Resource Impacts	High	Medium	High	Low
Compatibility with Existing Laws	High	Low	Low	High
Overall Ranking	High	Medium	Medium	Low

3.2.4 Efficiency

This evaluation criterion is a measure of how efficiently an alternative alleviates identified problems while realizing specified objectives. Possible approaches to evaluating efficiency include (1) dollars per unit of economic benefit, (2) least cost of attaining an objective, (3) and reduced opportunity costs relative to accomplishments of other alternatives. In this analysis, efficiency of the alternatives was evaluated using an estimated overall Project benefit.

3.2.4.1 Project Benefits

Alternatives 1, 2, and 4 scored high under the efficiency criterion. All three alternatives would restore lost water supply yield to south-of-Delta CVP contractors in comparison to water supply deliveries under existing conditions. Alternative 3 would not restore the lost water supply yield in comparison to existing conditions. Table 10 summarizes how each alternative was ranked for relative efficiency.

Table 10. Overall Efficiency Ranking for Final Alternatives

Efficiency Criteria	Alternative 1 (Raise Deficient Structures)	Alternative 2 (Adjust Canal Invert and Raise Deficient Structures)	Alternative 3 (Non-Structural)	Alternative 4 (Build New Parallel Canal)
Overall Ranking	High	High	Low	High

3.2.5 Level 2 Screening Results

Each of the alternatives were given a score that represents the degree to which it meets the federal planning criteria of completeness, effectiveness, acceptability, and efficiency. Table 11 presents the results of the screening process.

Table 11. Federal Planning Criteria Screening Results

Alternative	Completeness	Effectiveness	Acceptability	Efficiency
Alternative 1 (Raise Deficient Structures)	High	High	High	High
Alternative 2 (Adjust Canal Invert and Raise Deficient Structures)	Medium	Medium	Medium	Medium
Alternative 3 (Non-Structural)	Medium	Low	Medium	Low
Alternative 4 (Build New Parallel Canal)	Medium	High	Low	High

3.2.6 Alternative Carried Forward

Alternative 1 fully meets the Project purpose and need/objectives and fully meets the federal planning criteria. Therefore, Alternative 1 is being carried forward for further consideration in the Feasibility Report and EA/IS.

Although Alternative 2 fulfilled the Project purpose and need and the Project objectives, it scored medium under all four federal planning criteria; specifically, Alternative 2 would have impacts on water supply reliability during construction and would be overall difficult to implement. Alternative 3 would not meet the purpose and need and scored low to medium under all four federal planning criteria. While Alternative 4 scored high in two of the four federal planning criteria, this alternative would not be eligible for funding under Public Law 111-11, as described in Section 3.2.2.1.

Chapter 4 Analyzed Alternatives

This chapter presents alternatives developed and based on the evaluation described in Chapter 3. Alternatives identified for evaluation in the Feasibility Report and the EA/IS include a No Action/No Project Alternative and the Proposed Action/Proposed Project. The Proposed Action/Proposed Project would be operated within the limits of the operating rules identified in the 2020 ROC on LTO ROD, 2019 USFWS and NMFS Biological Opinions (USFWS 2019; NMFS 2019) and/or any future regulatory requirements and the terms and conditions specified in the relevant Biological Opinions.

The numbering of the alternatives identified for evaluation in the Feasibility Report and the EA/IS has been narrowed from the options that had been used to identify alternatives in the Feasibility Study of the Structural Alternatives. The two alternatives identified for evaluation in the Feasibility Report and the EA/IS, their names, and their corresponding alternative numbers from the Feasibility Study of the Structural Alternatives are detailed in Table 12.

Table 12. Alternatives Identified for Feasibility Report and EA/IS Evaluation

FSA Alternative #	Alternative Name in Feasibility Report and EA/IS
--	No Action/No Project
1	Raise Deficient Structures (Proposed Action/Proposed Project)

Key: FSSA = Reclamation's 2021 Feasibility Study of the Structural Alternatives

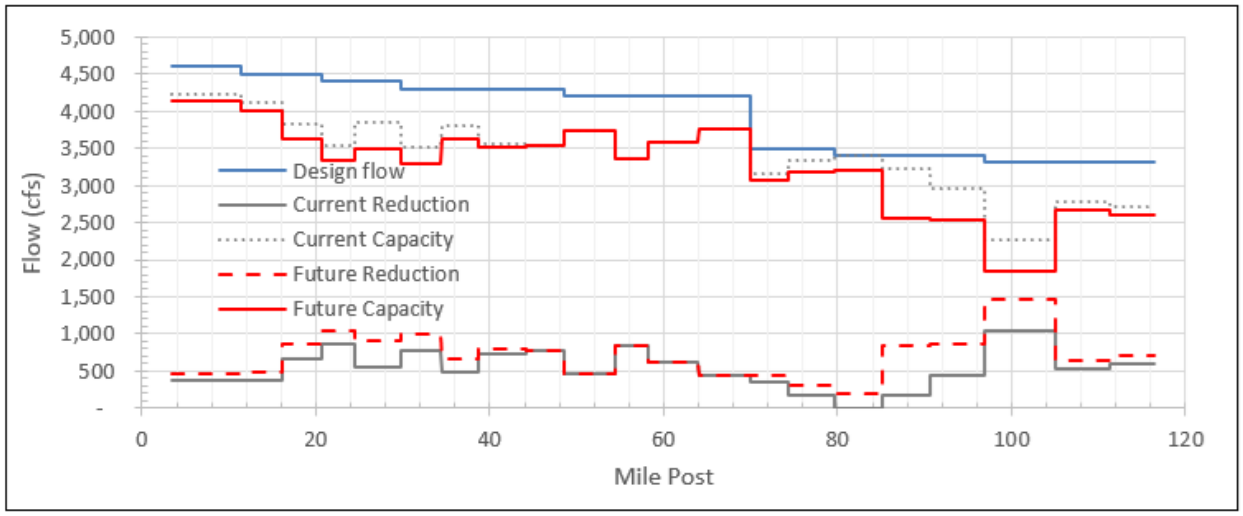
4.1 No Action/No Project Alternative

The No Action Alternative (under NEPA) describes future circumstances without the Proposed Action and includes predictable actions by persons or entities, other than the federal agency involved in a project action, acting in accordance with current management direction or level of management intensity. The No Project Alternative (under CEQA) describes the future without the project and may include some reasonably foreseeable changes in existing conditions and changes that would reasonably be expected to occur in the foreseeable future if the project were not approved.

Under the No Action/No Project Alternative (subsequently identified to as the No Action Alternative), the existing conditions of the DMC would remain unchanged, and the flow rates would be reduced from design capacity during operation to meet Reclamation Design Standards No. 3 (Reclamation 2014). Currently, 30 out of the existing 115 bridges along the DMC are considered deficient because they do not have one-foot of clearance above the Maximum Water Surface Elevation (MWSEL) when the canal is operated at design flow. However, the number of deficient bridges is expected to reach 45 when taking into consideration future subsidence conditions. Deficient bridges would be partially submerged when the canal is operated at the design flow, resulting in safety risks. To operate the canal safely and in accordance with Reclamation safety standards under the No Action Alternative, the maximum flow reduction in the DMC is estimated to be 1,457 cfs (44 percent reduction) from design capacity. Figure 7 details the current and anticipated future reduction of the canal capacity as compared to the designed capacity. The purpose

of the No Action Alternative is to provide decision-makers a comparison of the potential impacts of approving a project against the potential impacts of not approving the project.

The No Action Alternative includes current conditions in the Project area and will be analyzed consistently with the water deliveries under ROC on LTO of CVP and SWP and the 2018 Addendum to the Coordinated Operation Agreement Central Valley Project/State Water Project FONSI/ROD that are assumed to also reasonably portray future anticipated operational conditions. Both ROC on LTO of CVP and SWP and the 2018 Addendum to the Coordinated Operation Agreement CVP and SWP FONSI/ROD assumed DMC flow rate would be the original design capacity. As noted previously, the No Action Alternative assumes a reduced capacity of the DMC consistent with existing conditions.



Source: Feasibility Study of the Structural Alternatives

Figure 7. Design Flows, Reduction in Flow, and Actual Flow Capacities in the DMC for Current and Future (With Future Subsidence) Conditions

4.2 Raise Deficient Structures Alternative (Proposed Action)

The Raise Deficient Structures Alternative has been identified as the Proposed Action (under NEPA) and the Proposed Project (under CEQA). Under the Proposed Action/Proposed Project (subsequently identified as the Proposed Action), the deficient lining, embankment, and impacted structures of the canal would be raised to restore the canal capacity to its originally authorized design flow capacity. Under the Proposed Action, the canal would be modified to satisfy current Reclamation safety standards, including freeboard requirements for the canal lining and embankment, and would be able to safely operate to deliver the designed capacity of water (variable flow capacity starting at 4,600 cfs at the upstream end and reducing to 3,210 cfs at the downstream end) to contractors. Therefore, no changes to future operations and maintenance are anticipated.

Specific construction actions under the Proposed Action include:

- **Raising deficient canal concrete lining:** To achieve this, new concrete lining would be placed above the existing concrete lining, with seals installed between the old and new concrete linings to eliminate seepage at select locations along the canal. At locations with ladders installed in the concrete lining (every 750 feet), additional risers would be added in the new lining.
- **Raising the earth embankment at deficient bank segments of the canal:** This would be achieved by adding fill material from an existing borrow sites along the canal ROW at select locations along the canal. The added fill material would be rolled and smooth to match adjacent road elevations, and an asphalt chip seal will be installed on the left service road along the length of the canal.
- **Stabilizing the canal banks along the earthen-lined segment of the canal:** This would require lowering the water depth in the canal by up to six feet during construction, which would allow construction to extend about 6 feet below the maximum water surface elevation when the canal is operated at design flow for the canal (MWSEL). Two-foot-deep sections of earthen materials would be excavated from the sides of the canal, and a one-foot-thick strip of filter material would be installed above the excavated surface followed by a one-foot riprap that would be placed above the filter material.
- **Repairing distressed concrete lining above and below the water's surface:** Lining distresses were found to be either in the upper parts of the canal prism or more extensive, extending to the bottom of the canal prism. The distresses in the upper parts of the canal prism are local and do not extend to the bottom of the canal, so to fix these the water depth would be lowered about six feet below the design level during construction. Damaged lining would be removed, and the embankment would be excavated for at least two feet below the lining where all materials would be removed and replaced with selected and acceptable earth fill material. At locations where the lining distresses extend under the water surface to the bottom of the canal prism, the repairs required are more extensive. Damaged concrete lining and material distorting the canal would be removed with underwater operations, and grouted mattress would be installed and grouted with cement underwater at applicable locations.
- **Replacing impacted vehicle bridges:** Forty-five bridges have been identified as impacted. Identified bridges would be replaced by single span bridges with deep foundations at two abutments of the bridges in the concrete-lined segment. Along the earthen segment, intermediate piers would be constructed to support the replaced bridges within the canal prism. The low chord elevation of replaced bridges would be at least three feet above the MWSEL, including predicted subsidence. Asphalt pavement would be installed for the modified road segments. All affected utilities would be replaced and attached to newly constructed bridges. Earthwork would extend on both sides of the bridge to smoothly merge the profile of the bridge deck with the approach roads. Pipes carrying natural gas would be relocated under the canal utilizing horizontal directional drilling, whereas pipes carrying any other liquids would be replaced by pipes of equal diameter. New pipes would be epoxy coated and attached to bridges with hangers.

- **Replacing impacted pipeline crossings:** Thirty-six pipeline crossings have been identified as impacted.[3] The new pipelines would be carried by truss bridges, and pipes adjacent to each other would be carried by single bridges.
- **Modifying check structures and wasteways:** Although gates on check structures and wasteways were designed to have heights that exceeded the MWSEL at their locations, subsidence has caused an increase in water surface elevations which has resulted in some of these gates having heights lower than the MWSEL. To avoid overtopping, gates at seventeen check structures would require raising. Raising the heights of the gates could require changes to the drums, hoists, and cables to confirm that the gates will open to levels above the new MWSEL. The 20- by 17-foot gates are not likely to require hoist system replacements while the 18- by 15-foot gates, located at check structures 14, 15, 16, 17, 19, and 20, are likely to require hoist system replacements.
- **Modifying turnouts:** Walls for the stilling pits of 82 turnouts on the left side of the canal would require raising. The walls requiring raise would be raised with concrete, the existing galvanized steel would be removed, and metal guards would be installed around each stilling pit for all gravitational turnouts.
- **Modifying drainage structures:** Work on drainage structures would include installing trash racks for drain inlets; installing flared inlets for pipe culverts without inlets; replacing drain inlets that require relocation during replacement of deficient bridges; installing additional drain inlets at five structures; replacing existing headwalls and wing walls with new ones that are higher at seven structures; and replacing the clogged side culvert at one structure with a new box culvert, raising the headwalls for drain inlets, culverts, and overchutes at some locations; and installing or replacing riprap at inlets, outlets, culverts, and overchutes to protect embankment from erosion.

[3] Pipeline crossings with clearances less than one foot above the MWSEL (with predicted subsidence added).

Chapter 5 References

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Delta-Mendota Canal Subsidence Correction Project Environmental Assessment/Initial Study

Appendix C: Project Description

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Appendix C Project Description

This appendix presents detailed description of the No Action/No Project Alternative and the Proposed Action/Proposed Project.

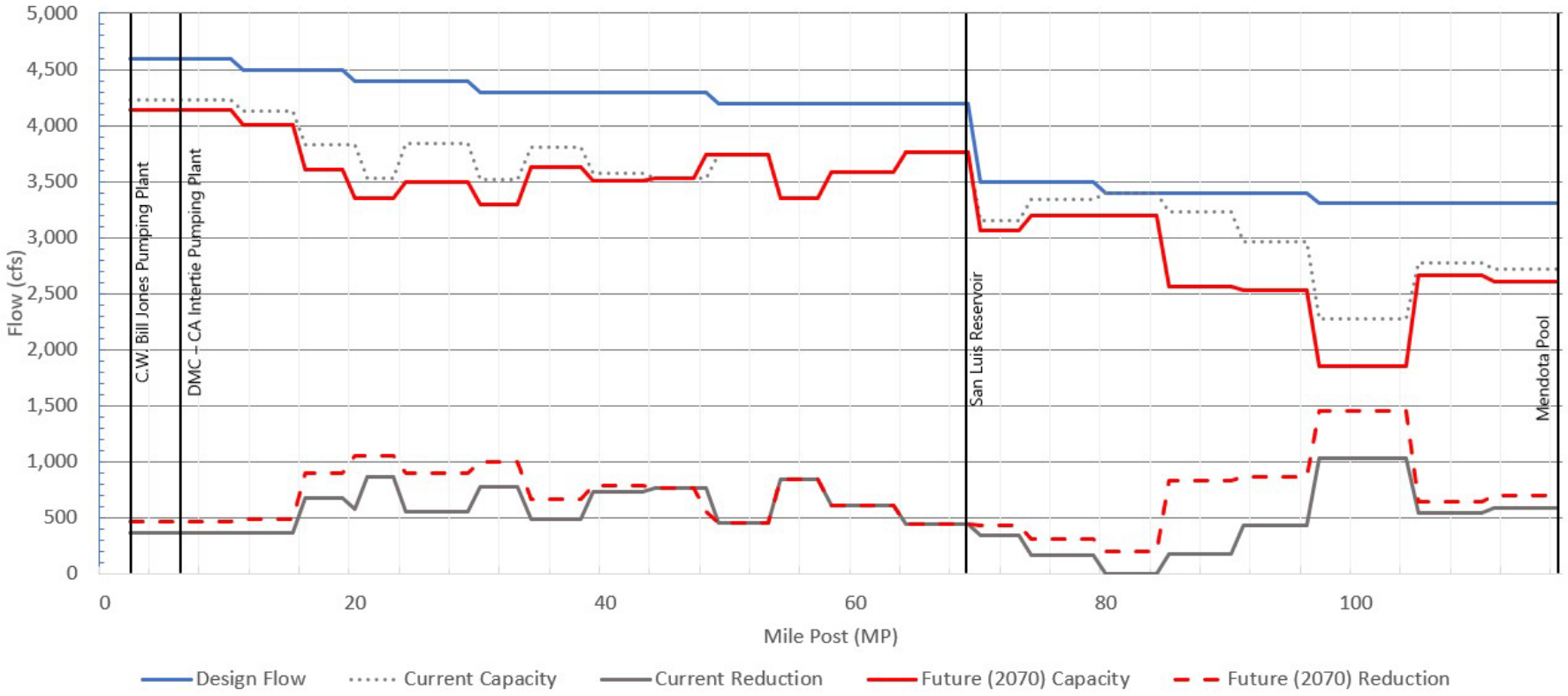
C.1 No Action/ No Project Alternative

The No Action Alternative (under the National Environmental Policy Act [NEPA]) describes future circumstances without the Proposed Action and includes predictable actions by persons or entities, other than the federal agency involved in a project action, acting in accordance with current management direction or level of management intensity. Under California Environmental Quality Act (CEQA), an evaluation of the No Project Alternative is not required in an Initial Study (IS)/ Mitigated Negative Declaration (MND). If the requirements of an EIR are triggered, the No Project Alternative describes the future without the project and may include some reasonably foreseeable changes in existing conditions and changes that would reasonably be expected to occur in the foreseeable future if the project were not approved.

The purpose of the No Action/No Project Alternative (subsequently identified as the No Action Alternative) is to provide decision-makers a comparison of the potential impacts of approving a project against the potential impacts of not approving the project. Under the No Action Alternative, the existing conditions of the Delta-Mendota Canal (DMC) would remain unchanged, and the flow rates would be further reduced from current flows during operation to obtain operational safety and meet Bureau of Reclamation [Reclamation] Design Standards No. 3 (Reclamation 2014). Currently, 30 out of the existing 115 bridges along the DMC are considered deficient because they do not have one foot of clearance above the Maximum Water Surface Elevation (MWSEL) when the canal is operated at design flow. However, the number of deficient bridges is expected to reach 45 when considering future subsidence conditions. Deficient bridges would be partially submerged when the canal is operated at the design flow, resulting in safety risks. To operate the canal safely and in accordance with Reclamation safety standards under the No Action Alternative, the maximum flow reduction in the DMC is estimated to be 1,457 cfs (44 percent reduction) from design capacity. Subsidence modeling was completed using the HydroGeoSphere San Joaquin Valley Groundwater Model to forecast the anticipated level of subsidence along the DMC through 2070. The simulated subsidence rates along the DMC were used to estimate forecasted design flows under future conditions. Figure C-1 details the current and anticipated reduction of the canal capacity compared to the designed capacity.

The No Action Alternative evaluates the reduced capacity of the DMC under (1) current conditions as of 2020; (2) under forecasted 2035 conditions; and (3) under forecasted 2070 conditions. The operations of the No Action Alternative would be consistent with the 2019 United States Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) Biological Opinions for the Reinitiation of Consultation on the Long-term Operations of the Central Valley Project (CVP) and State Water Project (SWP) (ROC on LTO) (USFWS 2019; NMFS 2019), Reclamation's 2020 ROC on LTO Record of Decision (ROD), and the 2018 Addendum to the Coordinated Operation Agreement CVP/SWP Finding of No Significant Impact (FONSI)/ROD. Both the Biological Opinions for ROC on LTO and the 2018 Addendum to the Coordinated Operation Agreement CVP and SWP FONSI/ROD assume a DMC flow rate reflecting the original design capacity. As

noted previously, the No Action/No Project Alternative assumes a reduced capacity of the DMC consistent with existing conditions.



Source: Feasibility Study of the Structural Alternatives

Figure C-1. Design Flows, Reduction in Flow, and Actual Flow Capacities in the DMC For Current and Future (With Future Subsidence) Conditions

C.2 Proposed Action/Proposed Project

The Raise Deficient Structures Alternative was selected as the Proposed Action (under NEPA) and the Proposed Project (under CEQA). Under the Proposed Action/Proposed Project (subsequently identified as the Proposed Action), the deficient lining, embankment, and impacted structures of the canal would be raised to restore the canal capacity to its originally authorized design flow capacity. Proposed modifications of the canal and related structures would be in accordance with current federal, state, and local design guidelines and standards.[1] The canal would be modified to satisfy current Reclamation safety standards, including freeboard requirements for the canal lining and embankment, and would be able to safely operate to deliver the designed capacity of water (variable flow capacity starting at 4,600 cfs at the upstream end and reducing to 3,210 cfs at the downstream end) to contractors. Therefore, no changes to future maintenance and operations are anticipated. Specific construction actions under the Proposed Action would include:

- Raising deficient concrete lining segments and bank segments to meet the minimum freeboard requirements;
- Installing riprap for erosion protection to stabilize the banks along the earthen-lined segment;
- Replacing bridges and pipeline crossings that do not have enough clearance above water surface elevation to meet minimum required clearings;
- Raising the gates of check structures and wasteways to design level and modify impacted structures; and
- Evaluating existing drainage structures to modify them for safe passage of stormwater.

C.2.1 Construction

C.2.1.1 Methods

Construction activities described above are presented below in more detail.

- **Raising deficient canal concrete lining**: To achieve this, new concrete lining would be placed above the existing concrete lining, with seals installed between the old and new concrete linings to eliminate seepage at approximately 80 miles along the canal. At locations with ladders installed in the concrete lining (every 750 feet), additional risers would be added in the new lining. Table C-1 and Figure C-2 detail the locations along the canal where this work would be necessary.

[1] Relevant guidelines/standards include Reclamation's Design Standards (Reclamation 2012; 2014; 2018), Reclamation's Engineering and O&M Guidelines for Crossings (Reclamation 2008), and Reclamation Earth Manual (Reclamation 1998).

Table C-1. Deficient Concrete Lining Raises

Mile Post Range		Length (miles)	Station Number Range	
4.67	10.54	5.87	241+90 – 250+20	609+00 – 610+00
11.68	61.68	50.00	661+47 – 673+00	2555+00 – 2574+00
61.87	64.52	2.65	2574+00 – 2577+57	2717+50 – 2730+00
65.08	65.46	0.38	2739+34 - 2765+70.70	2775+00 - 2780+50
65.65	66.03	0.38	2783+50 - 2802+98	2802+98 - 2811+50
66.22	66.41	0.19	2819+00	2819+00 - 2844+50
66.79	67.36	0.57	2847+00 - 2869+37	2869+83 - 2891+50
70.20	72.38	2.18	3029+60 - 3053+65	3145+75 - 3150+66.98
74.55	75.31	0.76	3257+37 - 3267+50	3297+50 - 3307+80
75.50	76.54	1.04	3310+50 - 3326+50	3346+50 - 3374+60
76.83	78.72	1.89	3381+50 - 3399+00	3477+40 - 3492+00
78.91	80.05	1.14	3492+00 - 3505+50	3554+05 - 3563+00
80.24	80.43	0.19	3563+00 - 3570+00	3570+19 - 3585+00
80.62	80.71	0.09	3585+00	3588+00 - 3601+36
81.56	81.65	0.09	3633+88 - 3641+23	3633+88 - 3641+23
83.27	87.82	4.55	3720+50 - 3730+00	3957+00 - 3969+30
88.10	88.19	0.09	3973+25 - 3981+42	3981+67 - 3987+35
90.27	90.46	0.19	4094+75	4101+10 - 4108+00
90.65	98.42	7.77	4110+64 - 4128+25	4498+99.80 - 4527+40

- **Raising the earth embankment at deficient bank segments of the canal**: This would be achieved by adding fill material from an existing borrow sites at approximately 50 miles along the canal right-of-way (ROW). The added fill material would be rolled and smoothed to match adjacent road elevations, and an asphalt chip seal installed on the left service road along the length of the canal. Table C-2 and Figure C-2 detail the locations along the canal where this work would be necessary.

Table C-2. Locations for Modifications of Embankments

Left Bank Raises			Right Bank Raises		
MP start	**Station Number**	**Length**	**MP start**	**Station Number**	**Length**
11.96	680+00 - 690+18	1.99	9.59	497+00 - 571+20	0.57
16.22	901+65 – 904+05	0.85	12.24	690+18 - 702+95	0.76
17.45	954+14 - 973+00	0.28	16.22	901+65 – 904+05	1.52
19.06	1038+00 - 1049+20	2.08	19.06	1038+00 - 1049+20	2.08
21.71	1183+00 - 1195+00	1.52	21.71	1183+00 - 1195+00	0.09
26.83	670+00 - 680+73	0.57	22.09	1199+00 - 1211+75	1.14
28.91	787+00 - 790+50	0.19	26.64	644+57 - 670+00	0.19
29.86	836+80 - 838+65	0.19	30.24	841+88 - 862+00	0.57
30.24	841+88 - 862+00	0.19	31.56	914+00 - 928+38	0.95
30.62	867+28 - 877+92	0.19	33.46	1018+27 - 1031+00	0.19
31.18	903+91 - 913+50	0.38	35.35	1118+00 - 1128+40	0.19
31.75	931+51 - 940+00	0.57	35.73	1146+90	0.19
32.70	982+72 - 994+00	0.57	36.11	1166+00 - 1182+00	0.95
33.46	1018+27 - 1031+00	5.49	37.62	1245+00 - 1251+00	0.57
39.14	1319+00 - 1330+42	0.38	38.38	1287+13.70	0.19
39.90	1365+00 - 1365+00	0.19	38.95	1309+00 - 1319+00	0.19
40.27	1365+00 - 1391+74	0.19	39.33	1331+00 - 1343+89	0.19
41.41	1433+50 - 1451+03	0.19	39.71	1343+89 - 1361+00	0.19
42.55	1506+19.5 - 1514+00	2.08	42.17	1483+20 - 1505+00	0.19
45.96	1683+00 - 1688+50	0.76	42.74	1514+00 - 1525+75	0.95
50.12	1902+33.44 - 1911+75	0.19	43.87	1569+25 - 1580+30	0.38
50.69	1935+75 - 1938+10	0.38	44.44	1600+65 - 1610+00	0.19
51.45	1975+80 - 1988+50	0.38	45.20	1645+00	0.19
52.96	2073+35 - 2083+00	0.19	45.77	1675+17	0.38
55.99	2248+50 - 2253+00	0.19	46.33	1697+79 - 1705+80	0.19
57.89	2354+18 - 2366+10	0.19	50.50	1927+40 - 1929+00	0.19
60.16	2481+00 - 2497+50	0.19	50.88	1948+00 - 196253.86	0.19
60.92	2508+46 - 2529+65	0.19	51.26	1966+08 - 1967+85	0.57
61.30	2542+00 - 2546+35.45	0.38	55.24	2162+00 - 2197+72	0.19
65.84	2783+50 - 2802+98	0.19	55.99	2248+50 - 2253+00	0.19
72.47	3150+66.98 - 3161+50	0.38	58.46	2392+79	0.19
86.11	3873+00 - 3878+06	0.19	61.30	2542+00 - 2546+35.45	0.19
88.57	3987+35 - 4006+50	0.09	65.84	2783+50 - 2802+98	0.19
95.39	4321+94 - 4368+05	0.38	94.44	4305+93 - 4317+54	2.27
96.90	4441+37 - 4457+66.75	4.17	96.90	4441+37 - 4457+66.75	4.55
110.92	5180+00 - 5186+97	0.19	110.16	5142+79 - 5151+32	0.19
115.46	5418+40 - 5430+15	0.19	110.92	5180+00 - 5186+97	0.38
			115.65	5433+25 - 5445+00	0.19
Sum (miles)		26.89			22.63

Key: MP = Mile Post

- **Stabilizing the canal banks along the earthen-lined segment of the canal:** The lower 18-mile segment of the canal from Mile Post (MP) 98.64 to 116.59 is earthen-lined. This construction activity would require lowering the water depth in the earthen-lined segment of the canal by up to six feet during construction, which would allow construction to extend about four feet below the MWSEL. Two-foot-deep sections of earthen materials would be excavated from the sides of the canal, and a one-foot-thick strip of filter material would be installed above the excavated surface, followed by one-foot of riprap that would be placed above the filter material.
- **Repairing distressed concrete lining above and below the water's surface:** Lining distresses were found to be either in the upper parts of the canal prism or more extensive, extending to the bottom of the canal prism. Distressed lining were observed at several locations along the DMC including MPs 8.2 (between station 422+01 and 433+00), 17.8 (between stations 982+00 and 996+51), 18.07 (between stations 997+50 and 1019+48), 23.2 (between stations 1260+50 and 1268+37.31), 30.64 (between stations 841+88 and 862+00), 33.7 (between stations 1054+75 and 1060+00), 42.39 (between stations 1483+20 and 1505+00), and 42.66 (between stations 1506+19.5 and 1514+00). The distresses at these locations are extensive and extend to nearly the bottom of the canal. Other more extensive damages were also observed at locations downstream of MP 50 (between station 1890+25 and 1905+00.00) including damages at MPs 64.28, 74.6 to 75.3, 87.3 to 87.8 and 92.6 to 97.6. Damaged concrete lining and material distorting the canal would be removed with underwater operations, and a grouted mattress would be installed and grouted with cement underwater at applicable locations.
- **Replacing impacted vehicle bridges**: 45 bridges have been identified as impacted.[2] Identified bridges would be replaced by single span bridges with deep foundations at two abutments of the bridges in the concrete-lined segment. Along the earthen-lined segment, intermediate piers would be constructed to support the replaced bridges within the canal prism. The low chord elevation of replaced bridges would be at least three feet above the MWSEL, including predicted subsidence. Asphalt pavement would be installed for the modified road segments. All affected utilities would be replaced and attached to newly constructed bridges. Earthwork would extend on both sides of the bridge to smoothly merge the profile of the bridge deck with the approach roads. Pipes carrying natural gas would be relocated under the canal using horizontal directional drilling, whereas pipes carrying any other liquids would be replaced by pipes of equal diameter. New pipes would be epoxy coated and attached to bridges with hangers. Table C-3 details the locations of the impacted bridges.

[2] Impacted bridges were defined as those bridges with a vertical clearance between the low chord elevation and the maximum water surface (with the project subsidence added to it) of one foot or less.

Table C-3. Deficient Bridges

MP	Station Number	Bridge Name	MP	Station Number	Bridge Name
13.25	752+60	S. Lammers Road	45.77	1675+17	Davis Road
14.80	833+87	Corral Hollow Road	46.84	1731+79	Fink Road
17.23	954+14	Durham Ferry Road	48.38	1812+75	Diehl Road
18.04	996+51	McArthur Road	51.40	1975+64	Stuhr Road
19.18	1052+83	Chrisman Road	52.01	2007+68	Orestimba Road
20.96	1146+85	Unnamed	56.60	2283+62	Pete Miller Road
21.49	1174+52	S. Bird Road	57.95	2366+10	Sullivan Road
23.36	494+35	Unnamed	58.46	2392+79	Gravel Pit Road
24.48	553+35	Koster Road	60.06	2477+17	Taglio Road
26.21	644+57	Gaffery Road	61.06	2530+22	Snyder Road
26.93	682+58	Unnamed	90.91	4128+25	Unnamed
28.27	754+19	Welty Road	95.45	4368+05	Unnamed
29.93	841+23	McCracken Road	96.61	4429+57	Althea Avenue
31.12	903+91	Unnamed	97.68	4482+25	Russell Avenue
31.59	928+38	Unnamed	98.74	4540+12	Unnamed
32.10	955+51	Unnamed	102.03	4713+89	Unnamed
32.61	982+32	Howard Road	105.03	4873+29	Jerrold Avenue
33.29	1018+27	Unnamed	105.55	4901+06	Unnamed
34.39	1076+33	Needham Road	106.59	4955+60	Unnamed
34.89	1102+78	Unnamed	107.42	5000+14	Nees Avenue
39.21	1330+56	Rodgers Road	110.12	5142+79	Washoe Avenue
42.53	1505+86	Ward Avenue	111.51	5216+16	Sierra Avenue
43.24	1541+41	Marshall Road			

- **Replacing impacted pipeline crossings:** 36 pipeline crossings have been identified as impacted.[3] The new pipelines would be carried by truss bridges, and pipes adjacent to each other would be carried by single bridges. Table C-4 details the locations of the impacted pipeline crossings.

Table C-4. Pipeline Crossing Replacements

Pipe	Mile Post	Station Number	Size	Notes
9	16.78	932+32	26"	Gasoline Line Crossing (Stan. Pac. Pipeline)
10		932+22	24"	Oil Line Crossing (Std. Oil Co.)
11	18.47	1019+48	24"	Gas Line Crossing (Stan. Pac. Pipeline) On Steel Piers
12			26"	Oil Line Crossing (Std. Oil Co.)
13	21.13	1155+50	16"	Irrigation Pipe Crossing on Concrete Piers (J.F. Traina)

[3] Pipeline crossings with clearances less than one foot above the MWSEL (with predicted subsidence added).

Pipe	Mile Post	Station Number	Size	Notes
14	22.75	1242+00	16"	Irrigation Pipe Crossing on Steel Piers (Logan)
15	23.76	515+22	16"	Irrigation Crossing on Steel Piers
16	46.17	1696+98	16"	Pipeline Crossing on U/S Side (Cerutti Bros.)
18	59.50	2448+00	16"	Irrigation Pipe Crossing on Concrete Piers (Simon Newman Co.)
32	83.36	3730+00	18"	Irrigation Pipe Crossing on Piers (H.G. Fawcett)
33	83.57	3740+86	30"	Irrigation Pipe Crossing on Piers (H.G. Fawcett)
35	83.88	3757+30	24"	Drainpipe Crossing on D/S Side of Bridge (Fawcett)
39	85.04	3819+00	18"	Irrigation Pipe Crossing on Piers (F. Cotta & R. Lindemann)
40	85.47	3841+00	18"	Irrigation Pipe Crossing on D/S Side (Jacob Dillinger)
42	86.70	3905+95	18"	Irrigation Pipe Crossing on Concrete Piers (Joe Fialho)
44	89.23	4039+92	18"	Irrigation Pipe Crossing (Joseph Y. Woo & Sam Hamburg Farms)
45	90.57	4110+64	24"	Pipe Crossing on Concrete Piers (Hamburg Lifelines)
46			36"	Pipe Crossing on Concrete Piers (Hamburg Lifelines)
47			30"	Pipe Crossing on Concrete Piers (Hamburg Lifelines)
48	90.91	4128+25	18"	Irrigation Pipe Crossing on U/S Side (Sam Hamburg Farms)
49	91.71	4170+50	18"	Irrigation Pipe Crossing on Concrete Piers (Sam Hamburg Farms)
50	92.23	4170+50	24"	Pipeline Crossing
51	92.73	4224+36	18"	Gas line On Underside of Bridge (PG&E) (Hugh Bennet)
52	93.23	4251+20	18"	Drainpipe Crossing on Piers (Pacific Western Oil)
53	94.26	4305+50	18"	Irrigation Pipe Crossing Piers (Pipe Removed)
54	95.45	4368+05	24"	Pipe on U/S Side of Bridge
55			30"	Unknown
57	98.74	4540+12	18"	Unknown
58	99.82	4597+05	18"	Irrigation Pipe Crossing D/S Side of Bridge
59	100.23	4619+00	36"	Irrigation Pipe Crossing on Timber Pile Bents (B.B. Britton)
60	101.27	4674+00	24"	Irrigation Pipe Crossing on Timber Pile Bents (V.C. Britton)
61	102.54	4750+70	24"	Irrigation Pipe Crossing on Timber Pile Bents (V.C. Britton)
62	102.93	4761+81	36"	Unknown
63			24"	Irrigation Pipe Crossing D/S Side of Bridge
64	105.04	4873+89	24"	Irrigation Pipe Crossing on Timber Pile Bents (V.C. Britton)
65	106.48	4950+00	24"	Irrigation Pipe Crossing on Timber Pile Bents (V.C. Britton)

- **Modifying check structures and wasteways:** Although gates on check structures and wasteways were designed to have heights that exceeded the MWSEL at their locations, subsidence has caused an increase in water surface elevations which has resulted in some of these gates having heights lower than the MWSEL. To avoid overtopping, gates at 17 check structures would require raising. Raising the heights of the gates could require changes to the drums, hoists, and cables to confirm that the gates will open to levels above the new MWSEL. The 20 by 17 foot gates are not likely to require hoist system replacements while the 18 by 15 foot gates, located at check structures 14, 15, 16, 17, 19, and 20, are likely to require hoist system replacements. Raising the gates at these check structures will increase the forces on the concrete structures supporting these gates and thus structural reinforcement will be required to reinforce the concrete elements. Table C-5 details the location of the check structures and wasteways to be modified and the required gate raise for each.

Table C-5. Check Structures and Wasteways to be Modified

Check Number	Mile Post	Station Number	Required Gate Raise (ft)
1	11.35	652+65	1.11
2	16.18	900+65	1.07
3	20.63	1129+35	1.65
4	24.42	550+00	2.06
5	29.81	835+00	1.9
6	34.42	1078+15	1.9
7	38.69	1303+80	1.23
8	44.26	1597+65	0.82
9	48.62	1825+65	0.42
10	54.41	2148+65	0.3
11	58.28	2383+65	0.09
14	74.4	3256+50	0.16
15	79.65	3534+20	0.87
16	85.09	3821+50	0.46
17	90.54	4109+20	2.68
19	105.06	4875+40	2.02
20	111.26	5202+30	2.26
Wasteway Number	**Mile Post**	**Station Number**	**Required Gate Raise (ft)**
1	34.32	1072+55	0.44
6	111.22	5200+90	1.9

Modifying turnouts. Walls for the stilling pits of 82 turnouts on the left side of the canal would require raising. The walls requiring raise would be raised with concrete, the existing galvanized steel would be removed, and metal guards would be installed around each stilling pit for all gravitational turnouts.

Modifying drainage structures. Work on drainage structures would include:

- Installing trash racks for drain inlets; installing flared inlets for pipe culverts without inlets;
- Replacing drain inlets that require relocation during replacement of deficient bridges; installing additional drain inlets at MP 18.06 (station 997+25), 20.71 (station 1133+75), 41.08 (between stations 1427+00 and 1433+50), 49.83 (between stations 1889+00 and 1890+25) and 60.44 (station 2497+50);
- Replacing existing headwalls and wing walls with new ones that are higher at MP 5.77 (station 303+15), 21.91 (station 1197+00), 25.62 (station 613+36), 30.63 (station 877+92), 41.93 (station 1474+40), 45.75 (station 1673+80), and 64.28 (station 2709+35);
- Replacing the clogged side culvert at MP 5.77 (station 303+15) with a new box culvert, raising the headwalls for drain inlets, culverts, and overchutes at some locations; and
- Installing or replacing riprap at inlets, outlets, culverts, and overchutes to protect embankment from erosion.

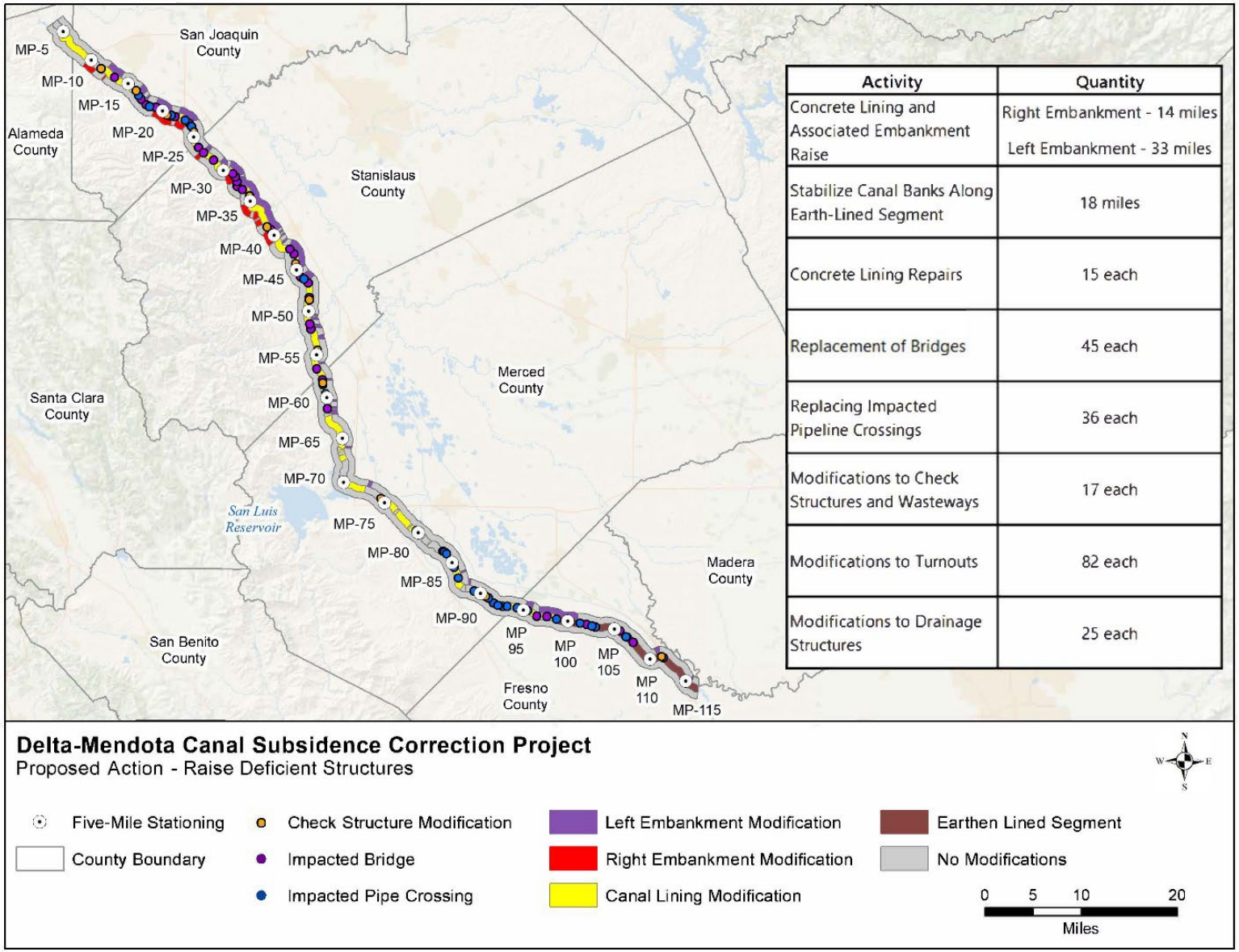


Figure C-2. Construction Details under the Proposed Project

C.2.1.2 Equipment and Staging

Construction staging and stockpiling would occur within the canal ROW, which extends approximately 100 to 200 feet on both sides of the canal depending on specific location. Construction staging and stockpiling would typically occur in the immediate vicinity of the construction activity and would be limited to duration of the construction activity (see details in Table C-6 and Table C-7 below). In addition to the construction staging area, 54 borrow areas (approximately 227.7 acres total) have been identified within the canal ROW for excavation of embankment material and backfill material. These areas would be returned to preconstruction condition after the Project is completed.

Equipment in the staging areas would include trailers, equipment to be used, and stockpiled materials. Construction equipment would access the construction sites and stockpiling areas through existing left and right bank service roads. Table C-6 below summarizes the construction equipment list by construction activity.

Table C-6. Assumptions for the Construction Equipment Under the Proposed Action

Activity	Equipment List
Concrete Lining and Associated Embankment Raise	1 Small Dozer, 2 Loaders, 1 Small Excavator, 1 Compacter, 1 Skid Steer, 7 Water Trucks and 2 Dump Trucks
Stabilize Canal Banks Along Earth-Lined Segment	2 Small Dozers, 5 Loaders, 1 Small Excavator, 2 Roller Compacters, 1 Plate Compactor, 1 Grader, 7 Water Trucks and 2 Dump Trucks
Concrete Lining Repairs	1 Excavator, 2 Dump Trucks, 1 Skid Steer
Replacement of Bridges	1 Crane, 1 Sawcut,1 Dozer,1 Compactor,1 Excavator,1 Drill Rig,1 Skid Steer, 1 Paver, 1 Tractor, 4 Water Trucks and 6 Dump Trucks
Replacing Impacted Pipeline Crossings	1 Small Excavator, 1 Skid Steer,1 Crane,1 Loader, 2 Dump Trucks
Modifications to Check Structures and Wasteways	2 Cranes and 3 Lifts
Modifications to Turnouts	2 Cranes, 1 Skid Steer, and 2 Dump Trucks
Modifications to Drainage Structures	2 Excavators, 2 Skid Steers, 1 Dump Truck

*Activities listed above could occur concurrently

C.2.1.3 Schedule

Construction duration for the Proposed Action is assumed to be seven and a half years. Work would be performed seven days per week, 12 months per year. Work during the weekdays (Monday through Friday) would be performed in one 10-hour work shift that would occur between 7 a.m. and 7 p.m. Work during the weekends (Saturday and Sunday) would be performed in one eight-hour shift that would occur between 9 a.m. and 5 p.m. It is assumed, for the purpose of this EA/IS, that construction would start in March 2025. The major assumptions for the schedule development of the Proposed Action as well as the anticipated construction duration of construction activities are detailed in Table C-7.

Table C-7. Assumptions for the Proposed Action Schedule Development

Activity	Seasonal Designation	Production Rates Used for the Schedule	Duration (Years)
Concrete Lining and Associated Embankment Raise	Low-flow work	400 feet per day - One Form/Reinforce/Place operation.	4 (October – May)
Stabilize Canal Banks Along Earth-Lined Segment	Low-flow work	400 feet per day - One construction operation.	1 (October – May)
Concrete Lining Repairs	Low-flow work	Two weeks for each repair area - one construction operation.	0.75 (November – February)
Replacement of Bridges	All season work	Six months per bridge - Three bridges are being constructed concurrently for the duration of the Project	7.25
Replacing Impacted Pipeline Crossings	All season work	Three weeks for each pipeline crossing - one construction operation	2
Modifications to Check Structures and Wasteways	Low-flow work	Four months per structure - Two structures are being constructed concurrently for the duration of the Project.	4.5 (November – February)
Modifications to Turnouts	All season work	One week each – one construction operation	2
Modifications to Drainage Structures	All season work	Two weeks each - one construction operation	1

*Activities listed above could occur concurrently

C.2.2 Operations

C.2.2.1 Operations During Construction

Some drawdowns of the canal water surface are needed to support in-water construction activities; however, no canal outages are required, thus providing flexibility in completing construction activities.

The proposed concrete lining and associated embankment raise low-flow construction actions in the upper DMC would be completed above water surface and would not impact flows. Proposed concrete lining repairs of the canal in the upper DMC would require underwater work and would also be completed without drawdown to flows. Modification to check structures in the upper DMC would require flows in the upper DMC to be held at levels not to exceed two thirds of current capacity (i.e., 66 percent of current capacity) between November through February of the construction duration.

The proposed embankment raise low-flow construction action in the lower DMC would be completed above water surface and would not impact flows. Proposed concrete lining repairs of the lined canal would require underwater work and would also be completed without drawdown to flows in the lower DMC. Similar to the upper DMC, modification of check structures along the lower DMC would require flows to be held at two thirds of current capacity (i.e., 66 percent of

current capacity). Repairs and stabilization activities along the earthen-lined segment of the lower DMC would require water levels to be drawn down by up to six feet from November through February, which is equivalent to an average reduction of approximately one third of the canal's current capacity in that segment. During these construction actions, limits on water levels in the earthen-lined segment of up to six feet could result in a water surface elevation in the Mendota Pool higher than the DMC, depending on inflow rates into Mendota Pool from the San Joaquin River. If these conditions were to occur during construction, water would be pumped from the DMC into Mendota Pool.

C.2.2.2 Operations After Construction

The Proposed Action would restore conveyance capacity in the DMC back to its originally authorized design capacity. Operation of the DMC after construction would conform to the existing operating rules identified in the 2019 USFWS and NMFS Biological Opinions for the ROC on LTO of CVP and SWP (USFWS 2019; NMFS 2019) or any future regulatory requirements and the terms and conditions specified in the relevant Biological Opinions. Reclamation would continue to maintain the facilities in compliance with the existing USFWS biological opinion titled *Formal Endangered Species Consultation on the Operations and Maintenance Program Occurring on Bureau of Reclamation Lands within the South-Central California Area Office* that was issued on February 17, 2005 (referred furthermore as the 2005 USFWS Biological Opinion) (USFWS 2005) or any future regulatory requirements and the terms and conditions specified in the relevant Biological Opinions. As the canal would be modified to meet originally authorized design capacity and flows, no changes to the current operations and maintenance are anticipated.

C.3 References

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Delta-Mendota Canal Subsidence Correction Project Environmental Assessment/Initial Study

Appendix D: CalSim Modeling

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Chapter 1 Background and Project Description

The Delta-Mendota Canal (DMC) is a 116-mile-long gravity canal that conveys water from the Delta region near Tracy, CA to the Mendota Pool near Mendota, CA. The DMC was constructed in 1951 in compliance with the then-current Design Standards and standard industry practices. The Bureau of Reclamation (Reclamation) documented that the canal was incapable of conveying the original designed capacity due to the occurrence of regional land subsidence within the California Central Valley, which caused structural deficiencies in the canal. The technical appendix describes analysis performed in support of the DMC Subsidence Correction Project (Project).

This technical appendix provides a description of the of the project alternatives (Chapter 1), analysis of historical operations data (Chapter 2), description of the CalSim model (Chapter 3), and analytical modeling results for the Proposed Action (Chapter 4).

1.1 Project Purpose and Need/Project Objectives

1.1.1 Project Purpose and Need

As a result of subsidence, the available freeboard for the canal lining and the canal embankment, and clearances between maximum water surface elevations and many structures crossing the DMC, no longer meet Reclamation standards. The combination of reduced freeboard and impacted structures requires that SLDMWA operate the DMC at a lower water surface elevation, which reduces its capacity to convey water supply deliveries to water users dependent on that supply. The continued, safe, and reliable operation of the DMC is critical to the users it serves, and the economies it supports. The purpose and need of Reclamation's Proposed Action is to restore the originally authorized conveyance capacity of the DMC (the design capacity conveys a variable flow rate decreasing from 4,600 cubic feet per second (cfs) at the upstream end to 3,210 cfs at the downstream end).

In compliance with the Council on Environmental Quality's *Economic and Environmental Principles, Requirements and Guidelines for Water and Land Related Resources Implementation Studies* and Reclamation's Directive and Standards CMP 09-02 *Water and Related Resources Feasibility Studies*, Reclamation and SLDMWA are evaluating the feasibility of alternatives that would restore the lost conveyance capacity in the DMC to regional subsidence. Reclamation is completing a Feasibility Study evaluation to identify, evaluate and select an alternative that can support the delivery of Central Valley Project (CVP) supplies needed by CVP water users dependent on the DMC that would otherwise be blocked by limits on its conveyance capacity generated by regional subsidence.

1.1.2 CEQA Goals and Objectives

Under CEQA, a lead agency must identify the objectives sought by the proposed project when that project requires an Environmental Impact Report (EIR) (CEQA Guidelines Section 15124(b)). Although a statement of project objectives is not required under CEQA for an IS, the additional information provided in this section is consistent with CEQA Guidelines. The primary goal for the Project is to restore conveyance capacity in the DMC lost to regional subsidence. The objectives of the Project are as follows:

1. To restore the long-term reliability and quantity of CVP supplies delivered to south-of-Delta contractors dependent on the DMC currently affected by reduced deliveries limited by the canal's reduced conveyance capacity.
2. To support the safe long-term operation of the DMC consistent with its design for freeboard and clearances between maximum water surface elevations and structures crossing the canal.

1.1.2.1 Additional Goals and Objectives

The Project is being designed and implemented to achieve the primary goals and objectives listed above. CEQA Guideline 15124(b) states that the goals and objectives may also outline Project benefits. The additional benefits of the Project are as follows:

- Restore capacity of the DMC for the short-term conveyance of transferred water[1] to provide increased water supply reliability and operational flexibility to south-of-Delta CVP contractors and potentially convey surface water supplies for other contractors.
- Design and maintain the restored capacity of the DMC for a service life of at least 50 years to avoid potential future reductions in conveyance capacity resulting from continued subsidence forecast following Project implementation.

1.1.3 No Action/No Project Alternative

Under the No Action/No Project Alternative (subsequently identified as the No Action Alternative), the existing conditions of the DMC would remain unchanged, and the flow rates would be further reduced from original design capacity during operation to meet Reclamation Design Standards No. 3 (Reclamation 2014). Currently, 30 of the existing 115 bridges along the DMC are considered deficient because they do not have one foot of clearance above the Maximum Water Surface Elevation (MWSEL) when the canal is operated at design flow. However, the number of deficient bridges is expected to reach 45 when taking future subsidence conditions into consideration. Under the No Action Alternative, deficient bridges would be partially submerged when the canal is operated at the design flow, resulting in safety risks. To operate the canal safely and in accordance with Reclamation safety standards under the No Action Alternative, flow in the canal would need to be restricted further below its current operating flows, with a forecasted maximum, permanent flow reduction in the DMC estimated at 1,457 cfs (44-percent reduction) from original design capacity by 2070. Figure 1 contains details the current and anticipated reduction of the canal capacity compared to the designed capacity.

The No Action Alternative evaluates the reduced capacity of the DMC under (1) current conditions as of 2020; (2) forecasted 2035 conditions; and (3) forecasted 2070 conditions. The operations of the No Action Alternative would be consistent with the 2019 United States Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) Biological Opinions (2019 USFWS and NMFS Biological Opinions) for the Reinitiation of Consultation on the Long-term Operations of CVP and State Water Project (SWP) (ROC on LTO), 2020 ROC on LTO Record of Decision (ROD), and the 2018 Addendum to the Coordinated Operation Agreement Central Valley

[1] Environmental compliance for the transfer actions including sellers making water available and the conveyance of transferred water to south-of-Delta CVP contractors is analyzed outside this EA/IS in separate environmental compliance documents, including but not limited to the Long-Term Water Transfers environmental document, available here: https://www.usbr.gov/mp/nepa/nepa_project_details.php?Project_ID=18361.

Project/State Water Project Finding of No Significant Impact (FONSI)/ROD. Both the Biological Opinion for ROC on LTO and the 2018 Addendum to the Coordinated Operation Agreement CVP and SWP FONSI/ROD assume a DMC flow rate reflecting the original design capacity. As noted previously, the No Action/No Project Alternative assumes a reduced capacity of the DMC consistent with existing conditions.

1.1.4 Raise Deficient Structures Alternative (Proposed Action)

The Raise Deficient Structures Alternative has been identified as the Proposed Action (under NEPA) and the Proposed Project (under CEQA). Under the Proposed Action/Proposed Project (subsequently identified as the Proposed Action), the DMC would be modified to satisfy current Reclamation safety standards, including freeboard requirements for the canal lining and embankment. The deficient lining, embankment, and impacted structures of the canal would be raised to restore the canal to its original conveyance capacity. The proposed modifications of the canal and related structures would be in accordance with current federal, state, and local design guidelines and standards.

Delta Mendota Canal Capacity (cfs)

Mile Post	Design Flow	Current Conditions		2035 Projected Conditions		2070 Projected Conditions	
	Capacity	Capacity	Reduction	Capacity	Reduction	Capacity	Reduction
11.35	4600	4232	-368	4189	-411	4136	-464
16.19	4498	4129	-369	4076	-422	4008	-490
20.63	4498	3825	-673	3738	-760	3630	-868
24.43	4399	3529	-870	3450	-949	3348	-1051
29.82	4399	3843	-556	3692	-707	3494	-905
34.42	4299	3518	-781	3395	-904	3299	-1000
38.68	4299	3810	-489	3743	-556	3633	-666
44.26	4299	3571	-728	3559	-740	3510	-789
48.62	4299	3530	-769	3530	-769	3530	-769
54.41	4199	3739	-460	3739	-460	3739	-460
58.28	4199	3356	-843	3356	-843	3356	-843
63.99	4199	3585	-614	3585	-614	3585	-614
70.01	4199	3759	-440	3759	-440	3759	-440
74.4	3501	3157	-344	3125	-376	3065	-436
79.64	3501	3339	-162	3269	-232	3191	-310
85.09	3400	3400	0	3376	-24	3195	-205
90.54	3400	3227	-173	2861	-539	2565	-835
96.81	3400	2966	-434	2750	-650	2532	-868
105.06	3310	2274	-1036	2090	-1220	1853	-1457
111.26	3310	2777	-533	2716	-594	2668	-642
116.41	3310	2724	-586	2683	-627	2607	-703

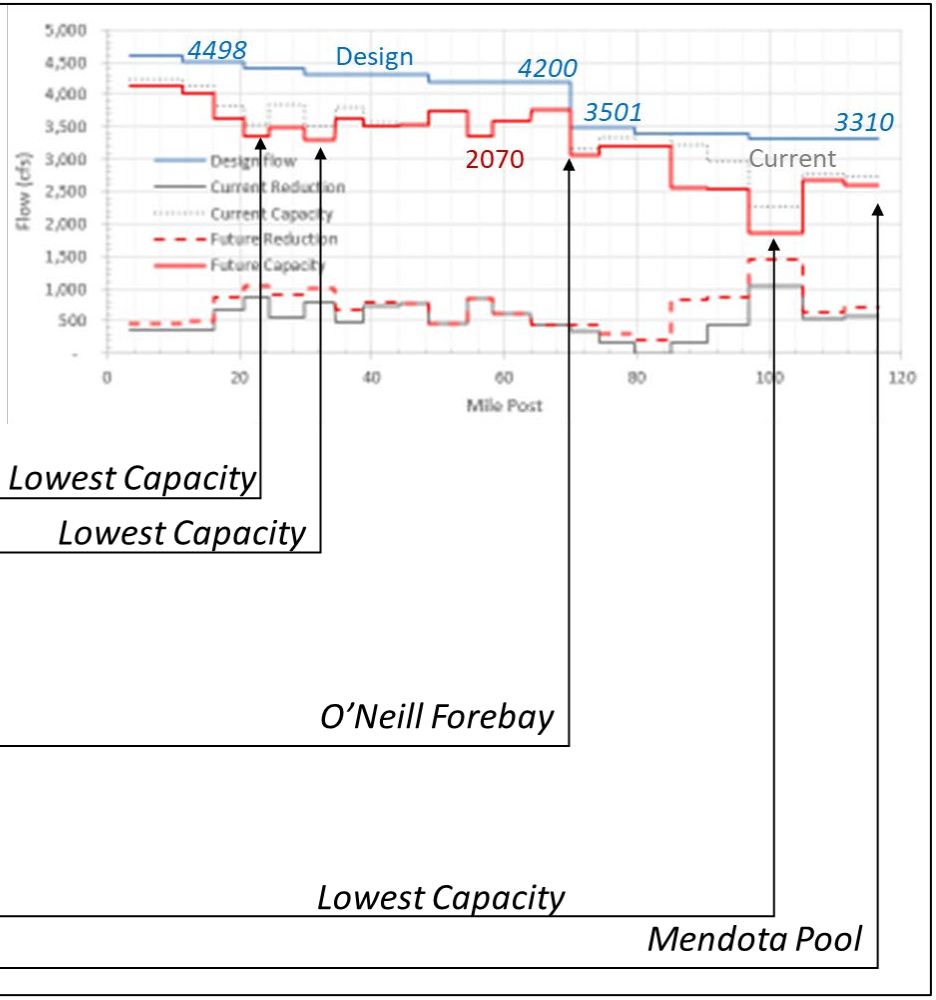


Figure 1. Design Flows, Reduction in Flow, and Actual Flow Capacities in the DMC for Current and Future (with-Future Subsidence) Conditions

Chapter 2 Historical Operations and Data

Evaluating historical operations data provides insights regarding the reduced capacity of the DMC and how reduced capacity has affected CVP south-of-Delta operations. Review of historical data also guides modeling and forms a basis for relating the modeling to actual CVP/SWP operations.

A key indicator for how DMC capacity reductions have affected CVP operations is historical pumping at C.W. "Bill" Jones Pumping Plant (Jones Pumping Plant). Figure 2 contains a plot of historical pumping at Jones Pumping Plant from 1955 through 2020. Until San Luis Reservoir began operation in about 1967, the Jones Pumping Plant rarely reached full pumping capacity. From 1967 through the late 1980s, Jones Pumping Plant often reached full capacity. Pumping at Jones Pumping Plant was below capacity during a drought in California that lasted from the late 1980s though 1994. After the wet hydrologic period from 1995 through 1998, Jones Pumping Plant pumping steadily declined due to reduced DMC capacity. The lowest pumping at Jones Pumping Plant occurred prior to the construction of the Intertie in 2012 but has continued a steady decline since then.

Figure 3 contains a chart with a DMC water balance for year 2011. Pumping at Jones Pumping Plant (positive bar in the chart) is water entering the DMC. Flow leaving the DMC are diversions along the DMC, flow to Mendota Pool, and pumping from the DMC at O'Neill (shown as negative bars in the chart). The maximum pumping at Jones Pumping Plant in 2011 is about 4,190 cfs, about 400 cfs below design capacity due to reduced DMC capacity during times when regulations do not constrain pumping to levels below design capacity. Figure 4 contains a DMC water balance for year 2012 and indicates when the Intertie began operation. Flow in the Intertie is shown as water leaving the DMC (red in Figure 4), and water released from CVP San Luis reservoir to meet water demands on the DMC is shown as water entering the DMC (orange). Maximum pumping at Jones Pumping Plant increased during June of 2012 due to operation of the Intertie. Figure 5 contains a DMC water balance for California's most recent wet year, 2017. Reduced DMC capacity limits Jones pumping during wet winter months by approximately 600 cfs, also indicated by pumping at O'Neill of 3,500 cfs being 700 cfs below capacity.

Review of historical data demonstrates that reduced DMC capacity has affected the CVP ability to satisfy full CVP contract demand in the export region. Overall CVP allocations have reduced, and CVP contractors have altered, their demands and operations as a result of reduced capacity. Modeling of the Proposed Action demonstrates consistent effects to CVP south-of-Delta operations as has been observed in historical operations records.

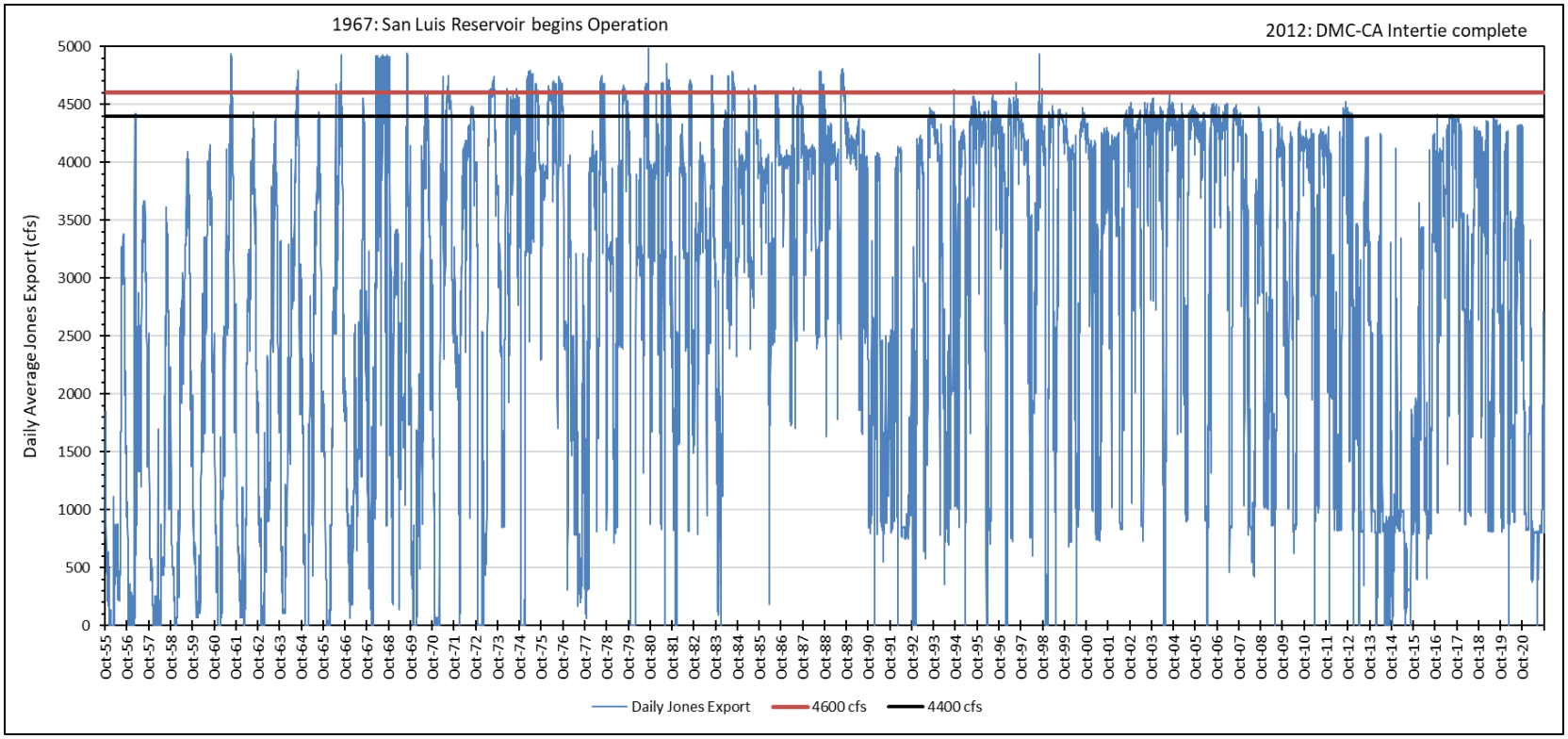


Figure 2. Average Daily Jones Pumping Plant Export (1955–2020)

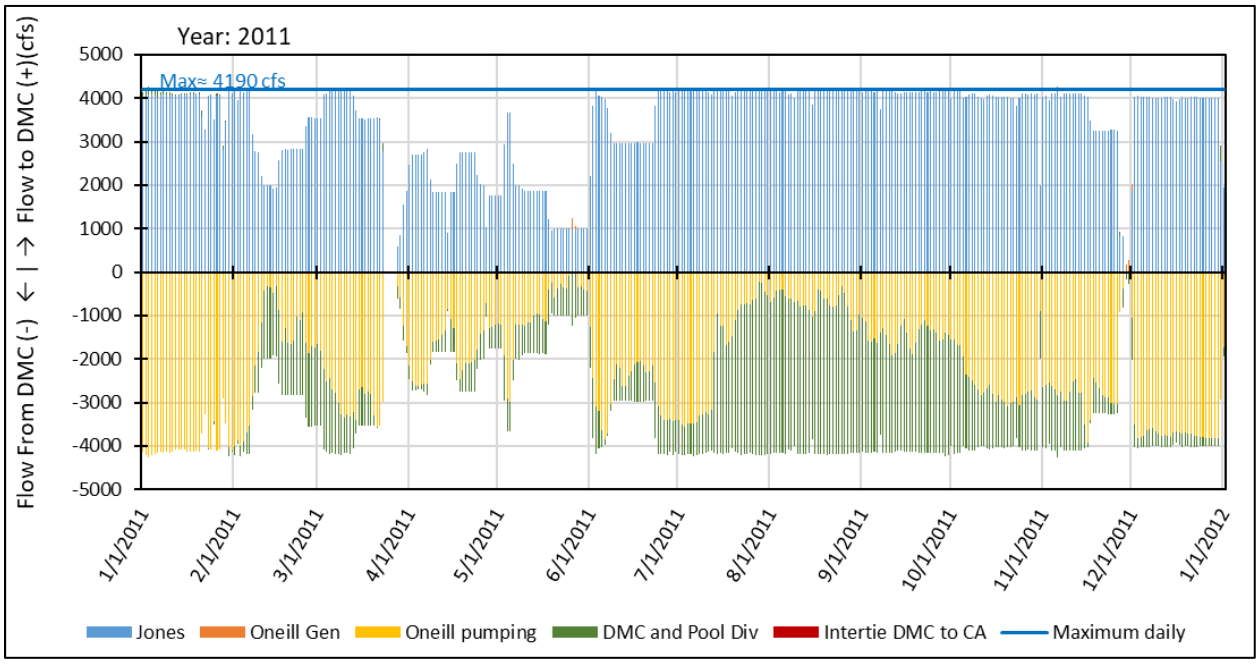


Figure 3. Historical Daily DMC Inflow (Jones Pumping Plant) and Outflow (2011)

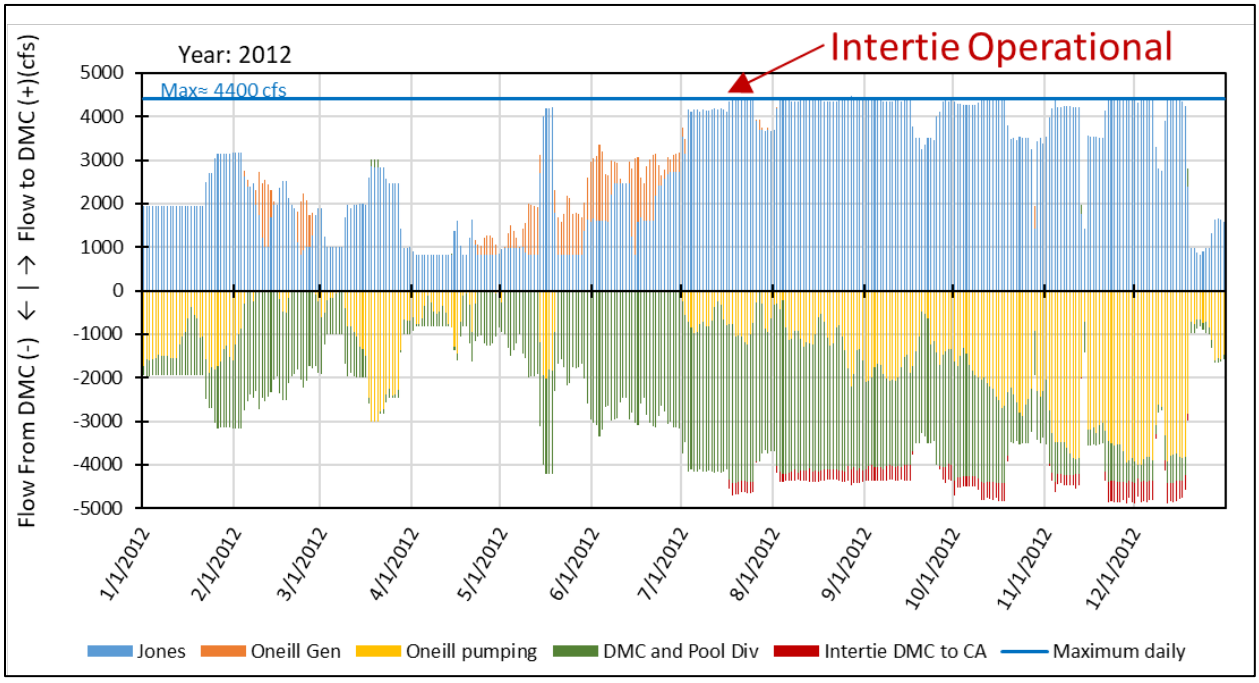


Figure 4. Historical Daily DMC Inflow (Jones Pumping Plant) and Outflow (2012)

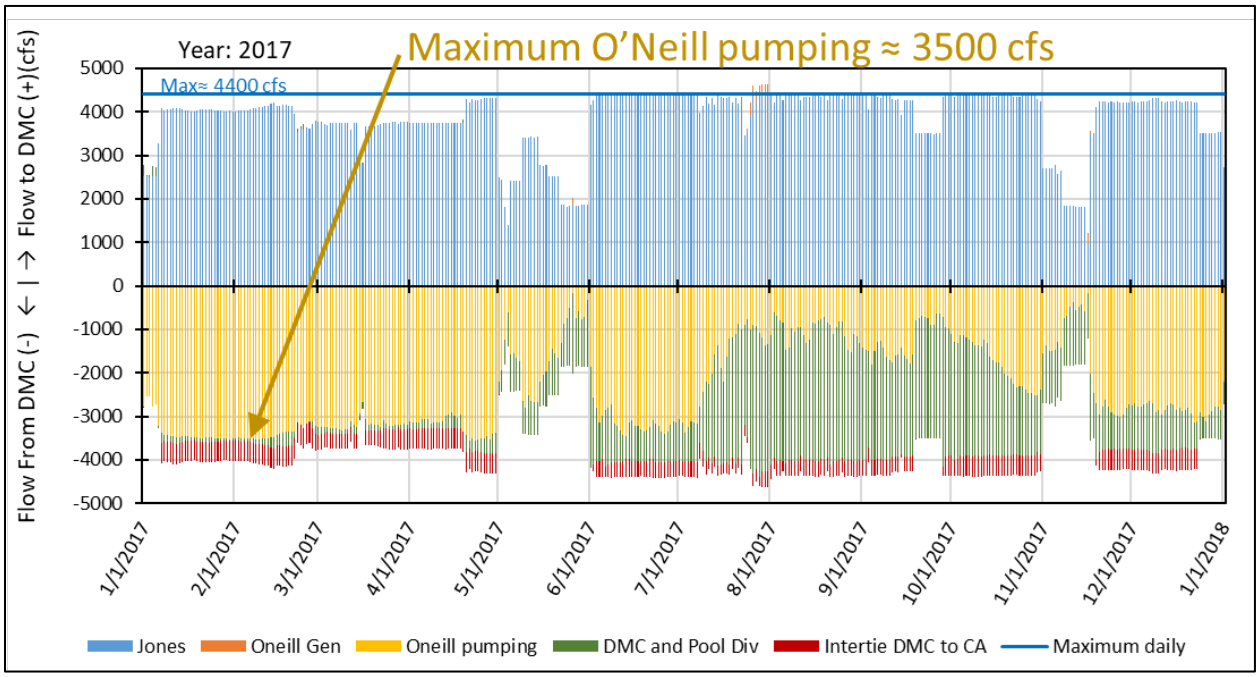


Figure 5. Historical Daily DMC Inflow (Jones Pumping Plant) and Outflow (2017)

Chapter 3 Water Operations Modeling

Water operations modeling is a key step in the analysis of Project alternatives. Water operations model results frequently serve as the basis of subsequent economic and environmental analyses. This section provides brief descriptions of the models used to analyze the alternatives. Descriptions include model assumptions and modifications made to baseline model files provided by Reclamation.

3.1 Operations Models

CalSim II was used to simulate CVP/SWP operations, including the DMC, for each Project alternative.

3.1.1 CalSim II

CalSim II is a planning model designed to simulate operations of CVP and SWP reservoirs and water delivery systems. CalSim II simulates flood control operating criteria, water delivery policies, and in-stream flow and Delta outflow requirements. CalSim II is the best available tool for modeling CVP and SWP operations and is the primary system-wide hydrologic model used by the Department of Water Resources (DWR) and Reclamation to conduct planning and impact analyses of potential projects.

CalSim II is a simulation by optimization model. The model simulates operations by solving a mixed-integer linear program to maximize an objective function for each month of the simulation. CalSim II was developed by Reclamation and DWR to simulate operation of the CVP and SWP for defined physical conditions and a set of regulatory requirements. The model simulates these conditions using 82 years of hydrology from water year 1922 through 2003.

CalSim II modeling conducted for the for the Project was developed from baseline models[2] provided by Reclamation. The model's input hydrology incudes historical hydrology and 2035 level climate change hydrology. The sensitivity analysis is performed by incorporating 2070 climate hydrology from the California Water Storage Investment Program (WSIP) into Reclamation's CalSim II Baseline. Land use projections for this model are based on Year 2020 estimates for the Sacramento Valley, and draft Year 2030 estimates for the San Joaquin Valley. Regulatory requirements imposed in CalSim II model for all Project alternatives included all existing regulatory requirements, as well as actions detailed in the 2019 USFWS and NMFS Biological Opinions for delta smelt and listed salmonid species, respectively (USFWS 2019, NMFS 2019) and the March 31, 2020, Incidental Take Permit (ITP) issued by the California Department of Fish and Wildlife (CDFW) for the SWP. The baseline model also includes the changes to operating criteria and requirements put in place under the 2018 Coordination Operations Agreement (COA) Addendum.

Table 1 contains a list of CalSim II model scenarios developed for analyzing the water operational effects of each Project alternative. Effects of the Project are determined by comparing CalSim II

[2] Reclamation Benchmark models released on March 01, 2022.

model scenarios that assume full design capacity to a corresponding no action/no project model scenario. The following model scenarios described in Table 1 are compared to assess Project effects:

- Existing Conditions With-Project (2) compared to Existing Conditions (1)
  - Evaluates current DMC capacity to design capacity using historically based hydrology
- 2035 Future With-Project (5) compared to 2035 Future No Action (3)
  - Evaluates forecasted DMC capacity in year 2035 to design capacity using 2035 (Central Tendency) climate change hydrology
- 2035 Future With-Project (5) compared to 2035 Future No Action (4)
  - Evaluates forecasted DMC capacity in year 2070 to design capacity using 2035 (Central Tendency) climate change hydrology

Model scenarios with 2070 climate (WSIP) hydrology are used to estimate how effects of the Project may be further influenced by changes in hydrology due to more extreme changes in climate. Model simulation 2070 Future With-Project (7) is compared to the simulation 2070 Future No Action (6) for the sensitivity analysis.

Table 1. CalSim II Modeling Scenarios

	Baseline/Action Alternatives	Modeled DMC Conveyance Capacity	Hydrology	CalSim II Reclamation Benchmark Simulation Name
1	Existing Conditions	Current Conditions	Historical	Benchmark_Hist_030122
2	Existing With Project	Design Capacity	Historical	Benchmark_Hist_030122
3	2035 Future No Action	2035 Level	2035 Climate (CT)	Benchmark_2035CT_03012035
4	2035 Future No Action	2070 Level	2035 Climate (CT)	Benchmark_2035CT_03012035
5	2035 Future With Project	Design Capacity	2035 Climate (CT)	Benchmark_2035CT_03012035
6	*2070 Future No Action	2070 Level	2070 Climate (WSIP)	Benchmark_030122 (2070 WSIP)
7	*2070 Future With Project	Design Capacity	2070 Climate (WSIP)	Benchmark_030122 (2070 WSIP)

Note: * Used for sensitivity modeling only

3.1.2 Modifications to Reclamation CalSim II Baselines

The baseline model provided by Reclamation required minor modifications for use in evaluating operations under the Project alternatives. These changes are made in close coordination with Reclamation modeling experts to better assess operational effects of the Project.

3.1.2.1 Delta-Mendota Canal/California Aqueduct Intertie (Intertie)

The Intertie is a shared federal-state water system located in a rural agricultural area of the San Joaquin Valley in Alameda County, west of the city of Tracy, California. The 500-foot-long Intertie connects the federal DMC and the California Aqueduct via two 108-inch-diameter pipes. The

Intertie Pumping Plant has a capacity of 700 cfs uphill from DMC to the California Aqueduct and 900-cfs gravity flow down from California Aqueduct to the DMC (Reclamation 2022). The Intertie is downstream from Jones and Harvey O. Banks (Banks) pumping plants at DMC Mile 7.2 and California Aqueduct Mile 9.

Intertie capacity is assumed to be 400 cfs in the baseline CalSim II model that was modified in this study to 700 cfs, as per the data in the factsheet[3] published by Reclamation. According to the factsheet, the final two pumps were installed in October 2022, expanding the capacity of the Intertie from 467 cfs to 700 cfs.

3.1.2.2 Joint Point of Diversion (JPOD)

On February 28, 1995, DWR and Reclamation filed a petition requesting, among other things, that their water right permits authorizing diversion or rediversion of water in the southern Delta be amended to add the SWP's Banks Pumping Plant as a point of diversion and rediversion in Reclamation's water rights, and to add the CVP's Jones Pumping Plant as a point of diversion and re-diversion in the DWR's water rights (California State Water Resources Control Board and California Environmental Protection Agency 1999). This use of one project's diversion facility by the other project is referred to as the Joint Points of Diversion (JPOD). Figure 6 shows the historical use of JPOD.

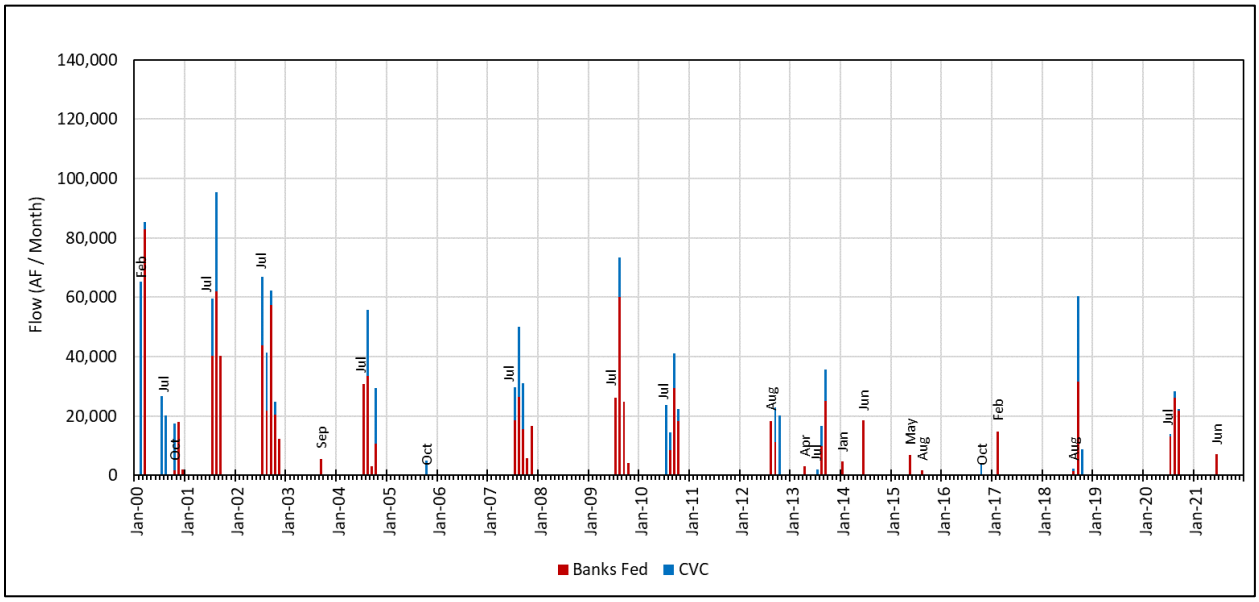


Figure 6. Historical Use of Joint Points of Diversion

In the baseline CalSim II model, the use of JPOD occurs only when Jones Pumping Plant is running at its capacity of 4,600 cfs. This is a simplification of actual operation of JPOD use, which is dependent on several factors. Given that it is beyond the scope of this Project to redefine the operations of JPOD, model runs were performed with the current logic for JPOD operations. Results showed a significant difference in the use of JPOD between the existing capacity model and

[3] https://www.usbr.gov/mp/mpr-news/docs/factsheets/intertie.pdf.

design capacity model. The difference in JPOD use between the two models is a result of the difference in the maximum export capacity at Jones Pumping Plant that resulted in an increase of the benefits of the Project by approximately 20 thousand acre-feet (TAF) on an annual average basis.

Several test runs were performed by adjusting the JPOD logic to have a consistent operation of JPOD between the two scenarios. Results were found to be inconsistent with the objectives of the analysis and eventually, JPOD operations were turned off in the models for this study to develop the most accurate assessment of effects of this project.

Chapter 4 Comparison of Alternative

This chapter compares With-Project CalSim II scenarios to the No Action Alternative with existing or projected reduced DMC conveyance capacity. Section 4.1 compares a With-Project Alternative to Existing Conditions capacity using historically based hydrology. Section 4.1.1 compares a With-Project Alternative to 2035 forecasted capacity using 2035 climate change hydrology. Section 4.1.2 compares a With-Project Alternative to 2070 forecasted capacity using 2035 climate change hydrology. Section 4.1.3 describes a sensitivity analysis that compares a With-Project Alternative to 2070 forecasted capacity using 2070 climate change hydrology.

Section 4.1 through Section 4.1.3 describe comparisons of CalSim II scenario output for components of CVP and SWP operations with greater detail on DMC flows, CVP deliveries and other key components of the entire CVP and SWP system.

4.1 Existing Conditions With-Project Compared to Existing Conditions

This section compares Existing Conditions With-Project to Existing Conditions (No Action Alternative) using historically based hydrology. One of the most informative metrics for the effects of the Project is change in Jones Pumping Plant export from the Delta. Table 2 contains average monthly and annual Jones Pumping Plant export by water year type for Existing Conditions, Existing Conditions With-Project, and the difference. Comparison of model scenarios show existing Jones Pumping Plant export has been reduced, due to subsidence, by an average annual of 58 TAF and restoring capacity would increase export by this amount. Reduced capacity has limited Jones Pumping Plant export of stored water during the June through October period, and export of Delta excess flows in the November through March period, as can be seen in Table 2.

The Intertie allows water exported at Jones Pumping Plant to be pumped into the California Aqueduct and then flow to O'Neill for use by the CVP. Use of the Intertie has decreased impacts of reduced DMC capacity and restoration of DMC capacity would reduce use of the Intertie. Table 3 contains average monthly and annual flow from the DMC to the California Aqueduct through the Intertie by water year type. Comparison of model scenarios show an annual average reduction of 140 TAF in use of the Intertie with restored DMC capacity. This decrease occurs mostly in winter of all year types and in summer of wetter year types, with smaller summer decreases in dryer year types.

Capacity reductions in the lower DMC limit the ability to meet full CVP contract demands for Exchange, Settlement, Water Service, and Repayment contractors. This limitation generally occurs during peak of the irrigation season in June, July, and August. The average annual reduction in deliveries from Mendota Pool, with the use of the Intertie Pumping Plant, is approximately 60 TAF, as shown in Table 4.

Table 2. Jones Pumping Plant Export for Existing Conditions and Existing Conditions With-Project

Existing Conditions Units: TAF

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	246	252	251	229	211	213	211	238	243	267	277	251	2890
AN	186	247	261	240	225	204	182	214	220	234	235	197	2645
BN	210	204	227	237	220	176	158	202	187	239	209	255	2523
D	151	159	195	236	216	166	116	154	165	186	192	222	2158
C	129	107	146	187	187	127	71	113	68	79	160	140	1512
All	193	201	221	228	212	182	157	192	187	212	224	221	2429

Existing Conditions With Project

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	254	271	262	233	221	205	206	240	244	275	280	255	2947
AN	184	256	278	245	232	199	184	214	226	239	264	211	2731
BN	213	196	238	243	229	170	157	203	192	259	229	259	2589
D	154	154	196	237	210	166	115	153	174	222	200	229	2210
C	134	116	147	183	187	124	71	113	74	88	168	140	1544
All	197	208	229	230	217	178	155	192	192	228	235	227	2487

Existing Conditions With Project -Minus- Existing Conditions

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	8	19	11	4	11	-8	-6	2	1	8	3	4	57
AN	-1	9	16	5	7	-5	2	0	5	5	29	14	86
BN	3	-8	11	6	9	-6	-1	1	6	19	20	4	66
D	2	-5	2	1	-5	0	-1	-2	9	36	7	6	52
C	6	9	1	-3	1	-3	0	0	6	9	8	0	33
All	4	6	8	3	5	-5	-2	1	5	16	11	5	58

Table 3. DMC to CA Intertie Flow for Existing Conditions and Existing Conditions With-Project

Existing Conditions Units: TAF

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	31	40	36	26	28	19	10	13	19	25	33	29	308
AN	5	35	43	27	26	15	3	4	9	13	13	4	197
BN	12	22	31	27	29	5	3	0	0	16	7	33	185
D	0	5	18	24	19	2	1	0	0	1	3	16	90
C	0	2	4	13	11	0	0	0	0	0	15	0	45
All	13	23	27	24	23	9	4	5	7	13	17	19	184

Existing Conditions With Project

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	8	20	14	10	11	5	1	0	0	0	2	4	76
AN	1	14	17	5	11	4	1	0	0	0	2	0	57
BN	2	8	10	7	12	1	0	0	0	1	1	5	47
D	0	2	4	0	1	0	0	0	0	0	0	5	13
C	0	0	2	0	0	0	0	0	0	0	4	0	6
All	3	10	10	5	7	2	0	0	0	0	2	3	44

Existing Conditions With Project -Minus- Existing Conditions

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	-23	-20	-22	-16	-16	-14	-9	-13	-19	-25	-31	-25	-232
AN	-3	-21	-26	-22	-15	-11	-3	-4	-9	-12	-11	-4	-140
BN	-10	-15	-20	-20	-17	-4	-3	0	0	-15	-7	-28	-138
D	0	-3	-14	-24	-18	-2	-1	0	0	-1	-3	-12	-77
C	0	-2	-2	-13	-11	0	0	0	0	0	-11	0	-38
All	-9	-13	-17	-19	-16	-7	-4	-5	-7	-12	-15	-16	-140

Table 4. DMC Flow to Mendota Pool for Existing Conditions and Existing Conditions With-Project

Existing Conditions Units: TAF

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	57	17	9	5	19	31	40	62	85	112	138	85	660
AN	61	19	10	8	29	41	54	95	126	136	140	86	807
BN	61	19	9	8	29	49	62	103	132	140	140	86	837
D	60	19	10	10	37	53	68	111	135	140	139	84	866
C	51	16	10	10	36	46	58	95	128	137	127	72	787
All	58	18	10	8	29	43	55	90	116	130	137	83	775

Existing Conditions With Project

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	57	17	9	5	19	31	40	62	100	139	155	85	719
AN	61	19	10	8	29	41	54	95	145	168	156	86	875
BN	61	19	9	8	29	49	62	103	157	176	156	86	914
D	60	19	10	10	37	53	68	111	158	171	152	84	934
C	51	16	10	10	36	46	58	95	136	147	130	72	807
All	58	18	10	8	29	43	55	90	134	158	151	83	835

Existing Conditions With Project -Minus- Existing Conditions

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	0	0	0	0	0	0	0	0	15	27	17	0	59
AN	0	0	0	0	0	0	0	0	19	32	17	0	68
BN	0	0	0	0	0	0	0	0	25	36	16	0	77
D	0	0	0	0	0	0	0	0	23	32	13	0	68
C	0	0	0	0	0	0	0	0	7	10	4	0	21
All	0	0	0	0	0	0	0	0	18	28	14	0	60

Restoring DMC conveyance capacity to design levels increases Reclamation's ability to meet CVP contractor demands. Table 5 contains a summary of CVP deliveries to CVP contractors south and north of the Delta. Average annual south-of-Delta deliveries would increase by approximately 58 TAF/year with restored capacity and use of the Intertie Pumping Plant. Restored conveyance capacity would allow Reclamation to distribute contract deliveries more evenly to all CVP water service contractors according to the CVP municipal and industrial (M&I) water shortage policy, this results in an average annual decrease to north-of-Delta CVP contractors by 3 TAF.

Table 5. CVP Delivery Summary for Existing Conditions and Existing Conditions With Project Change

	North of Delta			South of Delta					North + South
	Ag Service	M&I Service	Total	Ag Service	M&I Service	Exchange	Refuge	Total	Total
Wet	342	247	2294	1629	145	837	278	2888	5183
Abv. Norm	350	247	2282	1321	136	828	277	2562	4844
Blw. Norm	321	238	2309	1182	133	819	278	2412	4721
Dry	245	216	2183	784	114	809	274	1980	4163
Critical	49	161	1794	297	94	725	235	1351	3145
All Years	276	226	2197	1127	127	810	271	2335	4532

All Values are in 1,000 acre feet

	North of Delta			South of Delta					North + South
	Ag Service	M&I Service	**Total**	Ag Service	M&I Service	Exchange	Refuge	**Total**	**Total**
Wet	0	0	0	6	0	38	0	44	44
Abv. Norm	1	0	0	25	2	45	0	73	73
Blw. Norm	-3	-1	-4	31	1	55	0	87	83
Dry	-5	-1	-5	20	1	54	0	75	70
Critical	-3	-2	-5	0	0	19	0	19	13
All Years	-2	-1	-3	15	1	43	0	58	56

All Values are in 1,000 acre feet

Restored DMC capacity would allow the CVP to convey more of its share of Delta excess, as defined under the COA. Although analysis performed for COA negotiations assume the DMC is operating at design capacity, the CVP has been limited in export of its negotiated share due to diminished DMC capacity. Restoring DMC capacity would allow the CVP to export more of its share of excess, and therefore reduces the SWP export of unused CVP share. Restored DMC capacity would also allow the CVP to convey more stored water in years with high upstream storage, this results in less spill in upstream reservoirs that SWP may also divert. Thus, the restored DMC capacity would allow for a greater CVP export of its share under COA resulting in reduced SWP delivery of approximately 20 TAF, as shown in Table 6.

Table 6. SWP Delivery Summary for Existing Conditions and Existing Conditions With-Project Change

	Table A	Article 21	Article 56	Total
Wet	2848	235	340	3423
Abv. Norm	2610	91	236	2938
Blw. Norm	2556	78	215	2849
Dry	1533	31	199	1762
Critical	985	33	107	1125
All Years	2202	113	238	2553

All Values are in 1,000 acre feet

	Table A	Article 21	Article 56	Total
Wet	-16	-5	-2	-22
Abv. Norm	-18	-16	-2	-37
Blw. Norm	-23	-1	3	-22
Dry	-14	3	3	-9
Critical	-11	6	-11	-16
All Years	-16	-3	-1	-20

All Values are in 1,000 acre feet

Because Jones Pumping Plant is operated as an integral component of the CVP, changes in pumping at Jones Pumping Plant due to restoration of DMC capacity would affect operations of a majority of CVP and SWP facilities. Table 7 contains average monthly values for flow and storage at key locations in the CVP and SWP system for Existing Conditions, Existing Conditions With-Project, and the difference between these model scenarios. Although the maximum average monthly change in Delta outflow is approximately one percent, the average annual change is approximately 0.2 percent.

Table 7. Summary of Average Monthly System Effects

(Existing Conditions with Project compared to Existing Conditions with Existing capacity)

Existing Conditions NAA	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Delta Outflow (cfs)	6,260	8,726	22,406	42,036	54,072	43,297	30,322	21,053	12,896	8,160	5,124	7,346
Jones Pumping Plant (cfs)	3,143	3,383	3,588	3,701	3,783	2,964	2,631	3,117	3,149	3,450	3,637	3,719
Banks Pumping Plant (cfs)	3,535	4,814	4,785	3,447	4,086	3,238	1,653	1,413	2,378	5,437	4,003	4,800
Sac. R. into Delta (cfs)	11,166	14,380	26,752	41,182	52,154	40,836	27,569	20,901	17,070	17,981	13,582	15,160
Sac. R. at Keswick (cfs)	6,132	5,830	7,376	8,731	10,710	9,015	5,954	8,626	10,006	12,774	9,968	7,281
Sac R. at NCP (cfs)	6,281	7,288	11,635	13,662	15,412	14,235	10,706	7,106	5,847	6,629	5,174	6,915
Feather R. blw Thermalito(cfs)	2,531	1,907	2,908	4,198	4,977	5,490	2,853	3,821	4,123	6,597	4,465	3,967
Lower Feather R. (cfs)	3,082	2,764	5,220	10,747	12,733	12,853	8,847	7,968	6,881	7,164	5,103	5,682
American R. at Nimbus (cfs)	1,379	2,548	3,395	4,497	5,388	3,373	3,238	4,333	3,182	3,240	2,193	1,891
American R. at H. St. (cfs)	1,205	2,387	3,243	4,333	5,187	3,179	2,972	3,947	2,786	2,705	1,815	1,633
SJ R. at Vernalis (cfs)	2,523	2,333	3,089	4,732	6,350	6,636	7,143	5,620	4,497	3,237	2,088	2,323
Shasta Storage (TAF)	2,833	2,853	2,975	3,214	3,456	3,783	4,136	4,123	3,851	3,377	3,058	2,915
Folsom Storage (TAF)	511	486	508	526	535	674	805	860	821	685	602	546
Oroville Storage (TAF)	1,736	1,712	1,816	2,023	2,261	2,494	2,780	2,906	2,767	2,351	2,079	1,860
CVP San Luis Storage (TAF)	204	327	488	652	763	834	826	745	545	306	156	162
SWP San Luis Storage (TAF)	380	466	590	670	759	801	734	616	470	448	372	388
Existing Conditions With Project	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Delta Outflow (cfs)	6,230	8,664	22,176	42,003	53,940	43,304	30,301	21,042	12,891	8,158	5,117	7,350
Jones Pumping Plant (cfs)	3,210	3,491	3,726	3,743	3,872	2,889	2,598	3,126	3,229	3,707	3,823	3,808
Banks Pumping Plant (cfs)	3,500	4,748	4,741	3,404	4,009	3,270	1,660	1,399	2,316	5,402	4,038	4,778
Sac. R. into Delta (cfs)	11,169	14,360	26,619	41,147	52,034	40,802	27,534	20,883	17,079	18,193	13,794	15,230
Sac. R. at Keswick (cfs)	6,128	5,828	7,268	8,710	10,600	8,991	5,925	8,598	10,044	12,937	10,095	7,337
Sac R. at NCP (cfs)	6,279	7,306	11,597	13,661	15,396	14,219	10,700	7,085	5,892	6,797	5,290	6,962
Feather R. blw Thermalito(cfs)	2,546	1,923	2,924	4,206	4,980	5,477	2,849	3,827	4,072	6,565	4,511	3,969
Lower Feather R. (cfs)	3,096	2,780	5,236	10,755	12,735	12,840	8,843	7,974	6,830	7,131	5,149	5,684
American R. at Nimbus (cfs)	1,370	2,509	3,352	4,471	5,376	3,373	3,235	4,331	3,196	3,313	2,237	1,907
American R. at H. St. (cfs)	1,193	2,351	3,202	4,307	5,176	3,180	2,969	3,946	2,804	2,769	1,842	1,643
SJ R. at Vernalis (cfs)	2,523	2,333	3,089	4,732	6,350	6,636	7,143	5,620	4,501	3,246	2,088	2,323
Shasta Storage (TAF)	2,802	2,822	2,951	3,192	3,441	3,769	4,123	4,112	3,838	3,354	3,028	2,883
Folsom Storage (TAF)	501	479	504	523	533	672	803	859	819	678	593	535
Oroville Storage (TAF)	1,728	1,703	1,806	2,012	2,250	2,484	2,771	2,896	2,760	2,347	2,072	1,852
CVP San Luis Storage (TAF)	197	326	495	661	777	843	832	751	535	283	140	151
SWP San Luis Storage (TAF)	377	458	580	659	747	793	727	609	462	441	368	385
Change from No Action	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Delta Outflow (cfs)	-30	-63	-230	-33	-133	7	-21	-11	-5	-2	-7	4
Jones Pumping Plant (cfs)	68	109	137	41	89	-75	-33	9	79	258	186	89
Banks Pumping Plant (cfs)	-35	-67	-44	-43	-77	32	7	-14	-62	-35	35	-22
Sac. R. into Delta (cfs)	3	-20	-133	-36	-121	-35	-35	-17	8	212	212	69
Sac. R. at Keswick (cfs)	-4	-2	-108	-21	-110	-24	-30	-28	38	163	128	56
Sac R. at NCP (cfs)	-3	18	-38	-1	-17	-16	-6	-21	46	168	116	46
Feather R. blw Thermalito(cfs)	15	16	16	8	2	-13	-4	6	-51	-33	46	2
Lower Feather R. (cfs)	15	16	16	8	2	-13	-4	6	-51	-33	46	2
American R. at Nimbus (cfs)	-10	-39	-44	-26	-12	0	-3	-1	14	73	43	16
American R. at H. St. (cfs)	-11	-36	-41	-26	-11	1	-3	-1	18	64	27	10
SJ R. at Vernalis (cfs)	0	0	0	0	0	0	0	0	4	9	0	0
Shasta Storage (TAF)	-30	-30	-23	-21	-15	-14	-12	-11	-13	-23	-30	-32
Folsom Storage (TAF)	-9	-7	-4	-3	-2	-2	-2	-2	-2	-7	-9	-10
Oroville Storage (TAF)	-8	-8	-10	-11	-10	-10	-9	-10	-7	-5	-8	-8
CVP San Luis Storage (TAF)	-7	-1	7	9	14	9	6	6	-9	-23	-16	-11
SWP San Luis Storage (TAF)	-3	-8	-10	-11	-12	-8	-7	-7	-8	-7	-5	-4

4.1.1 2035 Future With-Project Compared to Forecasted 2035 Future No Action Capacity

This section compares 2035 Future With-Project to 2035 No Action with 2035 DMC capacity. One of the most informative metrics for the effects of the Project is change in exports. Table 8 contains average monthly and annual Jones Pumping Plant export by water year type for 2035 No Action with 2035 DMC capacity, 2035 Future With-Project, and the difference. Comparison of model scenarios show existing Jones Pumping Plant exports have been reduced, due to subsidence, by an average annual of 90 TAF and restoring capacity would increase export by this amount. Reduced capacity has limited Jones Pumping Plant export of stored water during the June through October period and export of Delta excess flows in the November through March period, as can be seen in Table 8.

Table 8. Jones Pumping Plant Export for 2035 No Action with 2035 Capacity and 2035 With Project

2035 No Action - 2035 Capacity Units: TAF

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	201	241	242	233	203	208	197	231	221	198	247	198	2619
AN	143	229	229	234	224	215	194	219	176	88	210	148	2308
BN	212	164	208	228	208	189	156	192	135	175	172	240	2279
D	143	145	181	225	214	167	111	158	106	119	152	209	1931
C	110	75	141	187	202	148	70	124	59	62	90	142	1410
All	170	180	206	224	208	188	151	191	151	143	185	194	2191

2035 With Project

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	205	266	256	248	217	202	190	230	226	210	262	220	2731
AN	141	240	239	243	236	225	188	215	180	98	241	170	2417
BN	206	193	213	235	230	194	147	193	157	193	183	237	2381
D	146	132	175	230	215	169	110	158	139	157	154	216	2000
C	105	75	147	197	206	146	69	124	70	78	90	148	1455
All	170	192	212	234	219	188	147	190	166	163	196	206	2281

2035 With Project -Minus- 2035 No Action - 2035 Capacity

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	4	24	13	15	14	-6	-6	-1	6	12	15	21	111
AN	-2	12	11	9	12	9	-6	-4	5	10	31	22	108
BN	-6	29	6	7	23	4	-10	2	23	18	11	-3	103
D	3	-13	-7	5	1	1	0	0	33	38	2	7	69
C	-4	0	5	10	4	-2	0	0	12	16	0	6	45
All	0	12	6	10	11	0	-5	-1	15	19	11	12	90

Use of the Intertie has decreased impacts of reduced DMC capacity and restoration of DMC capacity would reduce use of the Intertie. Table 9 contains average monthly and annual flow from the DMC to the California Aqueduct through the Intertie by water year type. Comparison of model scenarios show an annual average reduction of 124 TAF in use of the Intertie with restored DMC capacity. This decrease occurs mostly in winter of all year types and in summer of wet year types.

Table 9. DMC to CA Intertie Flow for 2035 No Action with 2035 Capacity and 2035 With Project

2035 No Action - 2035 Capacity Units: TAF

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	16	37	37	31	29	20	10	13	14	8	23	13	252
AN	0	27	34	27	31	24	10	14	9	0	11	0	188
BN	16	14	26	23	27	8	5	2	0	0	2	31	153
D	0	5	20	24	23	1	0	0	0	0	2	18	93
C	0	3	11	14	21	4	0	0	0	0	0	0	52
All	8	20	27	25	27	12	6	6	6	3	10	14	162

2035 With Project

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	4	19	12	13	12	4	1	0	0	0	1	1	67
AN	0	11	15	5	12	6	1	1	0	0	3	0	55
BN	2	6	6	5	11	3	0	0	0	0	0	2	36
D	0	1	2	0	2	0	0	0	0	0	0	3	8
C	0	0	3	0	2	2	0	0	0	0	0	0	7
All	2	9	8	6	8	3	0	0	0	0	1	1	38

2035 With Project -Minus- 2035 No Action - 2035 Capacity

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	-12	-19	-24	-18	-18	-16	-10	-13	-14	-8	-22	-12	-186
AN	0	-17	-19	-21	-19	-18	-9	-13	-9	0	-8	0	-133
BN	-14	-8	-20	-18	-16	-5	-5	-2	0	0	-2	-29	-117
D	0	-3	-18	-24	-22	-1	0	0	0	0	-2	-15	-85
C	0	-3	-8	-14	-19	-2	0	0	0	0	0	0	-46
All	-7	-11	-19	-19	-19	-9	-5	-6	-6	-3	-9	-12	-124

Capacity reductions in the lower DMC limit the ability to meet full CVP contract demands for Exchange and Settlement Contractors, water service and repayment contractors, and refuge contractors. This limitation generally occurs during peak of the irrigation season in June, July, and August. The average annual reduction in deliveries from Mendota Pool is approximately 86 TAF, as shown in Table 10.

Restoring DMC capacity to design levels would increase Reclamation's ability to meet CVP contractor demands. Table 11 contains a summary of CVP deliveries to CVP contractors south and north of the Delta. Average annual south-of-Delta deliveries would increase by approximately 92 TAF/year with restored capacity. Restored conveyance capacity would allow Reclamation to distribute water service contract deliveries more evenly to all CVP water service contractors according to the CVP M&I water shortage policy, which would result in an average annual decrease to north-of-Delta CVP contractors by 2 TAF.

Table 10. DMC Flow to Mendota Pool for 2035 No Action with 2035 Capacity and 2035 With Project

2035 No Action - 2035 Capacity Units: TAF

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	59	17	9	4	7	25	40	54	84	112	127	84	622
AN	61	19	10	7	17	35	50	67	116	129	129	85	725
BN	61	19	8	7	23	47	62	92	124	129	129	85	786
D	60	19	10	10	36	53	67	110	124	129	128	83	829
C	52	17	10	10	37	47	59	97	124	129	123	73	777
All	59	18	9	7	22	40	54	81	110	123	127	83	733

2035 With Project

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	59	17	9	4	7	25	40	54	103	148	155	84	704
AN	61	19	10	7	17	35	50	67	143	171	155	85	822
BN	61	19	8	7	23	47	62	92	159	174	154	85	892
D	60	19	10	10	36	53	67	110	157	170	150	83	925
C	52	17	10	10	37	47	59	97	138	150	133	73	822
All	59	18	9	7	22	40	54	81	135	161	150	83	818

2035 With Project -Minus- 2035 No Action - 2035 Capacity

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	0	0	0	0	0	0	0	0	19	36	27	0	82
AN	0	0	0	0	0	0	0	0	27	43	27	0	97
BN	0	0	0	0	0	0	0	0	35	46	26	0	106
D	0	0	0	0	0	0	0	0	32	41	22	0	96
C	0	0	0	0	0	0	0	0	14	21	9	0	45
All	0	0	0	0	0	0	0	0	25	38	23	0	86

Table 11. CVP Delivery Summary for 2035 No Action with 2035 Capacity and 2035 With Project

	North of Delta			South of Delta					North + South
	Ag Service	M&I Service	Total	Ag Service	M&I Service	Exchange	Refuge	Total	Total
Wet	326	243	2273	1468	141	812	278	2699	4972
Abv. Norm	347	247	2276	1041	125	794	277	2237	4512
Blw. Norm	300	237	2282	908	119	785	278	2090	4372
Dry	215	209	2147	546	108	777	272	1703	3849
Critical	43	156	1798	257	92	720	239	1308	3106
All Years	258	222	2178	934	120	784	271	2109	4287

All Values are in 1,000 acre feet

	North of Delta			South of Delta					North + South
	Ag Service	M&I Service	**Total**	Ag Service	M&I Service	Exchange	Refuge	**Total**	**Total**
Wet	0	0	0	18	-1	62	0	80	79
Abv. Norm	0	0	0	50	1	79	0	131	131
Blw. Norm	-2	-1	-3	48	1	89	0	138	134
Dry	-3	0	-3	8	-2	86	0	92	89
Critical	-3	-1	-4	-11	-1	41	0	30	26
All Years	-1	0	-2	21	0	71	0	92	90

All Values are in 1,000 acre feet

Restored DMC capacity would allow the CVP to convey more of its share of Delta excess, as defined under COA. Although analysis performed for COA negotiations assumes the DMC is operating at design capacity, the CVP has been limited in export its negotiated share due to

diminished DMC capacity. Restoring DMC capacity would allow the CVP to export more of its share of excess, and therefore reduce the SWP export of unused CVP share. Restored DMC capacity would also allow the CVP to convey more stored water in years with high upstream storage, resulting in less spill in upstream reservoirs that SWP may also divert. Thus, the restored DMC capacity would allow for a greater CVP export of its share under COA, which would result in reduced SWP export of approximately 33 TAF, as shown in Table 12.

Table 12. SWP Delivery Summary for 2035 No Action with 2035 Capacity and 2035 With Project

	Table A	Article 21	Article 56	Total
Wet	2771	279	293	3344
Abv. Norm	2474	76	156	2706
Blw. Norm	2378	48	227	2653
Dry	1354	21	135	1510
Critical	913	13	106	1031
All Years	2080	116	202	2398

All Values are in 1,000 acre feet

	Table A	Article 21	Article 56	Total
Wet	-20	-6	-14	-40
Abv. Norm	-16	-6	-22	-43
Blw. Norm	-17	-5	1	-20
Dry	-26	0	4	-22
Critical	-42	5	-5	-42
All Years	-23	-3	-7	-33

All Values are in 1,000 acre feet

Because Jones Pumping Plant is operated as an integral component of the CVP, changes in pumping at Jones Pumping Plant due to restoration of DMC capacity would affect operations of a majority of CVP and SWP facilities. Table 13 contains average monthly values for flow and storage at key locations in the CVP and SWP system for 2035 No Action with 2035 DMC capacity, 2035 Future With-Project, and the difference between these model scenarios. Although the maximum average monthly change in Delta outflow is approximately 2.3 percent, the average annual change is approximately 0.3 percent.

Table 13. Summary of Average Monthly System Effects

(2035 with Project compared to 2035 with 2035 capacity)

2035 NAA - 2035 Capacity	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Delta Outflow (cfs)	6,127	9,371	26,231	50,646	62,396	49,888	31,643	16,926	9,095	8,125	4,814	6,859
Jones Pumping Plant (cfs)	2,764	3,030	3,352	3,638	3,721	3,052	2,545	3,099	2,531	2,331	3,008	3,260
Banks Pumping Plant (cfs)	3,039	4,318	4,291	3,644	4,254	3,376	1,702	1,322	2,390	4,616	3,759	4,285
Sac. R. into Delta (cfs)	10,266	14,168	29,300	48,239	58,493	46,068	28,278	16,436	13,649	17,295	12,772	13,793
Sac. R. at Keswick (cfs)	5,668	5,538	7,759	9,959	11,635	9,787	6,344	8,710	10,204	13,130	9,280	6,344
Sac R. at NCP (cfs)	5,683	7,112	12,023	14,310	15,797	14,606	10,456	6,360	5,606	6,984	4,520	6,028
Feather R. blw Thermalito(cfs)	2,360	1,922	2,811	5,246	6,587	7,329	2,915	2,812	3,888	6,432	4,786	3,623
Lower Feather R. (cfs)	2,863	2,750	5,790	13,230	15,610	15,760	9,046	5,908	5,180	6,571	5,401	5,336
American R. at Nimbus (cfs)	1,313	2,539	4,137	6,256	6,869	4,405	3,826	3,007	1,793	2,768	1,752	1,754
American R. at H. St. (cfs)	1,142	2,384	3,984	6,078	6,646	4,191	3,536	2,712	1,519	2,293	1,451	1,505
SJ R. at Vernalis (cfs)	2,484	2,311	3,448	5,927	7,870	7,719	7,535	6,075	3,905	2,171	1,776	2,267
Shasta Storage (TAF)	2,719	2,767	2,934	3,201	3,457	3,796	4,121	4,029	3,699	3,177	2,900	2,801
Folsom Storage (TAF)	465	448	490	517	535	693	804	822	750	603	542	494
Oroville Storage (TAF)	1,615	1,609	1,800	2,081	2,358	2,575	2,825	2,861	2,646	2,220	1,925	1,730
CVP San Luis Storage (TAF)	175	283	434	602	725	813	816	767	572	314	162	150
SWP San Luis Storage (TAF)	345	417	520	633	749	803	743	630	499	440	363	366
2035 With Project	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Delta Outflow (cfs)	6,197	9,151	25,937	50,352	62,245	49,900	31,651	16,924	9,087	8,178	4,832	6,863
Jones Pumping Plant (cfs)	2,761	3,228	3,451	3,798	3,917	3,053	2,464	3,090	2,790	2,643	3,186	3,455
Banks Pumping Plant (cfs)	2,923	4,268	4,179	3,583	4,134	3,353	1,753	1,329	2,236	4,654	3,776	4,258
Sac. R. into Delta (cfs)	10,218	14,094	28,993	48,046	58,420	46,058	28,264	16,433	13,736	17,680	12,981	13,963
Sac. R. at Keswick (cfs)	5,652	5,488	7,515	9,812	11,574	9,718	6,310	8,710	10,365	13,406	9,406	6,493
Sac R. at NCP (cfs)	5,666	7,103	11,926	14,217	15,792	14,566	10,441	6,363	5,769	7,255	4,625	6,172
Feather R. blw Thermalito(cfs)	2,333	1,934	2,799	5,226	6,595	7,385	2,917	2,810	3,758	6,477	4,844	3,644
Lower Feather R. (cfs)	2,835	2,762	5,778	13,210	15,618	15,816	9,048	5,906	5,049	6,616	5,462	5,359
American R. at Nimbus (cfs)	1,310	2,495	4,080	6,223	6,850	4,408	3,841	3,002	1,850	2,834	1,783	1,751
American R. at H. St. (cfs)	1,139	2,343	3,928	6,046	6,628	4,194	3,552	2,707	1,572	2,359	1,473	1,504
SJ R. at Vernalis (cfs)	2,484	2,311	3,448	5,927	7,870	7,719	7,535	6,076	3,916	2,188	1,781	2,267
Shasta Storage (TAF)	2,675	2,726	2,908	3,184	3,443	3,787	4,113	4,022	3,682	3,145	2,861	2,754
Folsom Storage (TAF)	455	441	487	516	535	692	803	821	746	595	532	484
Oroville Storage (TAF)	1,617	1,610	1,802	2,084	2,360	2,574	2,824	2,861	2,653	2,224	1,925	1,730
CVP San Luis Storage (TAF)	152	271	428	606	739	827	824	772	565	288	128	127
SWP San Luis Storage (TAF)	338	408	508	618	731	785	731	620	483	430	358	363
Change from No Action	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Delta Outflow (cfs)	70	-220	-293	-293	-151	13	8	-2	-9	53	18	4
Jones Pumping Plant (cfs)	-2	198	99	160	196	0	-81	-9	260	312	178	195
Banks Pumping Plant (cfs)	-116	-50	-111	-61	-120	-23	50	7	-154	38	17	-27
Sac. R. into Delta (cfs)	-48	-74	-307	-192	-73	-10	-13	-4	87	386	208	170
Sac. R. at Keswick (cfs)	-16	-50	-244	-147	-61	-69	-34	1	161	276	127	149
Sac R. at NCP (cfs)	-17	-9	-98	-93	-6	-40	-15	3	163	271	105	144
Feather R. blw Thermalito(cfs)	-27	12	-12	-20	7	56	2	-1	-130	45	58	21
Lower Feather R. (cfs)	-28	12	-12	-20	7	56	2	-2	-131	45	61	24
American R. at Nimbus (cfs)	-3	-44	-57	-33	-19	4	15	-5	58	66	30	-3
American R. at H. St. (cfs)	-3	-41	-57	-33	-18	4	15	-5	53	66	22	0
SJ R. at Vernalis (cfs)	0	0	0	0	0	0	0	0	11	17	5	0
Shasta Storage (TAF)	-44	-41	-26	-17	-13	-9	-8	-7	-17	-32	-39	-48
Folsom Storage (TAF)	-10	-7	-3	-1	0	-1	-1	-1	-4	-8	-10	-10
Oroville Storage (TAF)	2	1	2	3	3	-1	-1	-1	7	4	0	0
CVP San Luis Storage (TAF)	-23	-12	-6	4	14	13	8	5	-7	-26	-34	-23
SWP San Luis Storage (TAF)	-8	-9	-12	-14	-18	-18	-12	-10	-16	-10	-4	-3

4.1.2 2035 Future With-Project Compared to Forecasted 2070 Future No Action Capacity

This section compares 2035 Future With-Project to 2035 No Action with 2070 DMC capacity. One of the most informative metrics for the effects of the Correction Project is a change in Jones Pumping Plant exports from the Delta. Table 14 contains average monthly and annual Jones Pumping Plant export by water year type for 2035 No Action with 2070 DMC capacity, 2035 Future With-Project, and the difference. Comparison of model scenarios show existing Jones Pumping Plant export has been reduced, due to subsidence, by an average annual of 122 TAF and restoring capacity would increase export by this amount. Reduced capacity has limited Jones Pumping Plant export of stored water during the June through October period and export of Delta excess flows in the November through March period, as can be seen in Table 14.

Table 14. Jones Pumping Plant Export for 2035 No Action with 2070 Capacity and 2035 With Project

2035 No Action - 2070 Capacity Units: TAF

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	201	239	239	225	205	204	200	231	218	193	240	192	2586
AN	154	224	228	233	210	207	176	210	166	98	201	151	2257
BN	207	169	202	223	206	189	162	193	125	179	170	237	2262
D	142	148	181	223	212	171	110	158	93	113	152	204	1909
C	109	89	126	193	198	135	70	124	57	60	87	146	1392
All	169	183	202	221	206	184	151	189	144	140	181	189	2159

2035 With Project

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	207	268	255	249	223	204	193	231	227	213	261	220	2752
AN	135	240	241	243	219	216	170	209	183	112	239	180	2387
BN	217	187	211	234	231	193	153	195	155	192	183	237	2388
D	146	132	175	230	215	169	110	158	139	157	154	216	2000
C	105	75	147	197	206	146	69	124	70	78	90	148	1455
All	170	192	212	234	219	188	147	190	166	163	196	206	2281

2035 With Project -Minus- 2035 No Action - 2070 Capacity

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	5	30	17	24	18	0	-7	1	10	19	21	28	166
AN	-19	15	14	10	9	9	-6	-1	16	14	39	29	130
BN	10	18	9	10	26	4	-9	3	30	12	13	0	126
D	4	-16	-7	6	3	-2	0	0	45	44	1	12	91
C	-4	-14	21	5	8	11	0	0	14	18	3	2	63
All	1	9	11	13	13	3	-5	1	22	23	15	16	122

Table 15 contains average monthly and annual flow from the DMC to the California Aqueduct through the Intertie by water year type. Comparison of model scenarios show an annual average reduction of 133 TAF in use of the Intertie with restored DMC capacity. This decrease occurs mostly in winter of all year types and in summer of wet year types.

Table 15. DMC to CA Intertie Flow for 2035 No Action with 2070 Capacity and 2035 With Project

2035 No Action - 2070 Capacity Units: TAF

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	17	40	37	31	30	22	12	17	16	9	25	14	270
AN	4	28	36	31	30	21	10	10	9	0	7	3	188
BN	15	15	27	22	30	9	6	2	0	0	2	32	161
D	0	5	20	27	26	3	0	0	0	0	2	19	103
C	0	3	7	17	25	5	0	0	0	0	0	1	58
All	8	21	27	26	28	13	6	7	7	3	10	15	171

2035 With Project

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	4	19	13	13	12	4	1	0	0	0	1	1	69
AN	0	11	12	5	10	5	1	1	0	0	3	0	48
BN	3	5	7	6	12	3	0	0	0	0	0	2	37
D	0	1	2	0	2	0	0	0	0	0	0	3	8
C	0	0	3	0	2	2	0	0	0	0	0	0	7
All	2	9	8	6	8	3	0	0	0	0	1	1	38

2035 With Project -Minus- 2035 No Action - 2070 Capacity

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	-13	-21	-24	-17	-18	-17	-11	-17	-16	-9	-23	-12	-200
AN	-4	-17	-23	-26	-19	-16	-9	-9	-9	0	-4	-3	-140
BN	-13	-10	-20	-17	-18	-6	-6	-2	0	0	-1	-30	-124
D	0	-3	-19	-26	-25	-3	0	0	0	0	-2	-16	-95
C	0	-3	-4	-17	-23	-3	0	0	0	0	0	-1	-51
All	-7	-12	-19	-21	-20	-10	-6	-7	-6	-3	-9	-13	-133

The average annual reduction in existing deliveries from Mendota Pool is approximately 125 TAF, as shown in Table 16. Restoring capacity would increase deliveries by this amount.

Table 17 contains a summary of CVP deliveries to CVP contractors south and north of the Delta. Average annual south-of-Delta deliveries would increase by approximately 124 TAF/year with restored capacity. Restored conveyance capacity would allow Reclamation to distribute contract deliveries more evenly to all CVP water service contractors according to the CVP M&I water shortage policy, which would result in an average annual decrease to north-of-Delta CVP contractors by 3 TAF.

Table 16. DMC Flow to Mendota Pool for 2035 No Action with 2070 Capacity and 2035 With Project

2035 No Action - 2070 Capacity Units: TAF

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	59	17	9	4	8	24	38	51	75	99	113	84	581
AN	61	19	10	6	17	38	53	75	106	114	114	85	699
BN	61	19	8	7	22	47	62	90	110	114	114	85	739
D	60	19	10	10	36	53	67	110	110	114	114	83	787
C	52	17	10	10	37	47	59	97	110	114	114	73	740
All	59	18	9	7	22	40	54	81	99	109	114	83	694

2035 With Project

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	59	17	9	4	8	24	38	51	100	147	155	84	696
AN	61	19	10	6	17	38	53	75	146	172	155	85	839
BN	61	19	8	7	22	47	62	90	159	174	153	85	888
D	59	19	10	10	36	53	67	110	157	170	150	83	925
C	52	17	10	10	37	47	59	97	138	150	133	73	822
All	59	18	9	7	22	40	54	81	135	161	150	83	818

2035 With Project -Minus- 2035 No Action - 2070 Capacity

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	0	0	0	0	0	0	0	0	25	47	41	0	114
AN	0	0	0	0	0	0	0	0	40	58	41	0	140
BN	0	0	0	0	0	0	0	0	49	60	40	0	149
D	0	0	0	0	0	0	0	0	46	56	36	0	138
C	0	0	0	0	0	0	0	0	28	36	19	0	82
All	0	0	0	0	0	0	0	0	36	51	37	0	125

Table 17. CVP Delivery Summary for 2035 No Action with 2070 Capacity and 2035 With Project

	North of Delta			South of Delta					North + South
	Ag Service	M&I Service	Total	Ag Service	M&I Service	Exchange	Refuge	Total	Total
Wet	326	243	2273	1457	140	779	278	2654	4927
Abv. Norm	348	247	2276	1044	125	753	277	2199	4475
Blw. Norm	302	237	2284	921	119	742	278	2059	4344
Dry	217	210	2148	573	109	734	272	1688	3836
Critical	44	156	1799	265	93	683	239	1280	3079
All Years	259	222	2178	940	121	745	271	2077	4255

All Values are in 1,000 acre feet

	North of Delta			South of Delta					North + South
	Ag Service	M&I Service	**Total**	Ag Service	M&I Service	Exchange	Refuge	**Total**	**Total**
Wet	0	0	0	30	0	95	0	125	125
Abv. Norm	-1	0	0	47	1	120	0	168	168
Blw. Norm	-4	-1	-5	35	1	132	0	168	163
Dry	-4	0	-4	-19	-2	129	0	107	103
Critical	-4	-1	-5	-19	-2	78	0	57	53
All Years	-2	-1	-3	15	-1	110	0	124	122

All Values are in 1,000 acre feet

Restored DMC capacity would allow the CVP to convey more of its share of Delta excess, as defined under the COA. Although analysis performed for COA negotiations assume the DMC is operating at design capacity, the CVP has been limited in export of its negotiated share due to diminished DMC capacity. Restoring DMC capacity would allow the CVP to export more of its share of excess, and therefore would reduce the SWP export of unused CVP share. Restored DMC capacity would also allow the CVP to convey more stored water in years with high upstream storage, which would result in less spill in upstream reservoirs that SWP may also divert. Thus, the restored DMC capacity would allow for a greater CVP export of its share under COA resulting in reduced SWP export of approximately 45 TAF, as shown in Table 18.

Table 18. SWP Delivery Summary for 2035 No Action with 2070 Capacity and 2035 With Project

	Table A	Article 21	Article 56	Total
Wet	2777	291	290	3357
Abv. Norm	2486	79	153	2718
Blw. Norm	2385	48	229	2662
Dry	1361	21	137	1519
Critical	914	17	116	1047
All Years	2086	121	203	2411

All Values are in 1,000 acre feet

	Table A	Article 21	Article 56	Total
Wet	-26	-17	-11	-54
Abv. Norm	-28	-9	-18	-55
Blw. Norm	-24	-4	-1	-29
Dry	-33	0	2	-32
Critical	-43	0	-15	-58
All Years	-30	-8	-8	-45

All Values are in 1,000 acre feet

Table 19 contains average monthly values for flow and storage at key locations in the CVP and SWP system for 2035 No Action with 2070 DMC capacity, 2035 Future With Project, and the difference between these model scenarios. Although the maximum average monthly change in Delta outflow is approximately 1.6 percent, the average annual change is approximately 0.37 percent.

Table 19. Summary of Average Monthly System Effects

(2035 with Project compared to 2035 with 2070 capacity)

2035 NAA - 2070 Capacity	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Delta Outflow (cfs)	6,198	9,182	26,351	50,639	62,548	49,929	31,659	16,941	9,102	8,114	4,841	6,858
Jones Pumping Plant (cfs)	2,745	3,073	3,280	3,590	3,683	3,000	2,541	3,081	2,412	2,273	2,938	3,185
Banks Pumping Plant (cfs)	3,053	4,448	4,268	3,695	4,277	3,410	1,702	1,321	2,505	4,588	3,739	4,205
Sac. R. into Delta (cfs)	10,332	14,151	29,327	48,234	58,631	46,090	28,279	16,430	13,664	17,211	12,726	13,636
Sac. R. at Keswick (cfs)	5,702	5,520	7,769	9,945	11,756	9,834	6,347	8,706	10,115	13,094	9,248	6,283
Sac R. at NCP (cfs)	5,719	7,082	12,019	14,267	15,837	14,622	10,454	6,355	5,515	6,952	4,490	5,969
Feather R. blw Thermalito(cfs)	2,386	1,928	2,812	5,250	6,602	7,308	2,919	2,810	4,024	6,388	4,766	3,526
Lower Feather R. (cfs)	2,889	2,757	5,791	13,234	15,625	15,739	9,050	5,905	5,317	6,526	5,378	5,241
American R. at Nimbus (cfs)	1,317	2,537	4,152	6,262	6,872	4,405	3,822	3,007	1,766	2,761	1,761	1,753
American R. at H. St. (cfs)	1,147	2,382	4,000	6,084	6,650	4,191	3,532	2,712	1,492	2,291	1,460	1,504
SJ R. at Vernalis (cfs)	2,484	2,311	3,448	5,927	7,870	7,719	7,535	6,075	3,894	2,159	1,762	2,267
Shasta Storage (TAF)	2,734	2,781	2,948	3,216	3,465	3,802	4,126	4,035	3,711	3,189	2,914	2,818
Folsom Storage (TAF)	466	449	491	518	535	693	805	822	752	606	544	496
Oroville Storage (TAF)	1,618	1,611	1,803	2,083	2,359	2,577	2,827	2,864	2,640	2,216	1,923	1,734
CVP San Luis Storage (TAF)	186	295	442	607	726	812	815	765	575	324	179	162
SWP San Luis Storage (TAF)	343	421	523	639	756	807	746	632	504	442	363	361
2035 With Project	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Delta Outflow (cfs)	6,197	9,151	25,937	50,352	62,245	49,900	31,651	16,924	9,087	8,178	4,832	6,863
Jones Pumping Plant (cfs)	2,761	3,228	3,451	3,798	3,917	3,053	2,464	3,090	2,790	2,643	3,186	3,455
Banks Pumping Plant (cfs)	2,923	4,268	4,179	3,583	4,134	3,353	1,753	1,329	2,236	4,654	3,776	4,258
Sac. R. into Delta (cfs)	10,218	14,094	28,993	48,046	58,420	46,058	28,264	16,433	13,736	17,680	12,981	13,963
Sac. R. at Keswick (cfs)	5,652	5,488	7,515	9,812	11,574	9,718	6,310	8,710	10,365	13,406	9,406	6,493
Sac R. at NCP (cfs)	5,666	7,103	11,926	14,217	15,792	14,566	10,441	6,363	5,769	7,255	4,625	6,172
Feather R. blw Thermalito(cfs)	2,333	1,934	2,799	5,226	6,595	7,385	2,917	2,810	3,758	6,477	4,844	3,644
Lower Feather R. (cfs)	2,835	2,762	5,778	13,210	15,618	15,816	9,048	5,906	5,049	6,616	5,462	5,359
American R. at Nimbus (cfs)	1,310	2,495	4,080	6,223	6,850	4,408	3,841	3,002	1,850	2,834	1,783	1,751
American R. at H. St. (cfs)	1,139	2,343	3,928	6,046	6,628	4,194	3,552	2,707	1,572	2,359	1,473	1,504
SJ R. at Vernalis (cfs)	2,484	2,311	3,448	5,927	7,870	7,719	7,535	6,076	3,916	2,188	1,781	2,267
Shasta Storage (TAF)	2,675	2,726	2,908	3,184	3,443	3,787	4,113	4,022	3,682	3,145	2,861	2,754
Folsom Storage (TAF)	455	441	487	516	535	692	803	821	746	595	532	484
Oroville Storage (TAF)	1,617	1,610	1,802	2,084	2,360	2,574	2,824	2,861	2,653	2,224	1,925	1,730
CVP San Luis Storage (TAF)	152	271	428	606	739	827	824	772	565	288	128	127
SWP San Luis Storage (TAF)	338	408	508	618	731	785	731	620	483	430	358	363
Change from No Action	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Delta Outflow (cfs)	-1	-31	-414	-287	-303	-29	-8	-17	-15	65	-10	5
Jones Pumping Plant (cfs)	17	155	171	208	234	52	-77	9	378	370	247	271
Banks Pumping Plant (cfs)	-130	-179	-89	-112	-143	-57	51	7	-269	66	36	54
Sac. R. into Delta (cfs)	-114	-56	-334	-187	-211	-32	-14	2	72	469	255	327
Sac. R. at Keswick (cfs)	-50	-32	-254	-133	-182	-116	-37	4	251	312	159	210
Sac R. at NCP (cfs)	-53	22	-93	-51	-46	-56	-14	7	254	303	135	203
Feather R. blw Thermalito(cfs)	-53	5	-13	-24	-8	78	-1	0	-266	89	78	118
Lower Feather R. (cfs)	-54	5	-13	-24	-8	77	-2	0	-268	90	83	119
American R. at Nimbus (cfs)	-7	-42	-72	-39	-22	3	19	-5	84	73	21	-2
American R. at H. St. (cfs)	-7	-39	-72	-38	-22	4	19	-5	80	68	13	1
SJ R. at Vernalis (cfs)	0	0	0	0	0	0	0	0	22	30	19	0
Shasta Storage (TAF)	-59	-55	-40	-32	-22	-15	-14	-13	-29	-45	-53	-65
Folsom Storage (TAF)	-11	-8	-4	-2	0	-1	-2	-1	-6	-11	-12	-11
Oroville Storage (TAF)	-1	-1	0	1	2	-3	-3	-3	13	8	2	-4
CVP San Luis Storage (TAF)	-33	-24	-14	-1	12	15	9	7	-10	-36	-52	-35
SWP San Luis Storage (TAF)	-5	-13	-15	-21	-25	-22	-15	-12	-21	-12	-4	2

4.1.3 2070 Future With-Project Compared to Forecasted 2070 Future No Action Capacity

This section compares 2070 Future With-Project to 2070 No Action with 2070 DMC capacity. The more extreme changes in the 2070 WSIP hydrology relative to historically based hydrology results in CalSim II simulations of the CVP and SWP that are not fully consistent with Reclamation and DWR operating policy; however, use of this hydrology for analysis provides insight into how the effects of the DMC capacity may change under more extreme conditions. Therefore, a comparison of model output using the 2070 WSIP hydrology is considered to be a sensitivity analysis that may provide generalized information rather than more specific project effects.

Table 20 contains average monthly and annual Jones Pumping Plant export by water year type for 2070 No Action with 2070 DMC capacity, 2070 Future With Project, and the difference. Comparison of model scenarios show existing Jones Pumping Plant export has been reduced, due to subsidence, by an average annual of 103 TAF and restoring capacity would increase export by this amount. Reduced capacity using the 2070 WSIP hydrology has limited Jones Pumping Plant export of stored water during the June through October period, similar to evaluation using 2035 hydrology. Pumping of Delta excess flows in the November through March period is less than when using 2035 climate change hydrology as can be seen in Table 20.

Table 20. Jones Pumping Plant Export for 2070 No Action with 2070 Capacity and 2070 With Project

2070 No Action - 2070 Capacity Units: TAF

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	168	205	226	241	221	220	190	224	160	112	211	200	2377
AN	141	187	195	221	221	218	182	198	134	81	171	185	2132
BN	135	187	178	203	198	195	177	159	120	122	186	218	2078
D	164	159	166	201	204	165	145	152	113	150	144	199	1963
C	159	105	133	180	181	121	80	119	61	62	102	148	1452
All	157	174	186	214	207	188	160	177	124	111	169	193	2060

2070 With Project

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	172	219	232	264	239	203	174	227	179	123	254	216	2501
AN	141	188	186	234	246	225	181	196	162	85	244	194	2283
BN	127	204	185	207	206	202	170	156	155	126	217	220	2175
D	162	167	170	204	207	153	149	149	154	178	154	208	2056
C	164	107	134	167	185	119	80	117	76	80	102	159	1490
All	157	183	189	222	219	181	154	177	152	125	200	203	2164

2070 With Project -Minus- 2070 No Action - 2070 Capacity

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	4	14	5	23	19	-17	-16	3	20	11	43	15	124
AN	0	1	-9	13	26	8	-1	-1	28	4	73	9	151
BN	-8	17	7	4	8	6	-7	-2	35	4	30	2	96
D	-2	8	4	3	3	-12	4	-2	41	28	10	10	93
C	5	2	0	-13	4	-2	0	-2	16	17	0	11	38
All	0	10	3	8	12	-7	-5	0	28	14	31	10	103

Table 21 contains average monthly and annual flow from the DMC to the California Aqueduct through the Intertie by water year type. Comparison of model scenarios show an annual average

reduction of 106 TAF in use of the Intertie with restored DMC capacity. This decrease occurs mostly in winter of all year types and in summer of wet year types.

Table 21. DMC to CA Intertie Flow for 2070 No Action with 2070 Capacity and 2070 With Project

2070 No Action - 2070 Capacity Units: TAF

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	4	25	34	37	37	26	12	13	5	2	11	10	215
AN	0	23	24	25	34	25	12	3	0	0	9	0	153
BN	1	18	20	16	23	13	12	0	0	0	7	17	127
D	6	10	17	21	25	6	3	2	0	0	0	11	100
C	7	1	6	17	15	1	0	0	0	0	4	0	51
All	4	16	22	25	28	15	8	5	2	1	6	8	141

2070 With Project

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	1	9	11	16	15	5	0	0	0	0	2	1	60
AN	0	5	6	6	16	9	2	0	0	0	2	0	46
BN	0	7	5	2	5	3	2	0	0	0	3	2	29
D	1	3	5	1	4	0	1	0	0	0	0	2	17
C	4	0	0	1	0	0	0	0	0	0	0	0	5
All	1	6	6	7	9	3	1	0	0	0	1	1	35

2070 With Project -Minus- 2070 No Action - 2070 Capacity

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	-2	-16	-23	-21	-22	-21	-12	-13	-5	-2	-9	-9	-155
AN	0	-17	-18	-19	-18	-16	-10	-3	0	0	-7	0	-107
BN	-1	-11	-14	-15	-19	-10	-10	0	0	0	-4	-15	-98
D	-5	-6	-12	-19	-21	-6	-2	-2	0	0	0	-9	-83
C	-3	-1	-6	-16	-15	-1	0	0	0	0	-3	0	-45
All	-3	-11	-16	-18	-20	-12	-7	-5	-2	-1	-5	-7	-106

Capacity reductions in the lower DMC limit the ability to meet full CVP contract demands for exchange, settlement, water service, and repayment contractors that divert water from Mendota Pool. This limitation generally occurs during the peak of irrigation season in June, July, and August. The average annual reduction in deliveries from Mendota Pool is approximately 127 TAF, as shown in Table 22.

Average annual south-of-Delta deliveries would increase by approximately 106 TAF/year with restored capacity, this is about 18 TAF/year less than delivery increases estimated using 2035 climate hydrology. Restored conveyance capacity would allow Reclamation to distribute contract deliveries more evenly to all CVP water service contractors according to the CVP M&I water shortage policy, which would result in an average annual decrease to north-of-Delta CVP contractors by 6 TAF.

Table 22. DMC Flow to Mendota Pool for 2070 No Action with 2070 Capacity and 2070 With Project

2070 No Action - 2070 Capacity Units: TAF

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	56	17	8	3	8	20	33	40	81	101	113	79	559
AN	61	19	11	8	14	20	36	70	110	114	114	85	662
BN	61	18	8	8	31	46	41	90	110	114	114	78	719
D	60	19	10	9	29	51	52	108	110	114	114	84	760
C	53	17	10	10	37	48	60	98	110	114	114	74	746
All	58	18	9	7	21	36	43	77	101	110	114	80	675

2070 With Project

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	56	17	8	3	8	20	33	40	107	148	154	79	673
AN	61	19	11	8	14	20	36	70	160	173	155	85	811
BN	60	18	8	8	31	46	41	90	158	171	153	78	862
D	60	19	10	9	29	51	52	108	159	172	153	84	906
C	53	17	10	10	37	48	60	98	140	152	134	74	833
All	58	18	9	7	21	36	43	77	140	162	151	80	802

2070 With Project -Minus- 2070 No Action - 2070 Capacity

Indx	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	0	0	0	0	0	0	0	0	26	47	41	0	114
AN	0	0	0	0	0	0	0	0	50	59	41	0	149
BN	0	0	0	0	0	0	0	0	47	57	39	0	143
D	0	0	0	0	0	0	0	0	49	58	39	0	145
C	0	0	0	0	0	0	0	0	30	38	20	0	87
All	0	0	0	0	0	0	0	0	39	52	37	0	127

Restored DMC capacity would allow the CVP to convey more of its share of Delta excess, as defined under COA. Although analysis performed for COA negotiations assume the DMC is operating at design capacity, the CVP has been limited in export of its negotiated share due to diminished DMC capacity. Restoring DMC capacity would allow the CVP to export more of its share of excess, and therefore would reduce the SWP export of unused CVP share. Restored DMC capacity would also allow the CVP to convey more stored water in years with high upstream storage, this results in less spill in upstream reservoirs that SWP may also divert. Thus, the restored DMC capacity would allow for a greater CVP export of its share under COA, resulting in reduced SWP export of approximately 35 TAF.

Because Jones Pumping Plant is operated as an integral component of the CVP, changes in pumping at Jones Pumping Plant due to restoration of DMC capacity would affect operations of a majority of CVP and SWP facilities. Table 23 contains average monthly values for flow and storage at key locations in the CVP and SWP system for 2070 No Action with 2070 DMC capacity, 2070 Future With-Project, and the difference between these model scenarios. Although the maximum average monthly change in Delta outflow is approximately 2.7 percent, the average annual change is approximately 0.25 percent.

Table 23. Summary of Average Monthly System Effects

(2070 with Project compared to 2070 with 2070 capacity)

2070 NAA - 2070 Capacity	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Delta Outflow (cfs)	7,290	7,723	27,513	57,004	71,588	53,225	28,990	13,774	8,586	8,979	5,389	7,208
Jones Pumping Plant (cfs)	2,553	2,921	3,025	3,473	3,699	3,056	2,684	2,880	2,088	1,810	2,756	3,244
Banks Pumping Plant (cfs)	2,001	3,882	3,872	3,830	4,742	3,580	1,712	1,167	2,614	4,041	2,856	3,659
Sac. R. into Delta (cfs)	10,495	12,331	28,905	53,436	66,136	47,980	25,561	13,514	14,449	17,490	12,333	13,655
Sac. R. at Keswick (cfs)	6,197	4,921	6,467	10,336	12,267	9,923	6,585	8,966	11,077	13,951	9,390	6,784
Sac R. at NCP (cfs)	6,127	6,345	11,735	14,467	15,933	14,830	10,652	6,330	6,583	7,996	4,769	6,542
Feather R. blw Thermalito(cfs)	2,211	1,651	3,105	6,830	9,622	8,276	2,244	2,239	4,043	5,874	3,983	3,098
Lower Feather R. (cfs)	2,656	2,373	6,000	15,747	19,539	16,803	7,118	4,155	5,000	6,110	4,796	4,837
American R. at Nimbus (cfs)	1,295	1,977	3,872	7,255	8,769	4,943	3,166	1,814	1,784	2,370	1,624	1,587
American R. at H. St. (cfs)	1,127	1,840	3,736	7,083	8,543	4,715	2,916	1,583	1,521	1,959	1,354	1,367
SJ R. at Vernalis (cfs)	2,418	2,223	4,229	6,793	9,648	9,319	8,034	6,050	2,767	1,720	1,554	2,057
Shasta Storage (TAF)	2,333	2,406	2,704	3,069	3,383	3,714	3,927	3,748	3,354	2,805	2,528	2,420
Folsom Storage (TAF)	368	364	415	470	499	658	749	725	628	500	439	398
Oroville Storage (TAF)	1,494	1,531	1,795	2,120	2,414	2,622	2,787	2,712	2,411	1,981	1,716	1,560
CVP San Luis Storage (TAF)	134	236	368	528	651	752	785	739	539	274	128	120
SWP San Luis Storage (TAF)	221	278	367	519	681	755	696	583	478	406	293	276
2070 With Project	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Delta Outflow (cfs)	7,263	7,516	27,600	56,721	71,385	53,124	28,969	13,738	8,587	9,037	5,372	7,220
Jones Pumping Plant (cfs)	2,557	3,082	3,067	3,611	3,911	2,947	2,594	2,875	2,553	2,037	3,257	3,419
Banks Pumping Plant (cfs)	2,014	3,895	3,642	3,657	4,552	3,642	1,750	1,179	2,280	3,993	3,076	3,566
Sac. R. into Delta (cfs)	10,486	12,298	28,803	53,116	65,952	47,835	25,543	13,487	14,561	17,697	13,019	13,749
Sac. R. at Keswick (cfs)	6,155	4,843	6,339	10,107	11,989	9,773	6,537	8,956	11,435	14,164	9,782	6,963
Sac R. at NCP (cfs)	6,100	6,318	11,723	14,455	15,925	14,737	10,634	6,331	6,953	8,207	5,164	6,709
Feather R. blw Thermalito(cfs)	2,237	1,667	3,162	6,774	9,715	8,253	2,245	2,220	3,705	5,895	4,238	3,029
Lower Feather R. (cfs)	2,683	2,388	6,058	15,690	19,632	16,779	7,118	4,136	4,663	6,134	5,070	4,763
American R. at Nimbus (cfs)	1,297	1,994	3,829	7,219	8,763	4,969	3,188	1,806	1,862	2,340	1,618	1,587
American R. at H. St. (cfs)	1,129	1,857	3,693	7,049	8,538	4,741	2,938	1,575	1,590	1,933	1,348	1,368
SJ R. at Vernalis (cfs)	2,418	2,223	4,229	6,793	9,648	9,319	8,034	6,050	2,791	1,749	1,573	2,057
Shasta Storage (TAF)	2,241	2,317	2,623	3,003	3,332	3,671	3,885	3,707	3,295	2,737	2,442	2,324
Folsom Storage (TAF)	363	357	411	469	498	655	745	721	620	494	434	393
Oroville Storage (TAF)	1,500	1,538	1,799	2,126	2,415	2,624	2,790	2,716	2,435	2,002	1,723	1,570
CVP San Luis Storage (TAF)	114	226	361	530	666	760	788	742	532	235	93	97
SWP San Luis Storage (TAF)	219	277	353	500	659	739	683	573	454	385	293	271
Change from No Action	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Delta Outflow (cfs)	-27	-206	87	-283	-202	-101	-21	-35	1	58	-17	12
Jones Pumping Plant (cfs)	4	161	43	138	212	-109	-90	-6	465	227	501	175
Banks Pumping Plant (cfs)	14	13	-229	-173	-190	62	38	11	-334	-48	220	-93
Sac. R. into Delta (cfs)	-9	-34	-102	-321	-184	-145	-18	-27	112	207	686	93
Sac. R. at Keswick (cfs)	-42	-78	-128	-229	-278	-150	-48	-10	358	213	392	180
Sac R. at NCP (cfs)	-27	-27	-12	-12	-8	-93	-18	0	370	211	395	167
Feather R. blw Thermalito(cfs)	26	17	57	-56	93	-23	1	-19	-338	22	255	-69
Lower Feather R. (cfs)	27	15	58	-57	93	-24	1	-19	-337	24	274	-74
American R. at Nimbus (cfs)	2	17	-43	-35	-6	26	22	-8	78	-30	-7	0
American R. at H. St. (cfs)	2	17	-42	-35	-6	26	22	-8	69	-26	-6	0
SJ R. at Vernalis (cfs)	0	0	0	0	0	0	0	0	24	30	18	0
Shasta Storage (TAF)	-92	-89	-81	-66	-51	-43	-41	-40	-59	-68	-86	-96
Folsom Storage (TAF)	-5	-6	-4	-1	-1	-3	-4	-3	-8	-6	-5	-5
Oroville Storage (TAF)	6	7	4	7	1	3	3	4	24	21	7	10
CVP San Luis Storage (TAF)	-20	-10	-7	2	15	8	3	3	-8	-39	-35	-23
SWP San Luis Storage (TAF)	-2	-1	-14	-19	-22	-17	-13	-10	-25	-21	-1	-5

Chapter 5 References

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Delta-Mendota Canal Subsidence Correction Project Environmental Assessment/Initial Study

Appendix E: Regulatory Settings

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Appendix E Regulatory Settings

This appendix presents the federal, State of California (state), and local laws, rules and regulations, Executive Orders (EOs), and compliance requirements for the implementation of the Proposed Action as presented in the Environmental Assessment/Initial Study (EA/IS). Descriptions are organized by federal, state, and local requirements. Relevant laws, regulations and plans and the associated resources are presented in Table E-1.

Table E-1. Applicable Laws, Regulations, and Plans

Laws, Regulations, and Plans	Applicable Resources
Federal	
Advisory Council on Historic Preservation Section 106 Consultation	Cultural
Bald and Golden Eagle Protection Act	Biological Resources
Central Valley Project Improvement Act	Water Supply
Clean Air Act	Air Quality
Clean Water Act	Water Quality; Biological Resources
Earthquake Hazard Reduction Act of 1977	Geology, Seismicity, and Soils
EO 11990, Protection of Wetlands	Water Quality; Biological Resources
EO 13990, Protecting Public Health and the Environmental and Restoring Science to Tackle the Climate Crisis	Greenhouse gases (GHG)
EO 14008, Tackling the Climate Crisis at Home and Abroad	GHG
EO 13007, Accommodation of Sacred Sites	Indian Sacred Sites
512 DM 2, Departmental Responsibilities for Indian Trust Resources	Indian Trust Assets
EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations	Environmental Justice
512 DM 2, Departmental Responsibilities for Indian Trust Resources	Indian Trust Assets
Endangered Species Act	Water Supply; Biological Resources
Migratory Bird Treaty Act of 1918	Biological Resources
National Historic Preservation Act	Cultural
Native American Graves Protection and Repatriation Act	Cultural
Paleontological Resources Preservation Act of 2009	Geology, Seismicity, and Soils
Principles and Requirements for Federal Investments in Water Resources	GHG
Resource Conservation and Recovery Act	Hazards and Hazardous Materials
Safe Drinking Water Act	Water Quality
Transportation Research Board Highway Capacity Manual, Sixth Edition	Traffic and Transportation
Uniform Building Code (International Building Code)	All Resources
US Department of the Interior (DOI), Reclamation National Environmental Policy Act (NEPA) Handbook	GHG
US DOI Secretarial Order No. 3398	GHG

Laws, Regulations, and Plans	Applicable Resources
State	
Alquist-Priolo Earthquake Fault Zoning Act	Geology and Soils
California Building Code	Geology and Soils, Noise and Vibration
California Clean Air Act	Air Quality
California Department of Fish and Wildlife (CDFW) Species Designations	Biological Resources
California Department of Transportation Guide for the Preparation of Traffic Impact Studies	Traffic and Transportation
California Department of Transportation, Highway Design Manual, Seventh Edition	Traffic and Transportation
California Endangered Species Act	Biological Resources
California Environmental Protection Agency (CalEPA) Unified Program	Hazards and Hazardous Materials
California Environmental Quality Act (CEQA) Guidelines	GHG, Cultural Resources
California EO S-3-05	GHG
California EO B-30-15 and Senate Bill 32	GHG
California Fish and Game Code Section 1600, Streambed Alterations	Biological Resources
California Fish and Game Code Section 1900-1913, Native Plant Protection Act	Biological Resources
California Fish and Game Code Sections 3500-3705, Migratory Bird Protection	Biological Resources
California Global Warming Solutions Act of 2006 (Assembly Bill [AB] 32)	GHG
California Natural Resources Agency Tribal Consultation Policy	Cultural
California Occupational Safety and Health Administration Standards	Hazards and Hazardous Materials
California Office of Historic Preservation	Cultural
California Porter-Cologne Water Quality Control Act	Water Quality, Biological Resources
California State Parks Guidelines	Recreation
California Water Code Section 13240, Regional Water Quality Control Plan	Water Quality
California Water Code, Water Rights	Water Supply
Hazardous Waste Control Act	Hazards and Hazardous Materials
Noise Element Guidelines	Noise and Vibration
Seismic Hazards Mapping Act	Geology and Soils
State Scenic Highways Program	Visual
State Water Resource Control Board Hazardous Waste Programs	Hazards and Hazardous Materials
Surface Mining and Reclamation Act of 1975	Geology and Soils
Local/ Regional	
Alameda County General Plan	Visual Resources, Geology and Soils, Utilities and Power
Alameda County Code of Ordinances	Noise and Vibration, Utilities and Power
Bay Area Air Quality Management District Air Quality Management Plan	Air Quality, GHGs
Fresno County General Plan	Visual Resources, Noise and Vibration, Hazards/Hazardous Materials, Biological Resources, Recreation, Geology and Soils, Utilities and Power

Laws, Regulations, and Plans	Applicable Resources
Fresno County Code of Ordinances	Noise and Vibration
Merced County General Plan	Water Quality, Visual Resources, Noise Vibration, Recreation, Geology, and Soils, Biological Resource, Utilities and Power, Cultural Resources, Hazards/Hazardous Materials
Merced County Code of Ordinances	Noise and Vibration, Geology and Soils
Merced County Office of Environmental Services	Hazards/ Hazardous Materials
San Joaquin County General Plan	Visual Resources, Noise and Vibration, Hazards/Hazardous Materials, Biological Resources, Geology and Soils, Utilities and Power
San Joaquin County Development Title	Noise and Vibration
San Joaquin Valley Air Pollution Control District (SJVAPCD) Air Quality Management Plans	Air Quality
SJVAPCD Programs	GHGs
Stanislaus County General Plan	Visual Resources, Geology and Soils, Utilities and Power
Stanislaus County Code of Ordinances	Noise and Vibration

Key: DM = Department of the Interior, Department Manual; EO = Executive Order; GHGs = Greenhouse Gases

E.1 Federal Requirements

E.1.1 Advisory Council on Historic Preservation

Advisory Council on Historic Preservation (ACHP) regulations[1] governing the Protection of Historic Properties establish procedures for compliance with Section 106 of the National Historic Preservation Act (NHPA). These regulations define the Criteria of Adverse Effect; outline the role of the State Historic Preservation Officer (SHPO) in the Section 106 review process; set forth documentation requirements; and describe procedures to be followed if significant historic properties are discovered during implementation of an undertaking. Effects on prehistoric and historic period cultural resources, as well as traditional cultural properties of importance to Native American communities, that are deemed significant (i.e., eligible for listing in the National Register of Historic Places (NRHP) under 36 CFR Part 60.4) must be considered in project planning and construction (ACHP 2016). The responsible Federal agency must consult with the SHPO and other parties regarding any proposed undertaking that may affect NRHP-eligible properties. The NHPA Section 106 process also requires that, if an undertaking will result in an adverse effect to historic properties, measures to avoid, minimize, or mitigate the adverse effect must be resolved through negotiated formal agreement in consultation with the SHPO and other consulting parties.

E.1.2 Bald and Golden Eagle Protection Act

Administered by the United States (U.S.) Fish and Wildlife Service (USFWS), the Bald and Golden Eagle Protection Act[2] provides for the protection of the bald eagle (*Haliaeetus leucocephalus*) and the golden eagle (*Aquila chrysaetos*) by prohibiting, except under certain specified conditions, the taking, possession and commerce of such birds. The act prohibits unregulated take and makes it illegal to kill, wound, pursue, shoot, shoot at, poison, capture, trap, collect, molest, or disturb bald or golden

[1] 36 Code of Federal Regulations [C.F.R.] Part 800.

[2] 16 U.S. Code [U.S.C.] 668-668c.

eagles. Surveys are required to determine whether nests will be disturbed and, if so, a buffer area with a specified radius around the nest must be established so that no disturbance or intrusion is allowed until the young have fledged and left the nest. Coordination with the USFWS is recommended for establishing an appropriate buffer (USFWS 2021a).

E.1.3 Central Valley Project Improvement Act (CVPIA)

On October 30, 1992, Public Law 102-575 was signed into law. This law included Title 34, the Central Valley Project Improvement Act (CVPIA), which amended previous authorizations of the Central Valley Project (CVP). The CVPIA mandated changes in management of the CVP, requiring fish and wildlife protection, restoration, and mitigation as project purposes equal to that of agricultural irrigation, municipal and industrial (M&I) supplies, and power generation (Bureau of Reclamation [Reclamation] 2022).

E.1.4 Clean Air Act

The U.S. Environmental Protection Agency (USEPA) is responsible for implementation of the Federal Clean Air Act (CAA).[3] The CAA was enacted in 1955 and was amended in 1963, 1965, 1967, 1970, 1977, 1990, and 1997. Under authority of CAA, USEPA established National Ambient Air Quality Standards (NAAQS) for the following criteria pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), inhalable particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}), fine particulate matter with an aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$), and sulfur dioxide (SO_2) (USEPA 2021a).

CAA requires States to classify air basins (or portions thereof) as either "attainment" or "nonattainment" with respect to criteria air pollutants, based on whether the NAAQS have been achieved, and to prepare State Implementation Plans (SIPs) containing emission reduction strategies to maintain the NAAQS for those areas designated as attainment and to attain the NAAQS for those areas designated as nonattainment.

E.1.4.1 General Conformity

Section 176 (c) of the CAA[4] requires any entity of the federal government that engages in, supports, or in any way provides financial support for, licenses or permits, or approves any activity to demonstrate that the action conforms to the applicable SIP required under Section 110 (a) of the CAA[5] before the action is otherwise approved. In this context, conformity means that such federal actions must be consistent with a SIP's purpose of eliminating or reducing the severity and number of violations of the NAAQS and achieving expeditious attainment of those standards. Each federal agency must determine that any action proposed that is subject to the regulations implementing the conformity requirements will, in fact, conform to the applicable SIP before the action is taken. This Project is subject to the General Conformity Rule because it involves a Federal agency (Reclamation).

[3] 42 U.S.C. Chapter 85, as amended.
[4] 42 U.S.C. 7506[c].
[5] 42 U.S.C. 7410[a].

The general conformity regulations apply to a proposed federal action in a nonattainment or maintenance area if the total of direct[6] and indirect[7] emissions of the relevant criteria pollutants and precursor pollutants caused by the proposed action equal or exceed certain *de minimis* amounts, thus requiring the federal agency to make a determination of general conformity. A federal agency can indirectly control emissions by placing conditions on federal approval or federal funding.

Table E-2 presents the *de minimis* amounts for nonattainment areas. The *de minimis* threshold for all maintenance areas is 100 tons per year (tpy), except for Pb, which has a *de minimis* threshold of 25 tpy.

Table E-2. General Conformity De Minimis Thresholds

Pollutant	Classification of Emissions Type	*De Minimis* Threshold (tpy)
O_3 (VOCs or NOx)	Serious NAA	50
O_3 (VOCs or NOx)	Severe NAA	25
O_3 (VOCs or NOx)	Extreme NAA	10
O_3 (VOCs or NOx)	Other NAA	100
CO	Not applicable	100
SO_2	Not applicable	100
NO_2	Not applicable	100
PM_{10}	Moderate NAA	100
PM_{10}	Serious NAA	70
$PM_{2.5}$	Direct emissions	100
$PM_{2.5}$	SO_2 precursor	100
$PM_{2.5}$	NOx precursor	100
$PM_{2.5}$	VOC or ammonia precursor[1]	100
Pb	Not applicable	25

Source: 40 CFR 93.153

Note:

[1] Pollutant not subject to de minimis threshold if the State does not determine it to be a significant precursor to $PM_{2.5}$ emissions.

Key: CO = carbon monoxide; NAA = nonattainment area; NO_2 = nitrogen dioxide; NO_x = nitrogen oxides; O_3 = ozone; Pb = lead; PM_{10} = inhalable particulate matter; $PM_{2.5}$ = fine particulate matter; SO_2 = sulfur dioxide; tpy = tons per year; VOC = volatile organic compounds

If the regulating Federal agency determines that the general conformity regulations do not apply to the proposed action (meaning the project emissions do not exceed the *de minimis* thresholds in a nonattainment or maintenance area), no further analysis or documentation is required.

[6] Direct emissions are those that are caused or initiated by the Federal action and occur at the same time and place as the federal action.

[7] Indirect emissions are reasonably foreseeable emissions that are further removed from the Federal action in time and/or distance and can be practicably controlled by the Federal agency on a continuing basis (40 C.F.R. 93.152).

E.1.5 Clean Water Act

Growing public awareness and concern for controlling water pollution led to enactment of the Federal Water Pollution Control Act Amendments of 1972. As amended in 1977, this law became commonly known as the Clean Water Act (CWA).[8]

The CWA implemented requirements to set water quality standards for all known contaminants in surface waters. Section 303(d) of the 1972 CWA requires states, territories, and authorized tribes to develop a list of water quality-impaired segments of waterways. The 303(d) list includes water bodies that do not meet water quality standards for the specified beneficial uses of that waterway, even after point sources (e.g., wastewater treatment plant discharges) of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for water bodies on their 303(d) lists and implement a process, called Total Maximum Daily Loads (TMDLs), to meet water quality standards (USEPA 2021b).

TMDLs are intended to address all significant stressors that cause, or threaten to cause, water body beneficial use impairments, including point sources, nonpoint sources (e.g., runoff from fields, streets, range, or forest land), and naturally occurring sources (e.g., runoff from undisturbed lands). The TMDL process is a tool for implementing water quality standards and is based on the relationship between point source pollution and its deleterious effects on ambient in-stream conditions. The TMDL establishes the maximum allowable loadings of a pollutant that can be assimilated[9] by a water body while still meeting applicable water quality standards. The TMDL provides the basis for the establishment of water quality-based controls. These controls should provide the pollution reduction necessary for a water body to meet water quality standards. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The TMDLs allocation calculation for each water body must include a margin of safety to ensure that the water body can be used for the beneficial uses the State has designated. Additionally, the calculation also must account for seasonal variation in water quality (USEPA 2021b). For example, pollutant loads might be greater during winter months with higher flows, however, the rivers may have more assimilative capacity for such pollutants.

TMDLs may be based on readily available information and studies. In some cases, complex studies or models are needed to understand how stressors are causing water body impairment. In many cases, simple analytical efforts provide an adequate basis for stressor assessment and implementation planning. TMDLs are developed to provide an analytical basis for planning and implementing pollution controls, land management practices, and restoration projects needed to protect water quality. States are required to include approved TMDLs and associated implementation measures in state water quality management plans. Within California, TMDLs implementation is regulated through regional Basin Plans.

Water quality of waters of the U.S. subjected to a discharge of dredged or fill material is regulated under Section 404 of the CWA. These actions must not violate federal or state water quality standards. Specifically, in the State of California, the applicable Regional Water Quality Control Board (RWQCB) administers Section 401 and either issues or denies water quality certifications depending upon whether the proposed discharge or fill material complies with applicable state and federal laws. The CWA also requires that a permit be obtained from USEPA and the U.S. Army

[8] 33 U.S.C. Section 1251 et seq.

[9] As known as assimilative capacity: the ability of a body of water to cleanse itself; to receive waste waters or toxic substances without deleterious effects and without damage to aquatic life or humans who consume the water.

Corps of Engineers (USACE) when discharge of dredged or fill material into wetlands and waters of the U.S. occurs. Section 404 of the CWA requires USEPA and USACE to issue individual and general permits for these activities.

In addition to complying with state and federal water quality standards, point sources that discharge into waters of the U.S. must obtain a National Pollutant Discharge Elimination System (NPDES) permit under provisions of Section 402 of the CWA, when exemptions do not apply. In California, the SWRCB and RWQCBs are responsible for the implementation of the NPDES permitting process at the State and regional levels, respectively. The NPDES permit process also provides a regulatory mechanism for the control of non-point source pollution created by runoff from construction and industrial activities, and general and urban land use, including runoff from streets. To prevent polluted stormwater runoff from being washed into municipal separate storm sewer systems (MS4s), certain operators are required to obtain NPDES permits. The 1990 Phase I regulation requires medium and large cities or certain counties with populations of 100,000 or more to obtain NPDES permit coverage for their stormwater discharges. The 1999 Phase II regulation requires small MS4s in U.S. Census Bureau defined urbanized areas to obtain NPDES permit coverage for their stormwater discharges. Phase II also includes nontraditional MS4s such as public universities, departments of transportation, hospitals and prisons. There are approximately 855 Phase I MS4s and 6,695 Phase II MS4s (USEPA 2022a).

Projects involving construction activities (e.g., clearing, grading, or excavation) with land disturbance greater than one acre must file a Notice of Intent (NOI) with the applicable RWQCB to indicate their intent to comply with the State General Permit for Stormwater Discharges Associated with Construction Activity (General Permit). The State General Permit specifies Best Management Practices (BMPs), to achieve compliance as well as numeric action levels to achieve federal standards to minimize sediment and pollutant loadings. The General Permit requires preparation and implementation of a Stormwater Pollution Prevention Plan (SWPPP) as well as a Rain Event Action Plan (REAP) prior to construction. The SWPPP and REAP are intended to help identify the sources of sediment and other pollutants and assess the effectiveness of BMPs in preventing or reducing pollutants in stormwater discharges and authorized nonstormwater discharges.

E.1.6 Earthquake Hazard Reduction Act of 1977, as amended

The Earthquake Hazard Reduction Act of 1977[10] established a national goal of reducing the risks of life and property from future earthquakes in the U.S. through the establishment and maintenance of an earthquake program including prediction and hazard assessment research, seismic monitoring and information dissemination. The Act established the Earthquake Hazard Reduction Program to promote the adoption of earthquake hazard reduction measures by federal, state, and local governments. Section 8 of the Act calls for the adoption of standards for assessing and enhancing the seismic safety of buildings constructed for or leased by the federal government (42 USC 7701 et. seq.) (National Earthquake Hazards Reduction Program 2008).

E.1.7 Executive Order 11990, Protection of Wetlands

Executive Order 11990 requires federal agencies to take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. This requirement extends to actions involved with construction activities or increased storage in

[10] Public Law 95-124, 42 U.S.C. 7701 et. seq., as amended by Public Laws 101-614, 105-47, 106-503, and 108-360.

existing reservoirs which would affect wetlands. Federal agencies must provide opportunities for early public review of any plans or proposals for new construction in wetlands (National Archives 2016).

E.1.8 Executive Order 13990, Protecting Public Health and the Environmental and Restoring Science to Tackle the Climate Crisis

Executive Order 13990 (January 20, 2021) directs federal agencies to immediately review and take action to address federal regulations that conflict with national objectives including reducing greenhouse gas emissions and bolstering resilience to the impacts of climate change (U.S. Department of Energy 2021). Section 7 of EO 13990 revoked EO 13783- Promoting Energy Dependence and Economic Growth and rescinded the Council on Environmental Quality's "Draft National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions" (Federal Register 2017).

E.1.9 Executive Order 14008, Tackling the Climate Crisis at Home and Abroad

Executive Order 14008 (January 27, 2021) places the climate crisis at the forefront of foreign policy and national security planning. Section 211 of EO 14008 requires the head of each federal agency to draft and submit an action plan that describes steps the agency can take with regard to its facilities and operations to bolster adaptation and increase resilience to the impacts of climate change (The White House 2021).

E.1.9.1 Department of Interior Climate Action Plan

On October 7, 2021, the U.S. Department of Interior (DOI) released the Climate Action Plan which outlines how DOI will use science as the foundation for planning and decision-making related to climate change risks, impacts and vulnerabilities (DOI 2021a).

E.1.10 Executive Order 13007, Accommodation of Sacred Sites

Executive Order 13007 (May 24, 1996) requires that federal agencies accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and avoids adversely affecting the physical integrity of such sacred sites.

E.1.11 Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

Executive Order 12898 (February 16, 1994) requires each federal agency to identify and address disproportionately high and adverse human health or environmental effects, including social and economic effects of its program, policies, and activities on minority populations and low-income populations.

E.1.12 512 DM 2, Departmental Responsibilities for Indian Trust Resources

Indian Trust Assets (ITA) are legal interests in property held in trust by the U.S. for Indian tribes or individuals. Department of the Interior's policy is to recognize and fulfill its legal obligations to identify, protect, and conserve the trust resources of federally recognized Indian tribes and individual Indians, to the extent required by relevant statutes and regulations; and to consult with tribes on a government-to-government basis whenever plans or actions affect tribal trust resources, trust assets, or tribal health and safety (512 DM 2). Under this policy, Reclamation is committed to

carrying out its activities in a manner that avoids adverse impacts to ITAs, when possible, and mitigates or compensates for such impacts when it cannot avoid the impacts.

E.1.13 Endangered Species Act

Under the ESA, the Secretary of the Interior and the Secretary of Commerce have joint authority to list a species as threatened or endangered (16 U.S.C. Section 1533[c]). The ESA prohibits the "take" of endangered or threatened fish and wildlife species, the take of endangered or threatened plants in areas under federal jurisdiction or in violation of state law, or adverse modifications to their critical habitat. Under the ESA, the definition of "take" is to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." USFWS and the National Marine Fisheries Service (NMFS) also interpret the definition of "harm" to include significant habitat modification that could result in the take of a species.

If an activity would result in the take of a federally-listed species, one of the following is required: an incidental take permit under Section 10(a) of the ESA for non-federal projects or an incidental take statement issued under Section 7 of the ESA for federal projects. Such authorization typically requires various measures to avoid and minimize species take, and to protect the species and avoid jeopardy to the species' continued existence.

Pursuant to the requirements of Section 7 of the ESA, a federal agency reviewing a proposed project which it may authorize, fund, or carry out must determine whether any federally-listed threatened or endangered species, or species proposed for federal listing, may be present in the project area and determine whether implementation of the proposed project is likely to affect the species. In addition, the federal agency is required to determine whether a proposed project is likely to jeopardize the continued existence of a listed species or any species proposed to be listed under the ESA or result in the destruction or adverse modification of critical habitat proposed or designated for such species (16 U.S.C. 1536[3], [4]).

Where a federal agency is not authorizing, funding, or carrying out a project, take that is incidental to the lawful operation of a project may be permitted pursuant to Section 10(a) of the ESA through approval of a habitat conservation plan (HCP).

The ESA requires the federal government to designate "critical habitat" for any species it lists under the ESA. "Critical habitat" is defined as: 1) specific areas within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to the species conservation, and those features that may require special management considerations or protection; and 2) specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation (USFWS 2021b).

E.1.13.1 C.1.9.1 Biological Opinions

The following Biological Opinions (BOs) are relevant to the Project:

Coordinated Long-Term Operation of the CVP and SWP

Most recently, Reclamation reinitiated consultation on coordinated long-term operation of the CVP and SWP and completed an Environmental Impact Statement (EIS) in 2019 and issued a ROD on February 18, 2020 (Reclamation 2020) upon receiving new USFWS and NMFS Biological Opinions on October 21, 2019 (USFWS 2019, NMFS 2019). Reclamation is currently in active litigation and has negotiated an "interim operations plan" that allows for deviations from the 2020 ROD and 2019 Final EIS. On September 30, 2021, Reclamation and DWR again requested reinitiation of

consultation with the USFWS and NMFS due to anticipated modifications to the proposed action that may cause effects to ESA-listed species or designated critical habitat that was not analyzed in the 2019 USFWS and NMFS Biological Opinions. On October 1, 2021, both agencies agreed to the reinitiation.

O&M Program for the South-Central California Area

Reclamation consulted with the USFWS under the ESA for operation and maintenance (O&M) activities occurring on Reclamation lands under the jurisdiction of the South-Central California Area Office. The USFWS issued a BO on February 17, 2005 (USFWS 2005). The BO considers the effects of routine O&M of Reclamation's facilities used to deliver water to the study area, as well as certain other facilities within the jurisdiction of the South-Central California Area Office, on California tiger salamander, vernal pool fairy shrimp, valley elderberry longhorn beetle, blunt-nosed leopard lizard, vernal pool tadpole shrimp, San Joaquin wooly-threads, California red-legged frog, giant garter snake, San Joaquin kit fox, and on proposed critical habitat for the California red-legged frog and California tiger salamander.

E.1.14 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA)[11] decrees that all migratory birds and their parts (including eggs, nests and feathers) are fully protected. The MBTA protects nearly all native North American bird species. Under the MBTA, taking, killing, or possessing migratory birds is unlawful. Under the MBTA, surveys are required to determine whether nests will be disturbed and, if so, a buffer area with a specified radius around the nest must be established so that no disturbance or intrusion is allowed until the young have fledged and left the nest. The size of the buffer area would vary depending on species and local conditions (e.g., presence of busy roads) and the professional judgment of the project biologist. Coordination with the USFWS is recommended for establishing an appropriate buffer (USFWS 2021c).

E.1.15 National Historic Preservation Act

The NHPA of 1966[12] requires federal agencies to consider the preservation of prehistoric and historic period resources. The NHPA authorizes the Secretary of the Interior to expand and maintain the NRHP, and it establishes the ACHP as an independent federal entity. Section 106 of the Act[13] requires federal agencies to take into account the effects of their undertakings on historic properties and affords the ACHP an opportunity to comment on the undertaking prior to the licensing or approval of the expenditure of funds on any undertaking that may affect properties listed, or eligible for listing, in the NRHP. The implementing regulations at 36 CFR Part 800 identify the steps that must be followed to comply with Section 106 of the NHPA. These steps include consultation with the SHPO (ACHP 2004).

The Project is subject to NHPA Section 106 compliance, to include consultation with the SHPO and other Section 106 consulting parties as required. Section 106 of the NHPA requires federal agencies to consider the effects of the undertaking on historic properties and to afford the ACHP and the SHPO a reasonable opportunity to comment on any undertaking that would adversely affect properties listed or eligible for listing in the NRHP. Section 302706 (a) of the NHPA allows

[11] 16 U.S.C. 703-712.
[12] 54 U.S.C Section 300101 et seq.
[13] 54 U.S.C Section 300108.

properties of traditional religious and cultural importance to Indian tribes to be determined eligible for inclusion in the NRHP. Under the NHPA, a "historic property" or significant cultural resource is one that meets the following NRHP criteria.[14]

The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and:

A. That are associated with events that have made a significant contribution to the broad patterns of our history, or

B. That are associated with the lives of persons significant in our past, or

C. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction, or

D. That have yielded, or may be likely to yield, information important in prehistory or history.

The federal review of projects is typically referred to as the Section 106 process. Section 106 review normally involves a four-step procedure that is detailed in the implementing regulations (36 CFR Part 800):

1. *Establish undertaking.* Determine whether the proposed federal action is an undertaking;
2. *Identification of historic properties.* Determine scope of identification efforts, phased identification and evaluation, evaluate historic significance, results of identification and evaluation;
3. *Assessment of adverse effects.* Apply criteria of adverse effect, finding of no adverse effect, consulting party review, results of assessment;
4. *Resolution of adverse effects.* Continue consultation, resolve adverse effects, memorandum of agreement.

Once cultural resources are identified in the project area of potential effects (APE), they must be evaluated under the four NRHP criteria found at 36 C.F.R. Part 60.4 pursuant to 36 C.F.R. Part 800.4(c). If the agency determines historic properties are within the APE, then the effect of the undertaking on historic properties is assessed as outlined in 36 CFR 800.5. The effect can be either no adverse effect or adverse effect. Adverse effects must be resolved in consultation with and through agreement among the responsible federal agency or agencies, the SHPO, and other Section 106 consulting parties pursuant to 36 C.F.R. Part 800.6.

E.1.16 Native American Graves Protection and Repatriation Act

The Native American Graves Protection and Repatriation Act (NAGPRA) is a U.S. federal law enacted in 1990 that requires federal agencies and institutions that receive federal funding to return Native American cultural items to lineal descendants, Indian tribes, Alaska Native Corporations, or Native Hawaiian organizations through excavated or discovered items on federal or tribal land. Cultural items include human remains, funerary objects, sacred objects, and objects of cultural patrimony. Consultation with all parties is a critical component for addressing identification,

[14] 36 C.F.R. Part 60.4.

treatment, and disposition of Native American cultural items (U.S. DOI Bureau of Land Management n.d.).

E.1.17 Paleontological Resources Preservation Act

The Paleontological Resources Preservation Act (PRPA) of 2009[15] requires the U.S. Department of Agriculture and the DOI to manage and protect paleontological resources on federal land using scientific principles and expertise. The law, which applies only to federal land, includes criminal and civil penalties for fossil theft and vandalism. The law also provides authority for issuing permits for collecting paleontological resources (Federal Register 2009).

Paleontological resources do not include any materials associated with an archaeological resource as defined in Section 3(1) of the Archaeological Resources Protection Act of 1979,[16] or any cultural item as defined in Section 2 of the NAGPRA.[17]

E.1.18 Principles and Requirements for Federal Investments in Water Resources

Reclamation is subject to *Principles and Requirements for Federal Investments in Water Resources* (Council on Environmental Quality 2013). This document requires areas of risk and uncertainty to be identified, described, and considered when analyzing potential investments in water resources. It specifically requires climate change impacts to be accounted for and addressed.

E.1.19 Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) of 1976, administered by the USEPA, governs the disposal of solid and hazardous waste. Under RCRA, USEPA was given authority of "cradle-to-grave" control of hazardous waste, and this is the current approach for hazardous waste management. Three programs were established under RCRA including the solid waste program, hazardous waste program, and underground storage tank (UST) program. Under the law, controls for the generation, transport, treatment, storage, and disposal of hazardous waste are strictly mandated. Only active and future facilities are controlled under RCRA (USEPA 2022b). There have been three amendments to RCRA, including the Hazardous and Solid Waste Amendments of 1984, the Federal Facility Compliance Act of 1992, and the Land Disposal Program Flexibility Act of 1996 (USEPA 2022b).

E.1.20 Safe Drinking Water Act

The Federal Safe Drinking Water Act (SDWA)[18] was enacted in 1974 to protect the quality of drinking water in the U.S. This law focuses on all waters actually or potentially designated for drinking use, whether from aboveground or underground sources. The SDWA authorized the USEPA to establish safe standards of purity for specified contaminants and required all owners or operators of public water systems to comply with primary (health-related) standards. State governments, which assume this power from the USEPA, also encourage attainment of secondary standards (nuisance-related). Contaminants of concern in a domestic water supply are those that either pose a health threat or in some way alter the aesthetic acceptability of the water. These types of contaminants are currently regulated by the USEPA through primary and secondary maximum

[15] 16 USC 470aaa-aaa-11.
[16] 16 U.S.C. 470bb(1).
[17] 25 U.S.C. 3001.
[18] 42 U.S.C. Section 300f et seq.

contaminant levels (MCLs). As directed by the SDWA amendments of 1986, the USEPA has been expanding its list of primary MCLs. MCLs have been proposed or established for approximately 100 contaminants.

E.1.21 Transportation Research Board Highway Capacity Manual, Sixth Edition

The Highway Capacity Manual (HCM), Sixth Edition provides methods for quantifying highway capacity. In its current form, it serves as a fundamental reference on concepts, performance measures, and analysis techniques for evaluating the multimodal operation of streets, highways, freeways, and off-street pathways. In this edition, the latest research in highway capacity, quality of service, Active Traffic and Demand Management, and travel time reliability are incorporated to keep user's needs and present times. The HCM consists of four dimensions (Transportation Research Board 2016):

1. *Quantity of travel*. The magnitude of use of a transportation facility or service;
2. *Quality of travel*. Users' perceptions of travel on a transportation facility or service with respect to their expectations;
3. *Accessibility*. The ease with which travelers can engage in desired activities; and
4. *Capacity*. The ability of a transportation facility or service to meet the quantity of travel demanded of it.

E.1.22 Uniform Building Code (International Building Code)

The design and construction of engineered facilities in the state of California must comply with the requirements of the Uniform Building Code (UBC). The International Code Council (ICC) was established in 1994 as a nonprofit organization dedicated to developing a single set of comprehensive and coordinated national model construction codes, or Uniform Building Codes. The founders of the ICC are Building Officials and Code Administrators International, Inc., International Conference of Building Officials, and Southern Building Code Congress International, Inc. Since the early twentieth century, these nonprofit organizations developed the three separate sets of model codes used throughout the U.S. Although regional code development has been effective and responsive in the past, a single set of codes was developed. The nation's three model code groups responded by creating the ICC and by developing codes without regional limitations, the International Codes (International Code Council 2022).

E.1.23 United States Department of the Interior, Bureau of Reclamation National Environmental Policy Act Handbook

The Reclamation *NEPA Handbook* (Reclamation 2012) recommends that climate change be considered, as applicable, in every NEPA analysis. The *NEPA Handbook* acknowledges that there are two interpretations of climate change regarding Reclamation actions: 1) Reclamation's action is a potentially significant contributor to climate change and 2) climate change could affect a Reclamation proposed action. The *NEPA Handbook* recommends considering different aspects of climate change (e.g., relevance of climate change to the proposed action, time frame for analysis, and relevant regional/local projections of climate change) to determine the extent to which it should be discussed under NEPA.

E.1.24 United States Department of the Interior Secretarial Order No. 3398

In 2021, DOI issued a Secretarial Order (SO) that continues the implementation of EO 13990 by rescinding documents inconsistent with EO 13990. The order rescinds SO 3355 "Streamlining National Environmental Policy Reviews and Implementation of EO 13807", "Establishing Discipline and Accountability in the Environmental Review and Permitting Process for Infrastructure Projects" (DOI 2021b).

E.2 State Requirements

E.2.1 Alquist-Priolo Earthquake Fault Zoning Act

The 1972 Alquist-Priolo Earthquake Fault Zoning Act[19] requires local agencies to regulate development within earthquake fault zones to reduce the hazards associated with surface fault ruptures. It also regulates construction in earthquake fault zones.

E.2.2 California Building Code

Minimum standards for structural design and construction are outlined in the California Building Standards Code (CBSC)[20] (California Department of General Services 2022). The CBSC is based on the UBC, which is widely used throughout the U.S. and has been modified for California conditions with numerous, more detailed and/or more stringent regulations.

E.2.2.1 Geology, Seismicity, and Soils

The CBSC requires that "classification of the soil at each building site…be determined when required by the building official" and that "the classification be based on observation and any necessary test of the materials disclosed by borings or excavations." In addition, the CBSC states that "the soil classification and design-bearing capacity shall be shown on the (building) plans, unless the foundation conforms to specified requirements." The CBSC provides standards for various aspects of construction, including but not limited to excavation, grading, and earthwork construction; fill placement and embankment construction; construction on expansive soils; foundation investigations; and liquefaction potential and soil strength loss. In accordance with California law, project design and construction would be required to comply with provisions of the CBSC (California Department of General Services 2022).

E.2.2.2 Noise and Vibration

The CBSC provides acoustical regulations for both exterior-to-interior sound insulation, as well as sound and impact isolation between adjacent spaces of various occupied units. Title 24 regulations generally state that interior noise levels generated by exterior noise sources must not exceed 45 A-weighted decibels (dBA) L_{dn}/Community Noise Equivalent Level (CNEL), with windows closed, in any habitable room for general residential uses (California Department of General Services 2022).

E.2.3 California Clean Air Act

The California Clean Air Act (CCAA) substantially added to the authority and responsibilities of the State's air pollution control districts. The CCAA establishes an air quality management process that

[19] California Public Resources Code [PRC] Section 2621 et seq.
[20] Title 24, California Code of Regulations.

generally parallels the federal process. The CCAA, however, focuses on attainment of the California Ambient Air Quality Standards (CAAQS) that, for certain pollutants and averaging periods, are typically more stringent than the comparable NAAQS. The CCAA requires that the CAAQS be met as expeditiously as practicable but does not set precise attainment deadlines. Instead, the act established increasingly stringent requirements for areas that will require more time to achieve the standards (California Environmental Protection Agency [CalEPA] 2020a).

The air quality attainment plan requirements established by the CCAA are based on the severity of air pollution problems caused by locally generated emissions. Upwind air pollution control districts are required to establish and implement emission control programs commensurate with the extent of pollutant transport to downwind districts.

The California Air Resources Board (CARB) is responsible for developing emission standards for on-road motor vehicles and some off-road equipment in the State. In addition, CARB develops guidelines for the local districts to use in establishing air quality permit and emission control requirements for stationary sources subject to the local air district regulations.

E.2.4 California Department of Fish and Wildlife Species Designations

The California Department of Fish and Wildlife (CDFW) maintains an informal list of species called "species of special concern." These are broadly defined as plant and wildlife species that are of concern to CDFW because of population declines and restricted distributions and/or because they are associated with habitats that are declining in California. These species are inventoried in the California Natural Diversity Database (CNDDB) regardless of their legal status. Impacts on species of special concern may be considered significant.

E.2.5 California Department of Transportation Highway Design Manual, Seventh Edition

The 7th Edition Highway Design Manual (HDM) establishes uniform policies and procedures for state highway design functions of the California Department of Transportation. It is neither intended as, nor does it establish, a legal standard for these functions but are for the information and guidance of the officers and employees of the Department (Caltrans 2019a).

The HDM is not intended to be a substitute for engineering knowledge, experience, or judgment. In no event will the Department be liable for costs of procurement of substitute goods, loss of profits, or for any indirect, special, consequential, or incidental damages, however caused, by use of the HDM. The Department will not be liable for any claims in connection with the use of the HDM, including without limitation, liability arising from third-party claims, liability related to the quality of calculations or the safety or quality or structures, liability for scheduling delays or re-design of structures, or other similar liability design, retrofit or rework.

E.2.6 California Department of Transportation Guide for the Preparation of Traffic Impact Studies

Traffic analysis in the State of California is guided by standards set at the State level by the California Department of Transportation (Caltrans), and by local jurisdictions. State highways fall under the jurisdiction of Caltrans. Other roadways fall under the local jurisdiction, either city or county, in which they are located.

Each jurisdiction has adopted standards regarding the desired performance level of traffic conditions on the circulation system within its jurisdiction. A performance measure called "Level of Service"

(LOS) is used to characterize traffic operating conditions of a circulation element. Progressively worsening traffic operating conditions are given the letter grades "A" through "F."

While most motorists consider LOS A, B, and C as satisfactory travel conditions, LOS D is considered marginally acceptable. Congestion and delay are considered unacceptable to most motorists and are given the LOS E or F ratings.

E.2.7 California Endangered Species Act

CDFW is responsible for administration of the California Endangered Species Act (CESA). CESA requires incidental take authorization or permits for certain projects undertaken by public agencies. For projects where CESA compliance is required, and that affect a species that is both State and federal listed, compliance with the federal ESA will satisfy the CESA if CDFW determines that the federal incidental take authorization is "consistent" with the CESA. Projects that result in a "take" of a State-listed species require an incidental take permit under the CESA. The State act also lends protection to species that are considered rare enough by the scientific community and trustee agencies to warrant special consideration, particularly with regard to protection of isolated populations, nesting or den locations, communal roosts, and other essential habitat.

E.2.7.1 Fully Protected Species under California Fish and Game Code

Protection of fully protected species is described in four sections of the California Fish and Game Code that list 37 fully protected species (California Fish and Game Code Sections 3511, 4700, 5050, and 5515) (California Legislative Information 1998). These statutes prohibit take or possession at any time of fully protected species.

E.2.8 California Environmental Protection Agency Unified Program

The CalEPA Unified Program was developed to protect Californians from hazardous waste and materials. CalEPA has certified 81 local government agencies as California Unified Program Agencies (CUPAs), including Merced County Department of Public Health, which is responsible for implementing the hazardous waste and materials standards for five different State agencies including: CalEPA, Department of Toxic Substances Control (DTSC), Governor's Office of Emergency Services, CalFire and the SWRCB (CalEPA 2020a). Under the Unified Program, the administration, permit, inspection and enforcement activities are consolidated for the following environmental and emergency management programs (CalEPA 2020b).

- Aboveground Petroleum Storage Act Program
- Area Plans for Hazardous Materials Emergencies
- California Accidental Release Prevention (CalARP) Program
- Hazardous Materials Release Response Plans and Inventories (Business Plans)
- Hazardous Material Management Plan and Hazardous Material Inventory Statements (California Fire Code)
- Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs
- Underground Storage Tank (UST) Program

A more in-depth discussion of some of these programs that have applicability are described below.

E.2.8.1 Hazardous Material Management Plan and Hazardous Material Inventory Statements

The Hazardous Material Business Plans (HMBP) program mandates the creation of a planning document by businesses and other entities who handle hazardous materials of certain quantities. The Business Plan should include, among other things, an inventory of hazardous materials, a site location map, emergency plan and training program for their employees. These plans are to be submitted electronically to the California Environmental Reporting System. The local CUPA agency may be contacted for assistance with preparation of Business Plans. The CUPA will verify this information and provide it to "local emergency responders such as firefighters, health officials, planners, public safety officers, health care providers, regulatory agencies and other interested" parties. This information is prepared in response to federal community right-to-know laws (California Office of Emergency Services [CalOES] 2020a).

E.2.8.2 California Accidental Release Prevention Program

The CalARP program was developed to assist with prevention of harmful substances releases which could seriously harm the public and/or the environment. Businesses that handle certain quantities of regulated substances are required to prepare a Risk Management Plan that includes an engineering analysis of potential accident scenarios with mitigation measures. The mitigation measures, when implemented, would reduce the accident potential at a business. CalARP is implemented at the local government level (CUPA) who work directly with the regulated business (CalOES 2020b):

E.2.8.3 California Area Plan Program

The Area Plan Program requires CUPAs to prepare a plan utilizing information from CalARP and HMBP. The Area Plan includes emergency response procedures to minimize impacts from a hazardous material release or threatened release. Provisions for multiagency coordination and notification during emergency responses are also to be addressed in the Area Plan (CalOES 2020c).

E.2.9 California Environmental Quality Act Guidelines

E.2.9.1 Greenhouse Gas Emissions

On March 18, 2010, the California Natural Resources Agency (CNRA) adopted amendments to the CEQA Guidelines to include provisions for evaluating the significance of greenhouse gas (GHG) emissions. The amended guidelines give the Lead Agency leeway in determining whether GHG emissions should be evaluated quantitatively or qualitatively but requires that the following factors be considered when assessing the significance of impacts from GHG emissions (Section 15064.4) (CEQA 2022):

- The extent to which the project may increase or reduce GHG emissions as compared to the existing environmental setting
- Whether the project emissions exceed a threshold of significance that the lead agency determines apply to the project
- The extent to which the project complies with regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of GHG emissions

The amended guidelines also specify that Lead Agencies must analyze potentially significant impacts associated with placing projects in locations susceptible to hazardous conditions (e.g., floodplains,

coastlines, and wildfire risk areas), including those that could be affected by climate change (Section 15126.2(a)).

Furthermore, the guidelines also suggest measures to mitigate GHG emissions, including implementing project features to reduce emissions, obtaining carbon offsets to reduce emissions, or sequestering GHG.

E.2.9.2 Cultural Resources

CEQA is the central law governing cultural resources at the State level. CEQA Guidelines Section 15064.5 states that a project may have a significant impact on the environment if it causes a substantial adverse change in the significance of a historical resource. Pursuant to Section 15064.5(a)(3), a historical resource is a resource that is included in, or eligible for inclusion in, the California Register of Historical Resources (CRHR); a resource listed in a local register of historical resources, as defined in PRC Section 5020.1(k) or identified as significant in a historical resource survey meeting the requirements of PRC Section 5024.1(g); or any object, building, structure, site, area, place, record, or manuscript that a lead agency determines to be significant. Resources automatically listed in the CRHR are those formally determined eligible for, or listed in, the NRHP, State Historical Landmarks numbered 770 or higher, and California Points of Historical Interest. If a lead agency determines that a cultural resource constitutes a historical resource, the provisions of PRC Section 21084.1 and CEQA Guidelines Section 15064.5 would apply. If a cultural resource does not meet the criteria for a historical resource, it may yet be regarded as a "unique" archaeological resource (PRC Section 21083.2). CEQA Guidelines Section 15064.5(c)(4) notes that if a resource is neither a unique archaeological resource nor a historical resource, the effects of a project on that resource shall not be considered a significant effect on the environment. Human remains, including those interred outside formal cemeteries, are protected under several State laws, including PRC Section 5097.98 and Health and Safety Code Section 7050.5 (CEQA 2022).

Signed in 2014, Assembly Bill (AB) 52 amends CEQA and creates a new category of environmental resource: "tribal cultural resources." These resources are defined as any site, feature, place, cultural landscape, sacred place, or object that has cultural value to a California Native American tribe. The bill further establishes a consultation process with all California Native American tribes listed by the Native American Heritage Commission, regardless of their federal recognition status.

E.2.10 California Executive Order S-3-05

On June 1, 2005, former California Governor Arnold Schwarzenegger signed EO S-03-05. This EO established the following GHG emission reduction targets for California:

- By 2010, reduce GHG emissions to 2000 levels.
- By 2020, reduce GHG emissions to 1990 levels.
- By 2050, reduce GHG emissions to 80 percent below 1990 levels.

The order also requires the Secretary of CalEPA to report to the Governor and the State Legislature biannually on progress made toward meeting the GHG emission targets, commencing in January 2006. The Secretary of the CalEPA is also required to report about impacts on water supply, public health, agriculture, the coastline, and forestry. Mitigation and adaptation plans to combat these impacts must also be developed.

California GHG emissions were estimated to be 446.06 million tonnes (metric tons) of CO_2 (carbon dioxide) equivalent (CO_2e) in 2010, compared to 467.19 million tonnes of CO_2e in 2000 (CARB

2019). The GHG emissions inventory indicates that emissions decreased by over 21 million tonnes of CO_2e over the decade, representing a four percent decrease in statewide emissions. Thus, the State was successful in meeting the first milestone of S-3-05.

E.2.11 California Executive Order B-30-15 and Senate Bill 32

California Governor Edmund G. Brown issued EO B-30-15 to reduce California GHG emissions to 40 percent below 1990 levels by 2030. The order aligns California's GHG reduction targets with the United Nations Climate Change Conference in Paris. In 2016, Senate Bill 32 codified the EO B-30-15 target and directed State regulatory agencies to develop rules and regulations to meet the 2030 State target.

E.2.12 California Fish and Game Code Section 1600, Streambed Alterations

Section 1600 et seq. of the California Fish and Game Code, administered by CDFW, states that "it is unlawful for any person to substantively divert or obstruct the natural flow or substantially change the bed, channel, or bank of any river, stream, or lake designated by the department, or use any material from the streambeds, without first notifying the department of such activity." Streambed alteration must be permitted by CDFW through a Streambed Alteration Agreement. CDFW defines streambeds as "a body of water that flows at least periodically or intermittently through a bed or channel having banks and supports fish or other aquatic life" and lakes as "natural lakes and man-made reservoirs." CDFW jurisdiction includes ephemeral, intermittent, and perennial watercourses, and can extend to habitats adjacent to watercourses, including flood plains. Wetlands near watercourses would also be considered "habitats adjacent to watercourses." A Lake and Streambed Alteration Agreement application may need to be submitted for construction actions disturbing the bed and bank of rivers or reservoirs.

E.2.13 California Fish and Game Code Section 1900 – 1913, Native Plant Protection Act

The Native Plant Protection Act[21] prohibits the take, possession, or sale within the state of any plants with a state designation of rare, threatened, or endangered (as defined by CDFW).

E.2.14 California Fish and Game Code Sections 3500 - 3705, Migratory Bird Protection

Sections 3500 through 3705 of the California Fish and Game Code regulate the taking of migratory birds and their nests. These codes prohibit the taking of nesting birds, their nests, eggs, or any portion thereof during the nesting season. Typically, the breeding/nesting season is from March 1 through August 30. Depending on each year's seasonal factors, the breeding season can start earlier and/or end later. Several species of migratory birds are known to occur in the area of analysis (California Fish and Game Code 3500-3705).

E.2.15 California Global Warming Solutions Act of 2006 (AB 32)

California AB 32, the Global Warming Solutions Act of 2006, codifies the state's GHG emissions targets by requiring the state's global warming emissions to be reduced to 1990 levels by 2020 and directs CARB to enforce the statewide cap that began to phase in during 2012. In 2007, CARB

[21] California Fish and Game Code 1900-1913.

recommended and adopted a 1990 GHG emissions level and 2020 emissions limit of 427 million metric tons CO_2e ($MMTCO_2e$); however, this limit has subsequently been updated to 431 $MMTCO_2e$ using the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report global warming potentials (GWPs) (CARB 2020). The limit is a statewide limit and does not require individual sectors or facilities to reduce emissions equally.

Key AB 32 milestones are as follows (CARB 2014):

- January 1, 2009 – Scoping Plan adopted indicating how emissions will be achieved from significant sources of GHGs via regulations, market mechanisms, and other actions.
- During 2009 – CARB staff drafted rule language to implement its plan and held a series of public workshops on each measure (including market mechanisms).
- January 1, 2010 – Early action measures took effect.
- During 2010 – CARB conducted series of rulemakings, after workshops and public hearings, to adopt GHG regulations, including rules governing market mechanisms.
- January 1, 2011 – Completion of major rulemakings for reducing GHGs, including market mechanisms.
- January 1, 2012 – GHG rules and market mechanisms adopted by CARB and are legally enforceable.
- November 14, 2012 – CARB held first quarterly auction of GHG emissions allowances as part of the cap-and-trade program.
- January 1, 2013 – Cap-and-trade program began with a GHG emissions cap that declines over time.
- September 17, 2013 – CARB issued first carbon offset credits as part of the cap-and-trade program.
- May 22, 2014 – CARB approved First Update to the Climate Change Scoping Plan.
- December 31, 2020 – Deadline for achieving 2020 GHG emissions cap.

CARB has been proactive in its implementation of AB 32 and has met each of the milestones identified above that have already passed and is on track to meet the last milestone.

E.2.16 California Natural Resources Agency Tribal Consultation Policy

Under EO B-10-11 it is policy that every state agency and Department subject to executive control to implement effective government-to-government consultation with California Indian Tribes. The purpose of California Natural Resources Agency Tribal Consultation Policy is to ensure effective government-to-government consultation between the Natural Resources Agency, its Departments of the Natural Resources Agency and Indian tribes and tribal communities. It is only by engaging in open, inclusive and regular communication efforts that the interests of California's Tribes and tribal communities will be recognized and understood in the larger context of complex decision-making. The goal of the policy is to engage in the timely and active process of respectfully seeking, discussing and considering the views of California Indian Tribes, Tribal communities and Tribal Consortia in an effort to resolve concerns of as many parties as possible.

E.2.17 California Occupational Safety and Health Administration Standards

The California Division of Occupational Safety and Health Administration (CalOSHA) enforces laws and regulations related to the safety and health of workers in the workplace. Laws and regulations enforced by CalOSHA include regulations related to construction and handling of carcinogens and asbestos (CalOSHA 2020).

E.2.18 California Office of Historic Preservation

The California Office of Historic Preservation (OHP) implements the policies of the NHPA on a Statewide level and maintains the State Historic Resources Inventory database. SHPO is responsible for the operation and management of the OHP and implements historic preservation programs within the State's jurisdiction while serving as a consulting party in the federal process described above.

E.2.19 California Porter-Cologne Water Quality Control Act

The California Porter-Cologne Water Quality Act (Porter-Cologne Act) was enacted in 1969 and established the SWRCB. The Porter-Cologne Act defines water quality objectives as the limits or levels of water constituents that are established for reasonable protection of beneficial uses, described in detail in Appendix H. Unlike the CWA, the Porter-Cologne Act applies to both surface and groundwater. The Porter-Cologne Act requires that each of nine semiautonomous RWQCB establish water quality objectives, while acknowledging that water quality may be changed to some degree without unreasonably affecting beneficial uses. Beneficial uses, together with the corresponding water quality objectives, are defined as standards, according to CWA regulations. Therefore, the regional plans provide the regulatory framework for meeting State and federal requirements for water quality control. Changes in water quality are only allowed if the change is consistent with the most restrictive beneficial use designation identified by the State, does not unreasonably affect the present or anticipated beneficial uses, and does not result in water quality less than that prescribed in the Regional Water Quality Control Plans (Basin Plans) (SWRCB 2022a).

E.2.19.1 State Water Resources Control Board Water Right Decision 1485 (D-1485)

The SWRCB Water Right Decision 1485 (D-1485) amended the water right permits of DWR and Reclamation for the SWP and CVP facilities. The decision was in exercise of the SWRCB's reserved jurisdiction to establish or revise terms and conditions for salinity control and for protection of fish and wildlife, and to coordinate the terms of the various permits for the two projects. The decision established that water quality standards in the Delta must be satisfied prior to any export from the Delta to other areas for any purpose. These standards must be maintained as first priority operating criteria for any and all projects or parts thereof that may be constructed and operated under the permits considered in the decision. It also required the establishment of a monitoring program to ensure collection of the data necessary to measure compliance with the water quality standards (D-1485).

E.2.19.2 State Water Resources Control Board Water Right Decision 1641 (D-1641)

SWRCB Decision-1641 presents the current water right requirements to implement the Delta flow-dependent objectives. In SWRCB Decision-1641, the SWRCB assigned responsibilities to Reclamation and DWR for meeting these requirements. These responsibilities require that the CVP and the SWP be operated to protect water quality, and that DWR and/or Reclamation will ensure that the flow-dependent water quality objectives are met in the Delta (SWRCB 2000).

E.2.20 California State Parks Guidelines

The California State Parks system does not have regulations regarding noise impacts on campgrounds. For CEQA purposes, the park system defines significant adverse noise impacts as an increase above background that would be clearly discernible and objectionable to park users (California Department of Parks and Recreation 2006).

E.2.21 California Water Code Section 13240, Regional Water Quality Control Plans

The California Water Code (Section 13240) requires the preparation and adoption of Regional Water Quality Control Plans (Basin Plans), and the CWA (Section 303) supports this requirement. According to Section 13050 of the California Water Code, Basin Plans consist of a designation or establishment for the waters within a specified area of beneficial uses to be protected, water quality objectives to protect those uses, and an implementation program needed for achieving the objectives. State law also requires that Basin Plans conform to the policies set forth in the Water Code, beginning with Section 13000, and any State policy for water quality control. The Basin Plans are regulatory references for meeting the State and federal requirements for water quality control (40 CFR 131.20). One significant difference between the State and federal programs is that California's basin plans also establish standards for groundwater in addition to surface water.

Basin Plans complement other WQCPs adopted by the SWRCB, such as the WQCP for Temperature Control and Ocean Waters. The SWRCB and the regional water boards maintain each Basin Plan in an updated and readily available edition that reflects the current water quality control programs.

Three different Water Quality Control Plans govern water bodies within the Delta-Mendota Canal (DMC) Subsidence Correction study area.

- The *Central Valley Region Basin Plan* covers the drainage areas of the entire Sacramento and San Joaquin River basins, involving an area bound by the crests of the Sierra Nevada on the east and the Coast Range and Klamath Mountains on the west. The area covered in this WQCP extends some 400 miles, from the California – Oregon border to the headwaters of the San Joaquin River.
- *San Francisco Bay/Sacramento-San Joaquin Delta Estuary Plan* establishes water quality objectives for water bodies within the region to protect beneficial uses. The WQCP includes beneficial uses to be protected, water quality objectives, and a program to help achieve the water quality objectives. This plan supplements other water quality control plans, by the SWRCB and RWQCBs, relevant to the Bay-Delta Estuary watershed. These other plans and policies establish water quality standards and requirements for parameters such as toxic chemicals, bacterial contamination, and other factors which have the potential to adversely affect beneficial uses or cause nuisance conditions (SWRCB 2021). On December 12, 2018, the SWRCB adopted amendments to the Water Quality Control Plan for the San Francisco/Sacramento – San Joaquin Delta Estuary (Bay-Delta Plan) pursuant to Resolution No. 2018-0059. On August 8, 2022, the SWRCB published a Notice of Preparation to announce that they are proposing a regulation that would implement lower San Joaquin River flows and southern Delta salinity objectives in the Bay-Delta Plan. Public comments were solicited for this project in September 2022 (SWRCB 2022b).

- *Water Quality Control Plan for the Tulare Lake Basin* covers the drainage area of the San Joaquin Valley south of the San Joaquin River. The Basin encompasses approximately 10.5 million acres, of which approximately 3.25 million acres are in federal ownership (SWRCB 2021). The WQCP includes existing and potential beneficial uses, water quality objectives, and an implementation plan.

E.2.22 California Water Code, Water Rights

The California Water Code establishes state policy, laws, statutes, and definitions for water rights. The Water Code established the SWRCB, delegating adjudicatory and regulatory functions of the state to the SWRCB in the field of water resources. Regulations pertaining to water law are found in Title 23, Sections 640 to 1024. After the enactment of the State Water Commission Act in 1914, the state required any person or agency seeking to use surface water, without an existing riparian right, to apply for and receive approval for such use from the SWRCB. Water rights permits granted by the SWRCB include detailed descriptions of the amounts, conditions, and construction timetables under which the proposed water project must comply. Prior to permit issuance, the SWRCB must take into account all prior rights and the availability of water in the basin. The SWRCB must also consider the flows needed to preserve in-stream uses such as recreation and fish and wildlife habitat. The SWRCB may impose additional conditions to ensure that these criteria are satisfied, and it may use its continuing authority to enforce and revise the conditions of water right permits over time. The SWRCB is also empowered to revoke a permit or issue cease and desist orders if conditions of the permit are not being met.

E.2.23 Hazardous Waste Control Act

The Hazardous Waste Control Act was passed in 1972 by the State Legislature. The Hazardous Waste Control Law[22] mandates regulatory standards for the generation, handling, processing, storage, transportation, and disposal of hazardous wastes through a "cradle-to-grave" system. The California DTSC and local CUPAs are responsible for administration of the California Hazardous Waste Control Program (California Department of Toxic Substances Control 2018).

E.2.24 Noise Element Guidelines (Health and Safety Code Section 46050.1)

The State of California provides guidance for the preparation of general plans and noise ordinances. In 1976, the State Department of Health Services (now the Department of Public Health) issued *Noise Element Guidelines* (Health and Safety Code Section 46050.1). In 1977, the State Office of Noise Control (ONC) published a model noise ordinance and mandated that each county develop a noise element as part of its general plan (Section 65203[f] of the California Government Code). The purpose of this element is to identify and appraise noise problems in the community. The ONC's model ordinance recommends limits on temporary construction noise levels and operational noise levels in residential, commercial, and industrial areas.

The State's *General Plan Guidelines* recommend that local governments "'analyze and quantify' noise levels and the extent of noise exposure through actual measurement and the use of noise modeling." In addition to other requirements, the guidelines state that "technical data relating to mobile and point sources must be collected and synthesized into a set of noise control policies and programs

[22] Health and Safety Code Section 25100 et seq.

that 'minimizes the exposure of community residents to excessive noise"' (California Office of Planning and Research [OPR] 2017).

As part of the county-level planning process, analysis of existing conditions and community tolerance for noise are used to dictate the normally acceptable community noise exposure. Measured in dBA, a normally acceptable community noise exposure is used by the State to signify satisfactory land use in relation to noise exposure. Other terms used by the State to analyze community noise exposure are:

- **Normally Acceptable -** Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.
- **Conditionally Acceptable -** New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.
- **Normally Unacceptable -** New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design.
- **Clearly Unacceptable -** New construction or development should generally not be undertaken.

Table E-3 displays land use categories and community noise exposure levels.

Table E-3. Noise Compatible Land Use Planning

Land Use	Normally Acceptable L_{dn} or CNEL (dBA)[1]	Conditionally Acceptable L_{dn} or CNEL (dBA)[1]	Normally Unacceptable L_{dn} or CNEL (dBA)[1]	Clearly Unacceptable L_{dn} or CNEL (dBA)[1]
Residential – Low Density Single Family, Duplex, Mobile Homes	50-60	55-70	70-75	75+
Residential – Multifamily	50-65	60-70	70-75	75+
Transient Lodging – Motels, Hotels	50-65	60-70	70-80	80+
Schools, Libraries, Churches, Hospitals, Nursing Homes	50-70	60-70	70-80	80+
Auditoriums, Concert Halls, Amphitheaters	N/A	50-70	N/A	65+
Sports Arena, Outdoor Spectator Sports	N/A	50-75	N/A	70+
Playgrounds, Neighborhood Parks	50-70	N/A	67-75	72+
Golf Courses, Riding Stables, Water Recreation, Cemeteries	50-75	N/A	70-80	80+
Office Buildings, Business Commercial and Professional	50-70	67-77	75+	N/A
Industrial, Manufacturing, Utilities, Agriculture	50-75	70-80	75+	N/A

Source: OPR 2017

Note:

[1] Ranges in the community noise exposure levels (and any subsequent overlaps in the different categories) reflect the differing noise goals of a community, the community's sensitivity to noise, and the community's assessment of the relative importance of noise pollution (OPR 2017).

Key: L_{dn} = day-night average level; CNEL = Community Noise Equivalent Level; dBA = A-weighted decibel scale; N/A = Not Applicable

E.2.25 Seismic Hazards Mapping Act

The 1990 Seismic Hazards Mapping Act[23] was enacted to minimize loss of life and property from strong ground shaking, liquefaction, landslides, or other ground failures as a result of earthquakes. The Act requires the California Geological Survey (CGS) to identify and map areas with the potential for liquefaction, landslides, or ground shaking. These maps are used by cities and counties in their land use permitting process and to adequately prepare the safety element of their general plans (California Department of Conservation [DOC] 2019). Cities and counties are required to regulate development within mapped Seismic Hazard Zones. Permit review is the primary mechanism for local regulation of development; cities and counties are prohibited from issuing development permits for sites in Seismic Hazard Zones until appropriate site-specific geologic or geotechnical investigations have been carried out, and measures to reduce potential damage have been incorporated into the development plans.

E.2.26 State Scenic Highway Program

California's Scenic Highway Program was created by the Legislature in 1963. Applicable State regulations protecting visual resources stem from the protection of State scenic highways running

[23] PRC Section 2690-2699.6.

through or near the project area. There are two officially designated State scenic highway, State Route (SR) 152 and Interstate 5 (I-5) from SR 152 to SR 205 near the City of Tracy, in the area of analysis (Caltrans 2019b). Caltrans has full control and possession of all State highways, and the Scenic Highway Program is under their stewardship as well. Scenic highway legislation establishes the State's responsibility to protect and enhance California's scenic beauty by identifying portions of the State highway system and adjacent scenic corridors, which require special conservation treatment. The legislation also assigns responsibility for regulating land use and development along scenic highways to the appropriate local governmental agencies (Caltrans 2008).

E.2.27 State Water Resource Control Board Hazardous Waste Programs

The California SWRCB is responsible for several programs related to cleanup and management of hazardous waste sites in California including: the Site Cleanup Program, UST Program, Department of Defense Program, and Land Disposal (SWRCB 2018). All of these programs are administered by the Central Valley RWQCB in Merced County (SWRCB 2018). The Cleanup Program regulates unauthorized releases to soils and groundwater, and in some cases surface waters or sediments. The purpose of the UST Program is to "protect public health and safety and the environment from releases of petroleum and other hazardous substances from tanks." The Land Disposal program regulates the discharge of waste "to land for treatment, storage and disposal" (SWRCB 2018).

E.2.28 Surface Mining and Reclamation Act of 1975

The Surface Mining and Reclamation Act (SMARA) of 1975[24] addresses surface mining and requires mitigation to reduce adverse impacts to public health, property, and the environment. Through the law, the State Geologist instated mineral land classifications to help identify and protect mineral resources in the State that may be subject to urban development pressures or other "irreversible land uses" which would inhibit mineral extraction (DOC and State Mining and Geology Board [SMGB] 2007). Following classification by the State Geologist, the SMGB designates lands containing mineral deposits as being of regional or statewide significance (DOC and SMGB 2007).

The SMARA applies to anyone (including a government agency) that disturbs more than one acre or removes more than 1,000 cubic yards of material through surface mining activities, even if activities occur on federally managed lands (DOC and SMGB 2007). Local city and county governments are required to develop ordinances for permitting that provide the regulatory framework for mining and reclamation activities. The SMGB reviews local ordinances to ensure they comply with SMARA (DOC and SMGB 2007).

According to SMARA regulations, the State Geologist shall classify land into Mineral Resource Zones (MRZs) solely on the basis of geologic factors and without regard to existing land use. There are no areas designated as having regional mineral significance within the construction area of the Proposed Action; there are two areas near the Project area that are classified as MRZ-2, or areas of prime importance due to the presence of known economic mineral deposits. One of these sites is located in south City of Tracy in San Joaquin County, approximately half a mile from the DMC; the other is located in the City of Newman in Stanislaus County, approximately a mile from the DMC (DOC 2022). However, neither of these sites are within the DMC ROW.

[24] PRC, Division 2, Chapter 9, Section 2710 et. Seq.

E.3 Local/Regional Requirements

E.3.1 Alameda County General Plan

As required by state law, counties have developed their own general plans. At a minimum, these documents must address the topics of land use, transportation, housing, conservation, open space, noise, and safety. These documents serve as a statement of county goals, policies, standards, and implementation programs for the physical development of a county.

The following goals and policies from Alameda County General Plan are relevant to the DMC Subsidence Correction Project Resources. The Alameda County General Plan was adopted in 2000 (Alameda County 2000).

E.3.1.1 Visual Resources

The Land Use section of the East County Area Plan of the Alameda County General Plan (2000) contains the following goals and policies that pertain to visual resources:

- **Goal:** To preserve unique visual resources and protect sensitive viewsheds.
    - **Policy 105:** The County shall preserve the following major visually-sensitive ridgelines largely in open space use: (1) the ridgelines of Pleasanton, Main, and Sunol Ridges west of Pleasanton; (2) The ridgelines of Schafer, Shell, Skyline, Oak and Divide Ridges west of Dublin and the ridgelines above Doolan Canyon east of Dublin; (3) The ridgelines above Collier Canyon and Vasco Road and the ridgelines surrounding Brushy Peak north of Livermore; (4) The ridgelines above the vineyards south of Livermore; and (5) The ridgelines above Happy Valley south of Pleasanton.

E.3.1.2 Geology and Soils

The Safety Element of the Alameda County General Plan (2000) contains the following goals and policies that pertain to soils, geology, and seismicity:

- **Goal 1:** To minimize risks to lives and property due to seismic and geologic hazards.
    - **Policy P1:** To the extent possible, projects should be designed to accommodate seismic shaking and should be sited away from areas subject to hazards induced by seismic shaking (landsliding, liquefaction, lurking, etc.) where design measures to mitigate the hazards will be uneconomic or will not achieve a satisfactory degree of risk reduction.
    - **Policy P3:** Aspects of all development in hillside areas, including grading, vegetation removal and drainage, should be carefully controlled in order to minimize erosion, disruption to natural slope stability, and landslide hazards.
    - **Policy P4:** Within areas of demonstrated or potential slope instability, development should be undertaken with caution and only after existing geological and soil conditions are known and considered. In areas subject to possible widespread major landsliding, only very low-density development should be permitted, consistent with site investigations; grading in these areas should be restricted to minimal amounts required to provide access.
    - **Policy P11:** All construction in unincorporated areas shall conform to the Alameda County Building Ordinance, which specifies requirements for the structural design of foundations and other building elements within seismic hazard areas.

    - **Policy P14:** In order to minimize off-site impacts of hillside development, new construction on landslide-prone or potentially unstable slopes shall be required to implement drainage and erosion control provisions to avoid slope failure and mitigate potential hazards.

- **Goal 3:** To reduce hazards related to flooding and inundation.
    - **Policy P2:** Surface runoff from new development shall be controlled by on-site measures including, but not limited to structural controls and restrictions regarding changes in topography, removal of vegetation, creation of impervious surfaces, and periods of construction such that the need for off-site flood and drainage control improvements is minimized and such that runoff from development will not result in downstream flood hazards.

The Environmental Health and Safety section of the East County Area Plan of the Alameda County General Plan (2000) contains the following goals and policies that pertain to geology, soils, and seismicity:

- **Goal:** To minimize the risks to lives and property due to soil and slope instability hazards.
    - **Policy 307:** The County shall encourage Zone 7, cities, and agricultural groundwater users to limit the withdrawal of groundwater in order to minimize the potential for land subsidence.
- **Goal:** To minimize risks to lives and property due to seismic and geologic hazards.
    - **Policy 309:** The County shall not approve new development in areas with potential for seismic and geologic hazards unless the County can determine that feasible measures will be implemented to reduce the potential risk to acceptable levels, based on site-specific analysis. The County shall review new development proposals in terms of the risk caused by seismic and geologic activity.

E.3.1.3 Utilities and Power

The Public Services and Facilities section of the East County Area Plan of the Alameda County General Plan (2000) contains the following goals and policies that pertain to utilities and power:

- **Goal:** To provide infrastructure and services necessary to accommodate East County holding capacities in a logical, cost-effective, and timely manner.
    - **Policy 221:** Basic rural services should normally be provided by Alameda County and other existing service districts.
- **Goal:** To ensure the prompt and efficient provision of police, fire, and emergency medical facility and service needs.
    - **Policy 241:** The County shall provide effective law enforcement, fire, and emergency medical services to unincorporated areas.
    - **Policy 242:** The County shall reserve adequate sites for sheriff, fire, and emergency medical facilities in unincorporated locations within East County.
    - **Policy 245:** The County shall adhere to the provisions of the Alameda County Fire Protection Master Plan.

- **Goal:** To ensure the safe and efficient disposal or recycling of wastes.
    - **Policy 247:** The County shall conform its solid waste policies and programs to the Recycling Plan prepared by the Recycling Board, and generally coordinate its hazardous and solid waste management with the Alameda County Waste Management Authority's goals, policies, and plans, except to the extent that they are inconsistent with the Initiative or the Recycling Plan.
    - **Policy 249:** The County shall support efforts to provide solid waste resource recovery facilities and household hazardous waste collection facilities convenient to residences, businesses, and industries.
- **Goal:** To provide an adequate, reliable, efficient, safe, and cost-effective water supply to the residents, businesses, institutions, and agricultural uses in East County.
    - **Policy 251:** The County shall work with the Alameda County Flood Control and Conservation District (Zone 7), local water retailers, and cities to develop a comprehensive water plan to assure effective management and long-term allocation of water resources, to develop a contingency plan for potential short-term water shortages, and to develop uniform water conservation programs. The water plan should include a groundwater pump monitoring and cost allocation system in order to facilitate groundwater management and to recover the cost of purchased water stored in the groundwater basin. In developing this plan, the East Bay Regional Park District (EBRPD) shall be consulted regarding potential direct or indirect effects of water use on EBRPD recreation facilities.
    - **Policy 252:** The County shall encourage Zone 7 to pursue new water supply sources and storage facilities only to the extent necessary to serve the rates and levels of growth established by the Initiative and by the general plans of the cities within its service area.
    - **Policy 260:** The County shall require major projects to mitigate projected water consumption by applying one or more Best Management Practices that reduce water consumption off-site.
- **Goal:** To provide efficient and cost-effective sewer facilities and services.
    - **Policy 268:** The County shall continue to pursue adequate sewage export capacity for unincorporated residential, commercial, and industrial development, consistent with the East County Area Plan, through participation in the Tri-Valley Wastewater Authority or by other means.
- **Goal:** To provide efficient, cost-effective, and environmentally sound storm drainage and flood control facilities.
    - **Policy 277:** The County shall work with the Alameda County Flood Control and Water Conservation District (Zone 7) to provide for development of adequate storm drainage and flood control systems to serve existing and future development.
    - **Policy 278:** The County shall promote flood control measures that advance the goals of recreation, resource conservation (including water quality and soil conservation), groundwater recharge, preservation of natural riparian vegetation and habitat, and the preservation of scenic values of the county's arroyos and creeks.

- **Goal:** To provide efficient and cost-effective utilities.
  - **Policy 285:** The County shall facilitate the provision of adequate gas and electric service and facilities to serve existing and future needs while minimizing noise, electromagnetic, and visual impacts on existing and future residents.
  - **Policy 286:** The County shall work with PG&E to design and locate appropriate expansion of gas and electric systems.

E.3.2 Alameda County Code of Ordinances

E.3.2.1 Noise and Vibration

The Alameda County Code (Section 6.60.040) sets exterior noise standards for the county. General limitations state that it is prohibited to create noise which causes the exterior noise level when measured at any single- or multiple-family residence, school, hospital, church, public library in the incorporated or unincorporated area to exceed the noise level standards described below in Table E-4. If measured ambient noise levels exceed the applicable noise level standard in any category above, the applicable standard shall be adjusted so as to equal the ambient noise level.

Table E-4. Single- or Multiple-Family Residence, School, Hospital, Church, or Public Library Properties Noise Standards

Category	Cumulative number of minutes in any one-hour time period	Noise Level Standards, dBA	
		Daytime (7 a.m. to 10 p.m.)	Nighttime (10 p.m. to 7 a.m.)
1	30	50	45
2	15	55	50
3	5	60	55
4	1	65	60
5	0	70	65

Source: Alameda County 2022

Note: Noise level standards shall be reduced by 5 dBA for simple tone noises, noises consisting primarily of speech or music, or for recurring impulsive noises. If the intruding noise source is continuous and cannot be reasonably discontinued or stopped for a time period to allow for ambient noise level to be measured, the noise level measured while the source is in operation shall be directly compared to the applicable noise level standards.
Key: dBA = decibel A scale

The Alameda County Code (Section 6.60.070.E) states that the provisions of Chapter 6.60 (Noise ordinances) do not apply to noise sources associated with construction, provided said activities do not take place before 7 a.m. or after 7 p.m. on any day except Saturday or Sunday, or before 8 a.m. or after 5 p.m. on Saturday or Sunday.

E.3.2.2 Utilities and Power

Chapter 13 of the Alameda County Code of Ordinances provides the general provisions regarding sewer service systems, stormwater management and discharge control, watercourse protection, underground utility districts, water service system, and more.

E.3.3 Bay Area Air Quality Management District Air Quality Management Plan

The Bay Area Air Quality Management District (BAAQMD) is tasked with regulating stationary sources of air pollution in the nine counties that surround San Francisco Bay: Alameda, Contra

Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, southwestern Solano, and southern Sonoma counties. The air district's *2017 Clean Air Plan* includes a range of control measures designed to decrease emissions of the air pollutants that are most harmful to Bay Area residents: particulate matter, ozone, and toxic air contaminants; to reduce emissions of methane and other "super-GHGs" that are potent climate pollutants in the near-term; and to decrease emissions of carbon dioxide by reducing fossil fuel combustion (BAAQMD 2020). The plan lays the groundwork for a long-term effort to reduce Bay Area GHG emissions 40 percent below 1990 levels by 2030 and 80 percent below 1990 levels by 2050 (BAAQMD 2017).

E.3.4 Fresno County General Plan

As required by state law, Fresno County has developed its own General Plan. The following goals and policies from the *Fresno County General Plan* are relevant to the DMC Subsidence Correction Project resources. The *Fresno County General Plan*, adopted in 2000, established the plan's time horizon as 15 to 25 years (Fresno County 2000).

E.3.4.1 Visual Resources

The Agriculture and Land Use Element of the *Fresno County General Plan* (2000) contains the following goals and policies that pertain to visual resources:

- **Goal OS-K:** To conserve, protect, and maintain the scenic quality of Fresno County and discourage development that degrades areas of scenic quality.
    - **Policy OS-K.1:** The County shall encourage the preservation of outstanding scenic views, panoramas, and vistas wherever possible. Methods to achieve this may include encouraging private property owners to enter into open space easements for designated scenic areas.
    - **Policy OS-K.2**: The County shall identify and map significant scenic resources within the County and shall develop a program to manage these resources.
    - **Policy OS-K.3:** The County should preserve areas of natural scenic beauty and provide for public access to scenic vistas by purchasing sites for park use.
    - **Policy OS-K.4:** The County should require development adjacent to scenic areas, vistas, and roadways to incorporate natural features of the site and be developed to minimize impacts to the scenic qualities of the site.
- **Goal OS-L:** To conserve, protect, and maintain the scenic quality of land and landscape adjacent to scenic roads in Fresno County.
    - **Policy OS-L.6:** The County shall request city, State, and Federal agencies to maintain County-designated landscaped drives, scenic drives, and scenic highways under their jurisdictions in a manner consistent with the goals and policies in this section.
    - **Policy OS-L.7**: The County shall encourage the State of California to landscape urban freeway and highway routes which pass through Fresno County.
    - **Policy OS-L.8:** The County shall encourage cities within Fresno County to develop complementary policies and principles to enhance the visual qualities of streets and highways within their boundaries.

E.3.4.2 Noise and Vibration

The Noise Element of the *Fresno County General Plan* (2000) contains the following goals and policies that pertain to noise and vibration:

- **Goal HS-G:** To protect residential and other noise-sensitive uses from exposure to harmful or annoying noise levels; to identify maximum acceptable noise levels compatible with various land use designations; and to develop a policy framework necessary to achieve and maintain a healthful noise environment.
    - **Policy HS-G.5:** Where noise mitigation measures are required to achieve acceptable levels according to land use compatibility or the Noise Control Ordinance, the County shall place emphasis of such measures upon site planning and project design. These measures may include, but are not limited to, building orientation, setbacks, earthen berms, and building construction practices. The County shall consider the use of noise barriers, such as soundwalls, as a means of achieving the noise standards after other design-related noise mitigation measures have been evaluated or integrated into the program.

E.3.4.3 Hazards/Hazardous Materials

The Health and Safety Element of the *Fresno County General Plan* (2000) contains the following goals and policies that pertain to hazards and hazardous materials:

- **Goal HS-F: To** minimize the risk of loss of life, injury, serious illness, and damage to property resulting from the use, transport, treatment, and disposal of hazardous materials and hazardous wastes.
    - **Policy HS-F.1:** The County shall require that facilities that handle hazardous materials or hazardous wastes be designed, constructed, and operated in accordance with applicable hazardous materials and waste management laws and regulations.
    - **Policy HS-F.2:** The County shall require that applications for discretionary development projects that will use hazardous materials or generate hazardous waste in large quantities include detailed information concerning hazardous waste reduction, recycling, and storage.
    - **Policy HS-F.3:** The County, through its Hazardous Materials Incident Response Plan, shall coordinate and cooperate with emergency response agencies to ensure adequate countywide response to hazardous materials incidents.
    - **Policy HS-F.4:** For redevelopment or infill projects or where past site uses suggest environmental impairment, the County shall require that an investigation be performed to identify the potential for soil or groundwater contamination. In the event soil or groundwater contamination is identified or could be encountered during site development, the County shall require a plan that identifies potential risks and actions to mitigate those risks prior to, during, and after construction.

E.3.4.4 Biological Resources

The Open Space and Conservation Element of the *Fresno County General Plan* (2000) contains the following goals and policies that pertain to biological resources:

- **Goal OS-D**: To conserve the function and values of wetland communities and related riparian areas throughout Fresno County while allowing compatible uses where appropriate. Protection of these resource functions will positively affect aesthetics, water quality, floodplain management, ecological function, and recreation/tourism.
    - **Policy OS-D.1**: The County shall support the "no-net-loss" wetlands policies of the US Army Corps of Engineers, the US Fish and Wildlife Service, and the California Department of Fish and Game. Coordination with these agencies at all levels of project review shall continue to ensure that appropriate mitigation measures and the concerns of these agencies are adequately addressed.
    - **Policy OS-D.2**: The County shall require new development to fully mitigate wetland loss for function and value in regulated wetlands to achieve "no-net-loss" through any combination of avoidance, minimization, or compensation. The County shall support mitigation banking programs that provide the opportunity to mitigate impacts to rare, threatened, and endangered species and/or the habitat which supports these species in wetland and riparian areas.
    - **Policy OS-D.3**: The County shall require development to be designed in such a manner that pollutants and siltation do not significantly degrade the area, value, or function of wetlands. The County shall require new developments to implement the use of Best Management Practices (BMPs) to aid in this effort.
    - **Policy OS-D.4**: The County shall require riparian protection zones around natural watercourses and shall recognize that these areas provide highly valuable wildlife habitat. Riparian protection zones shall include the bed and bank of both low- and high-flow channels and associated riparian vegetation, the band of riparian vegetation outside the high-flow channel, and buffers of 100 feet in width as measured from the top of the bank of unvegetated channels and 50 feet in width as measured from the outer edge of the dripline of riparian vegetation.
- **Goal OS-E**: To help protect, restore, and enhance habitats in Fresno County that support fish and wildlife species so that populations are maintained at viable levels.
    - **Policy OS-E.1**: The County shall support efforts to avoid the "net" loss of important wildlife habitat where practicable. In cases where habitat loss cannot be avoided, the County shall impose adequate mitigation for the loss of wildlife habitat that is critical to supporting special-status species and/or other valuable or unique wildlife resources. Mitigation shall be at sufficient ratios to replace the function, and value of the habitat that was removed or degraded. Mitigation may be achieved through any combination of creation, restoration, conservation easements, and/or mitigation banking. Conservation easements should include provisions for maintenance and management in perpetuity. The County shall recommend coordination with the US Fish and Wildlife Service and the California Department of Fish and Game to ensure that appropriate mitigation measures and the concerns of these agencies are adequately addressed. Important habitat and habitat components include nesting, breeding, and foraging areas, important spawning grounds, migratory routes, migratory stopover areas, oak woodlands, vernal pools, wildlife movement corridors, and other unique wildlife habitats (e.g., alkali scrub) critical to protecting and sustaining wildlife populations.

  - **Policy OS-E.10**: The County shall support State and Federal programs to acquire significant fish and wildlife habitat areas for permanent protection and/or passive recreation use.
  - **Policy OS-E.11**: The County shall protect significant aquatic habitats against excessive water withdrawals that could endanger special-status fish and wildlife or would interrupt normal migratory patterns.
  - **Policy OS-E.12**: The County shall ensure the protection of fish and wildlife habitats from environmentally-degrading effluents originating from mining and construction activities that are adjacent to aquatic habitats.
  - **Policy OS-E.13**: The County should protect to the maximum extent practicable wetlands, riparian habitat, and meadows since they are recognized as essential habitats for birds and wildlife.

- **Goal OS-F**: To preserve and protect the valuable vegetation resources of Fresno County.
  - **Policy OS-F.1**: The County shall encourage landowners and developers to preserve the integrity of existing terrain and natural vegetation in visually-sensitive areas such as hillsides and ridges, and along important transportation corridors, consistent with fire hazard and property line clearing requirements.
  - **Policy OS-F.2**: The County shall require developers to use native and compatible non-native plant species, especially drought-resistant species, to the extent possible, in fulfilling landscaping requirements imposed as conditions of discretionary permit approval or for project mitigation.

E.3.4.5 Recreation

The Open Space and Conservation Element of the *Fresno County General Plan* (2000) contains the following goals and policies that pertain to recreation:

- **Goal OS-H**: To designate land for and promote the development and expansion of public and private recreational facilities to serve the needs of residents and visitors.
  - **Policy OS-H.1**: The County shall promote the continued and expanded use of national forest, national park, and other recreational areas to meet the recreational needs of County residents.
  - **Policy OS-H.5**: The County shall encourage Federal, State, and local agencies currently providing recreation facilities to maintain, at a minimum, and improve, if possible, their current levels of service.
  - **Policy OS-H.7**: The County shall encourage the development of public and private campgrounds and recreational vehicle parks where environmentally appropriate. The intensity of such development should not exceed the environmental carrying capacity of the site and its surroundings.
  - **Policy OS-H.8**: The County shall encourage development of private recreation facilities to reduce demands on public agencies.
  - **Policy OS-H.11**: The County shall support the policies of the San Joaquin River Parkway Master Plan to protect the San Joaquin River as an aquatic habitat, recreational amenity, aesthetic resource, and water source.

- **Policy OS-H.13**: The County shall require that structures and amenities associated with the San Joaquin River Parkway be designed and sited to ensure that such features do not obstruct flood flows, do not create a public safety hazard, or result in a substantial increase in off-site water surface elevations, and that they conform to the requirements of other agencies having jurisdiction. For permanent structures, such as bridge overcrossings, the minimum level of flood design protection shall be the greater of the Standard Project Flood (which is roughly equivalent to a 250-year event) or the riverine requirements of other agencies having jurisdiction to ensure flood flows are not dammed and to prevent flooding on surrounding properties.

- **Goal OS-I**: To develop a system of hiking, riding, and bicycling trails and paths suitable for active recreation and transportation and circulation.
  - **Policy OS-I.1**: The County shall develop a countywide Recreational Trail Master Plan, integrated with existing County facilities, similar facilities in cities and adjoining counties, and on State and Federal land. The recreational trail system shall be oriented to providing safe, off-street access from urban areas to regional recreation facilities of countywide importance.
  - **Policy OS-I.14**: The Fresno County General Services Department shall maintain trails located within County parks, along but separated from the roadway, along irrigation canals, flood control channels, abandoned railroad rights-of-way or easements, utility easements, and along floodplains.

E.3.4.6 Geology and Soils

The Agriculture and Land Use Element of the *Fresno County General Plan* (2000) contains the following goals and policies that pertain to geology and soils:

- **Goal LU-A:** To promote the long-term conservation of productive and potentially-productive agricultural lands and to accommodate agricultural-support services and agriculturally-related activities that support the viability of agriculture and further the County's economic development goals.
  - **Policy LU-A.18:** The County shall encourage land improvement programs to increase soil productivity in areas containing lesser quality agricultural soils.
  - **Policy LU-A.19:** The County shall encourage landowners to participate in programs that reduce soil erosion and increase soil productivity. To this end, the County shall promote coordination between the Natural Resources Conservation Service, Resource Conservation Districts, UC Cooperative Extension, and other agencies and organizations.

- **Goal LU-B:** To preserve the unique character of the Westside Rangelands, which includes distinctive geologic and topographic landforms, watersheds, important agricultural activities, and significant biological resources, while accommodating agriculture, grazing, recreation, resource recovery, and other limited uses that recognize the sensitive character of the area.
  - **Policy LU-B.12:** The County shall require a preliminary soils report for discretionary development projects when the project site is subject to moderate or high-risk landslide potential and has slopes in excess of 15 percent. If the preliminary soil report indicates soil conditions could be unstable, a detailed geologic report by a registered geologist and

registered civil engineer, or a registered engineering geologist, shall be required indicating the suitability of any proposed or additional development.

The Health and Safety Element of the *Fresno County General Plan* (2000) contains the following goals and policies that pertain to soil, geology, and seismic hazards:

- **Goal HS-D:** To minimize the loss of life, injury, and property damage due to seismic and geologic hazards.
  - **Policy HS-D.1:** The County shall continue to support scientific geologic investigations that refine, enlarge, and improve the body of knowledge on active fault zones, unstable areas, severe ground shaking, avalanche potential, and other hazardous geologic conditions in Fresno County.
  - **Policy HS-D.2:** The County shall ensure that the General Plan and/or County Ordinance Code is revised, as necessary, to incorporate geologic hazard areas formally designated by the State Geologist (e.g., Earthquake Fault Zones and Seismic Hazard Zones). Development in such areas, including public infrastructure projects, shall not be allowed until compliance with the investigation and mitigation requirements established by the State Geologist can be demonstrated.
  - **Policy HS-D.3:** The County shall require that a soils engineering and geologic-seismic analysis be prepared by a California-registered engineer or engineering geologist prior to permitting development, including public infrastructure projects, in areas prone to geologic or seismic hazards (i.e., fault rupture, ground shaking, lateral spreading, lurchcracking, fault creep, liquefaction, subsidence, settlement, landslides, mudslides, unstable slopes, or avalanche).
  - **Policy HS-D.4:** The County shall require all proposed structures, additions to structures, utilities, or public facilities situated within areas subject to geologic-seismic hazards as identified in the soils engineering and geologic-seismic analysis to be sited, designed, and constructed in accordance with applicable provisions of the Uniform Building Code (Title 24 of the California Code of Regulations) and other relevant professional standards to minimize or prevent damage or loss and to minimize the risk to public safety.
  - **Policy HS-D.8:** The County shall require a soils report by a California-registered engineer or engineering geologist for any proposed development, including public infrastructure projects, that requires a County permit and is located in an area containing soils with high "expansive" or "shrink-swell" properties. Development in such areas shall be prohibited unless suitable design and construction measures are incorporated to reduce the potential risks associated with these conditions.
  - **Policy HS-D.9:** The County shall seek to minimize soil erosion by maintaining compatible land uses, suitable building designs, and appropriate construction techniques. Contour grading, where feasible, and revegetation shall be required to mitigate the appearance of engineered slopes and to control erosion.

E.3.4.7 Utilities and Power

The Public Facilities and Services Element of the *Fresno County General Plan* (2000) contains the following goals and policies that pertain to utilities and power:

- **Goal PF-C:** To ensure the availability of an adequate and safe water supply for domestic and agricultural consumption.
  - **Policy PF-C.9:** The County shall work with local irrigation districts to preserve local water rights and supply.
  - **Policy PF-C.11:** The County shall assure an on-going water supply to help sustain agriculture and accommodate future growth by allocation of resources necessary to carry out the water resource management programs.
  - **Policy PF-C14:** The County shall require that water supplies serving new development meet US Environmental Protection Agency and California Department of Health Services and other water quality and quantity standards.
  - **Policy PF-C.29:** The County shall, in order to reduce excessive water usage, required tiered water pricing within County Service Areas and County Waterworks Districts.
- **Goal PF-D:** To ensure adequate wastewater collection and treatment and the safe disposal of wastewater.
  - **Policy PF-D.2:** The County shall require that any new community sewer and wastewater treatment facilities serving residential subdivisions be owned and maintained by a County Service Area or public entity approved by the County.
- **Goal PF-E:** To provide efficient, cost-effective, and environmentally sound storm drainage and flood control facilities that protect both life and property and to divert and retain runoff for groundwater replenishment.
  - **Policy PF-E.2**: The County shall encourage the agencies responsible for flood control of storm drainage to coordinate the multiple use of flood control and drainage facilities with other public agencies.
  - **Policy PF-E.12**: The County shall coordinate with the local agencies responsible for flood control or storm drainage to ensure that future drainage system discharges comply with applicable State and Federal pollutant discharge requirements.
  - **Policy PF-E.16:** The County shall minimize sedimentation and erosion through control of grading, cutting of trees, removal of vegetation, placement of roads and bridges, and use of off-road vehicles. The County shall discourage grading activities during the rainy season, unless adequately mitigated, to avoid sedimentation of creeks and damage to riparian habitat.
  - **Policy PF-E.21**: The County shall require the use of feasible and practical best management practices (BMPs) to protect streams from the adverse effects of construction activities, and shall encourage the urban storm drainage systems and agricultural activities to use BMPs.
- **Goal PF-F:** To ensure the safe and efficient disposal or recycling of solid waste generated in the county in an effort to protect the public health and safety.

  - **Policy PF-F.7**: The County has designated the American Avenue Landfill as the regional landfill to serve the incorporated and unincorporated areas of the county. The publicly-operated Coalinga and Clovis landfills may continue to operate provided the sites are operated economically and in compliance with all environmental laws and regulations. Existing publicly-operated landfills may be expanded.

- **Goal PF-G:** To protect life and property by deterring crime and ensuring the prompt and efficient provision of law enforcement service and facility needs to meet the growing demand for police services associated with an increasing population.
  - **Policy PF-G.1**: The County shall ensure the provision of effective law enforcement services to the unincorporated areas in the county.
  - **Policy PF-G.2:** The County shall strive to maintain a staffing ratio of two (2) sworn officers serving unincorporated residents per 1,000 residents served. (This count of officers includes all ranks of deputy sheriff personnel and excludes all support positions and all sworn officers serving county wide population interests such as bailiffs, and sworn officers serving contract cities and grant specific populations).
- **Goal PF-H:** To ensure the prompt and efficient provision of fire and emergency medical facility and service needs, to protect residents of and visitors to Fresno County from injury and loss of life, and to protect property from fire.
  - **Policy PF-H.1:** The County shall work cooperatively with local fire protection districts to ensure the provision of effective fire and emergency medical services to unincorporated areas within the county.
- **Goal PF-J:** To provide efficient and cost-effective utilities that serve the existing and future needs of people in the unincorporated areas of the county.
  - **Policy PF-J.1:** The County shall encourage the provision of adequate gas and electric, communications, and telecommunications service and facilities to serve existing and future needs.
  - **Policy PF-J.2**: The County shall work with local gas and electric utility companies to design and locate appropriate expansion of gas and electric systems, while minimizing impacts to agriculture and minimizing noise, electromagnetic, visual, and other impacts on existing and future residents.

E.3.5 Fresno County Code of Ordinances

The Fresno County Code (Section 8.40.040.A) sets exterior noise standards for the county. General limitations state that it is prohibited to create noise which causes the exterior noise level when measured at any affected single- or multiple-family residence, school, hospital, church, or public library to exceed the noise level standards as set forth in Table E-5.

Table E-5. Fresno County Exterior Noise Standards

Category	Cumulative number of minutes in any one-hour time period	Noise Level Standards, dBA	
		Daytime (7 a.m. to 10 p.m.)	Nighttime (10 p.m. to 7 a.m.)
1	30	50	45
2	15	55	50
3	5	60	55
4	1	65	60
5	0	70	65

Source: Fresno County 2022
Key: dBA = decibel A scale

The County's ordinance (Section 8.40.060.C) exempts activities with construction, provided such activities do not take place before 6 a.m. or after 9 p.m. on any day except Saturday or Sunday, or before 7 a.m. or after 5 p.m. on Saturday or Sunday are from the other noise provisions in Chapter 8.40 (Noise Control).

E.3.6 Merced County General Plan

As required by State law, counties have developed their own general plans. At a minimum, these documents must address the topics of land use, transportation, housing, conservation, open space, noise, and safety. These documents serve as statements of county goals, policies, standards, and implementation programs for the physical development of a county.

The following goals and policies from the *2030 Merced County General Plan* are relevant to the DMC Subsidence Correction Project resources. The *2030 Merced County General Plan*, adopted in 2013, has established the year 2030 as the plan's time horizon (Merced County 2013).

E.3.6.1 Water Quality

The Water Element contains the following goal and policies related to water quality (Merced County 2013):

- **Goal W-2**: Protect the quality of surface and groundwater resources to meet the needs of all users.
    - **Policy W-2.1**: Ensure that land uses and development on or near water resources will not impair the quality or productive capacity of these water resources.
    - **Policy W-2.2**: Prepare updated development regulations, such as best management practices, that prevent adverse effects on water resources from construction and development activities.
    - **Policy W-2.3**: Encourage the use of natural channels for drainage and flood control to benefit water quality and other natural resource values.
    - **Policy W-2.4**: Encourage agriculture and urban practices to comply with the requirements of the RWQCB for irrigated lands and confined animal facilities, which mandate agricultural practices that minimize erosion and the generation of contaminated runoff to ground or surface waters by providing assistance and incentives

- **Policy W-2.7**: Monitor and enforce provisions of the USEPA NPDES program to control non-point source water pollution.
- **Policy W-2.8**: Coordinate with the SWRCB, RWQCB, and other responsible agencies to ensure that sources of water contamination (including boron, salt, selenium and other trace element concentrations) do not enter agricultural or domestic water supplies and will be reduced where water quality is already affected.

E.3.6.2 Visual Resources

The Natural Resources Element and a Recreation and Cultural Resources Element provide goals and policies for visual resources in the county. The following policies are relevant to the protection of visual resources in the project area:

- **Goal NR-4:** Scenic Resources: Protect scenic resources and vistas.
  - **Policy NR-4.1**: Scenic Resource Preservation: Promote the preservation of agricultural land, ranch land, and other open space areas as a means of protecting the County's scenic resources.
  - **Policy NR-4.2:** Special Review Process for Structures Adjacent to Scenic Highways: Coordinate with Caltrans, during the review of proposed structures and activities located adjacent to State-designated scenic highways, to ensure that scenic vistas and local scenic values are not significantly degraded.
  - **Policy NR-4.4:** New Roads: Consider the surrounding landscape, topography, and existing scenic values when determining the location and construction of new roads.
  - **Policy NR-4.5:** Light Pollution Reduction: Require good lighting practices, such as the use of specific light fixtures that reduce the light pollution, minimize light impacts, and preserve views of the night sky.
- **Goal RCR-1:** Preserve, enhance, expand, and manage Merced County's diverse system of regional parks, trails, recreation areas, and natural resources for the enjoyment of present and future residents and park visitors.
  - **Policy RCR-1.11**: Scenic Resource and Public Land Protection: Encourage the use of regional parks and open space areas as a mechanism to preserve the County's natural scenic beauty and protect land for public purposes.

E.3.6.3 Noise and Vibration

The plan includes noise standards for new noise-sensitive land uses such as residences, hospitals, and churches that are affected by transportation noise sources, as shown in Table E-6 (Merced County 2013). Table E-7 summarizes the interior and exterior noise level standards for noise-sensitive areas affected by existing nontransportation noise sources.

Table E-6. Noise Standards for New Uses Affected by Traffic, Railroad and Airport Noise in Merced County

New Land Use	Sensitive Outdoor Area[1] – L_{dn} (dBA)	Sensitive Indoor Area[2] – L_{dn} (dBA)
All residential[3]	65	45
Transient Lodging[3,4]	65	45
Hospitals & Nursing Homes[3,4,5]	65	45
Theaters & Auditoriums[4]	---	35
Churches, Meeting Halls, Schools, Libraries, etc.[4]	65	40
Office Buildings[4]	65	45
Commercial Buildings[4]	---	50
Playgrounds, Parks, etc.	70	---
Industry[4]	65	50

Source: Merced County 2013

Notes:

[1] Sensitive Outdoor Areas include primary outdoor activity areas associated with any given land use at which noise-sensitivity exists and the location at which the County's exterior noise level standards are applied.

[2] Sensitive Interior Areas includes any interior area associated with any given land use at which noise-sensitivity exists and the location at which the County's interior noise level standards are applied. Examples of sensitive interior spaces include, but are not limited to, all habitable rooms of residential and transient lodging facilities, hospital rooms, classrooms, library interiors, offices, worship spaces, theaters. Interior noise level standards are applied within noise-sensitive areas of the various land uses with windows and doors in the closed positions.

[3] Railroad warning horn usage shall not be included in the computation of Ldn.

[4] Only the interior noise level standard shall apply if there are no sensitive exterior spaces proposed for these uses.

[5] Since hospitals are often noise-generating uses, the exterior noise level standards are applicable only to clearly identified areas designated for outdoor relaxation by either hospital staff or patients.

Table E-7. Nontransportation Noise Standards Median (L_{50}) / Maximum (L_{max})[1]

Receiving Land Use	Outdoor Daytime (dBA)	Outdoor Nighttime (dBA)	Interior Day or Night (dBA)
All residential	55 / 75	50 / 70	35 / 55
Transient Lodging[4]	55 / 75	---	35 / 55
Hospitals and Nursing Homes[5,6]	55 / 75	---	35 / 55
Theaters and Auditoriums[6]	---	---	30 / 50
Churches, Meeting Halls, Schools, Libraries, etc.[6]	55 / 75	---	35 / 60
Office Buildings[6]	60 / 75	---	45 / 65
Commercial Buildings[6]	55 / 75	---	45 / 65
Playgrounds, Parks, etc.[6]	65 / 75	---	---
Industry[6]	60 / 80	---	50 / 70

Source: Merced County 2013

Notes:

[1] These standards must be reduced by 5 dB for sounds consisting primarily of speech or music, and for recurring impulsive sounds. If the existing ambient noise level exceeds the standards in this table, then the noise level standards shall be increased at 5 dB increments to encompass the ambient.

[2] Sensitive Outdoor Areas include primary outdoor activity areas associated with any given land use at which noise-sensitivity exists and the location at which the County's exterior noise level standards are applied.

[3] Sensitive Interior Areas includes any interior area associated with any given land use at which noise-sensitivity exists and the location at which the County's interior noise level standards are applied. Examples of sensitive interior spaces include, but are not limited to, all habitable rooms of residential and transient lodging facilities, hospital rooms, classrooms, library interiors, offices, worship spaces, theaters. Interior noise level standards are applied within noise-sensitive areas of the various land uses with windows and doors in the closed positions.

[4] Outdoor activity areas of transient lodging facilities are not commonly used during nighttime hours.

[5] Since hospitals are often noise-generating uses, the exterior noise level standards are applicable only to clearly identified areas designated for outdoor relaxation by either hospital staff or patients.

[6] The outdoor activity areas of these uses (if any) are not typically used during nighttime hours.

These standards are enforced to protect noise-sensitive land uses in the county and do not pertain to short-term construction noise.

E.3.6.4 Recreation

The Recreation and Cultural Resources Element provides policy context to achieve the county's vision for recreation opportunities. The following goal and policies are relevant to the protection of recreation in the project area:

- **Goal RCR-1:** Preserve, enhance, expand, and manage Merced County's diverse system of regional parks, trails, recreation areas, and natural resources for the enjoyment of present and future residents and park visitors.
    - **Policy RCR-1.1:** Public Recreation Land Use – Encourage the continuation and expansion of existing public recreation land uses, including, but not limited to, public beaches, parks, recreation areas, wild areas, and trails.
    - **Policy RCR-**1.6: Require buffering between nonrecreational land uses and sensitive public recreation lands through site design and other techniques when the nonrecreational land use may significantly impact recreational lands.

- **Policy RCR-**1.7: Consider agriculture as a compatible land use and appropriate buffer for public and private recreation areas.
- **Policy RCR-**1.9: Require that areas proposed for the California Recreational Trails System be reviewed during project proposals for consideration of easements and integration into County recreation facilities.
- **Policy RCR-1.11:** Scenic Resource and Public Land Protection – Encourage the use of regional parks and open space areas as a mechanism to preserve the County's natural scenic beauty and protect land for public resources.
- **Policy RCR-1.12:** Recreation Services – Support recreation services to promote the full use of recreation facilities within their design capacity, and improve connections and access to a wide range of recreation opportunities in order to improve the quality of life for residents and visitors.

E.3.6.5 Geology and Soils

The Health and Safety Element outlines the following goals and policies related to seismic and geologic hazards (Merced County 2013):

- **Goal HS-1:** Minimize the loss of life, injury, and property damage of County residents due to seismic and geologic hazards.
  - **Policy HS-1.1:** Require that all new habitable structures be located and designed in compliance with the Alquist-Priolo Special Studies Zone Act and related State earthquake legislation.
  - **Policy HS-1.2:** Support efforts to obtain financial assistance from Federal and State agencies in order to implement corrective seismic safety measures required for existing County buildings and structures.
  - **Policy HS-1.3:** Require all new structures located within dam inundation areas to conform to standards of dam safety as required by the State Division of Safety of Dams.
  - **Policy HS-1.4:** Require earthquake resistant design for proposed critical structures such as hospitals, fire stations, emergency communication centers, private schools, high occupancy buildings, bridges and freeway overpasses, and dams that are subject to County permitting requirements.
  - **Policy HS-1.5:** Encourage educational programs to inform the public of earthquake dangers in Merced County.
  - **Policy HS-1.6:** Prohibit habitable structures on areas of unconsolidated landslide debris or in areas vulnerable to landslides.
  - **Policy HS-1.7:** Discourage construction and grading on slopes in excess of 30 percent.
  - **Policy HS-1.8**: Require that the provisions of the International Building Code be used to regulate projects subject to hazards from slope instability.
  - **Policy HS-1.9:** Require and enforce all standards contained in the International Building Code related to construction on unstable soils.

The Natural Resources Element addresses goals, objectives, and policies related to soil and mineral resources in the county (Merced County 2013). Applicable policies include:

- **Goal NR-3:** Facilitate orderly development and extraction of mineral resources while preserving open space, natural resources, and soil resources and avoiding or mitigating significant adverse impacts.
    - **Policy NR-3.1:** Protect soil resources from erosion, contamination, and other effects that substantially reduce their value or lead to the creation of hazards.
    - **Policy NR-3.2:** Require minimal disturbance of vegetation during construction to improve soil stability, reduce erosion, and improve stormwater quality.
    - **Policy NR-3.3:** Encourage landowners to participate in programs that reduce soil erosion and increase soil productivity. This shall include promoting and coordinating the efforts of University of California Cooperative Extension, various Resource Conservation Districts, and other similar agencies and organizations.

E.3.6.6 Biological Resources

The main goals and policies governing biological resources falls under the natural resources element at the regional or local level in Merced County and are outlined in the *2030 Merced County General Plan* (Merced County 2013). The most inclusive of these is Goal NR-1, which addresses preservation and protection through private and public sectors for the biological resources in the county.

- **Goal NR-1**: Preserve and protect, through coordination with the public and private sectors, the biological resources of the County.
    - **Policy NR-1.1**: Habitat Protection- Identify areas that have significant long-term habitat and wetland values including riparian corridors, wetlands, grasslands, rivers and waterways, oak woodlands, and vernal pools, and provide information to landowners.
    - **Policy NR-1.2**: Protected Natural Lands- Identify and support methods to increase the acreage of protected natural lands and special habitats, including but not limited to, wetlands, grasslands, and vernal pools, potentially through the use of conservation easements.
    - **Policy NR-1.4**: Important Vegetative Resource Protection- Minimize the removal of vegetative resources which stabilize slopes, reduce surface water runoff, erosion, and sedimentation.
    - **Policy NR-1.5:** Wetland and Riparian Habitat Buffer- Identify wetlands and riparian habitat areas and designate a buffer zone around each area sufficient to protect them from degradation, encroachment, or loss.
    - **Policy NR-1.11**: On-Going Habitat Protection and Monitoring- Cooperate with local, State, and Federal agencies to ensure that adequate on---going protection and monitoring occurs adjacent to rare and endangered species habitats or within identified significant wetlands.
    - **Policy NR-1.12:** Wetland Avoidance- Avoid or minimize loss of existing wetland resources by careful placement and construction of any necessary new public utilities and facilities, including roads, railroads, high speed rail, sewage disposal ponds, gas lines, electrical lines, and water/wastewater systems.
    - **Policy NR-1.13:** Wetland Setbacks- Require an appropriate setback, to be determined during the development review process, for developed and agricultural uses from the delineated edges of wetlands.

- **Policy NR-1.15:** Urban Forest Protection and Expansion- Protect existing trees and encourage the planting of new trees in existing communities. Adopt an Oak Woodland Ordinance that requires trees, larger than a specified diameter, that are removed to accommodate development be replaced at a set ratio.
- **Policy NR-1.17:** Agency Coordination- Coordinate with private, local, State, and Federal agencies to assist in the protection of biological resources and prevention of degradation, encroachment, or loss of resources managed by these agencies.

E.3.6.7 Utilities and Power

The Public Facilities and Services Element of the *2030 Merced County General Plan* (2013) provides the following goals and policies that are relevant to utilities and power:

- **Goal W-1:** Ensure the adequate wastewater collection, treatment, and disposal within the County.
  - **Policy PFS-2.1:** Water and Sewer Expansion – Encourage public sewer system operators to maintain and expand their systems to meet the development needs of the County.
- **Goal PFS-3:** Ensure the management of stormwater in a safe and environmentally sensitive manner through the provision of adequate storm drainage facilities that protect people, property, and the environment.
  - **Policy PFS-3.4**: Agency Coordination – Coordinate with the USACE and other appropriate agencies to develop stormwater detention/retention facilities and recharge facilities that enhance flood protection and improve groundwater recharge.
- **Goal PFS-4**: Ensure the safe and efficient disposal and recycling of solid and hazardous waste generated in the County.
  - **Policy PFS-4.7:** Solid Waste Reduction – Support and promote feasible waste reduction, recycling, and composting efforts.
- **Goal PFS-5:** Ensure the provision of adequate utilities to the residents of Merced County.
  - **Policy PFS-5.1:** Adequate Utility Facilities and Services - Encourage the provision of adequate gas and electric, communications, and telecommunications service and facilities to serve the needs of existing and future residents and businesses
- **Goal PFS-6:** Ensure the provision of timely and adequate law enforcement through proper management and staffing of the Sheriff Department in Merced County.
  - **Policy PFS-6.1:** Encourage optimum staffing levels for both sworn Sheriff Deputies and civilian support staff in order to provide quality law enforcement services in Merced County.
  - **Policy PFS-6.2:** Sheriff Department Response Time Standards – Strive to achieve and maintain appropriate Sheriff Department response times for all call priority levels to provide adequate law enforcement services for all County residents.
- **Goal PFS-7:** Provide adequate fire and emergency medical facilities and services to protect County residents from injury and loss of life, and to protect property from fire.

- **Policy PFS-7.1**: Fire Staffing and Response Time Standards - Strive to maintain fire department staffing levels and response times consistent with National Fire Protection Association standards.
- **Policy PFS-7.2:** Fire Protection Service Expansion - Strive to expand fire protection service in areas that are currently underserved or areas that experience growth in order to maintain adequate levels of service.
- **Policy PFS-7.3:** Water Service Standards - Require all development within unincorporated communities to be served by water supplies, storage, and conveyance facilities supplying adequate volume, pressure, and capacity for fire protection.

E.3.6.8 Cultural Resources

The main goals and policies governing cultural resources at the regional or local level in Merced County are outlined in the *2030 Merced County General Plan* (Merced County 2013). The most inclusive of these is Goal RCR-2, which calls for the protection and preservation of cultural, archaeological, and historic resources to maintain the unique character of Merced County.

E.3.6.9 Hazards/ Hazardous Materials

The Health and Safety Element of the *2030 Merced County General Plan* (2013) provides the following goals and policies that are relevant to hazards and hazardous materials:

- **Goal HS-3:** Minimize the exposure of County residents and public and private property to the effects of urban and wildland fires.
  - **Policy HS-3.1**: Require adequate water supplies be available for fire suppression prior to occupancy of any structure in urban areas where a public water system does not exist prior to occupancy of any structures located in the County.
  - **Policy HS-3.5**: Encourage and maintain vegetation "clear zones" around new and existing residential structures in areas designated as having a high or extreme fire hazard severity and assist property owners in identifying how the clear zones should be maintained.
  - **Policy HS-3.8**: Encourage cluster developments in areas identified as subject to high or extreme fire hazard in order to provide for more localized and effective fire protection measures, such as consolidations of fuel build-up abatement, firebreak maintenance, firefighting equipment access, and water service provision.
  - **Policy HS-3.10**: Require safe all-weather access for fire and other emergency equipment as part of the subdivisions and building permit application review process.
  - **Policy HS-3.11**: Encourage the construction of safe all-weather access for fire and emergency equipment to serve existing residential uses in areas designated as having a very high fire hazard severity.
- **Goal HS-5:** Protect Merced County residents, visitors, and property through providing for the safe use, storage, transport, and disposal of hazardous materials and wastes.
  - **Policy HS-5.1**: Require that hazardous materials are used, stored, transported, and disposed of in a safe manner, in compliance with local, State, and Federal safety standards.

- **Policy HS-5.4**: Require new development and redevelopment proposals that have suspected or historic contamination to address hazards concerns and protect soils, surface water, and groundwater from hazardous materials contamination by conducting Phase I Environmental Site Assessments according to the American Society for Testing and Materials standards and applicable DTSC remediation guidelines. Also, complete additional Phase II Environmental Site Assessments and soil investigations, and any identified or needed remediation when preliminary studies determine such studies are recommended.

E.3.7 Merced County Code of Ordinances

E.3.7.1 Noise

The Merced County Code (Section 10.60.030) sets sound level limitations for the county. General limitations state that no sound source should exceed the background sound level at the receiving property line by 10 dBA or more during the daytime hours (7 a.m. to 10 p.m.) and by 5 dBA or more during the nighttime hours (10 p.m. to 7 a.m.). The maximum permissible sound levels for residential property are 65 dBA L_{dn} or 75 dBA $L_{max.}$ The maximum permissible sound levels for property other than residential property are 70 dBA L_{dn} or 80 dBA L_{max} (Merced County 2009).

The County's ordinance exempts construction activities, "provided that all construction in or adjacent to urban areas shall be limited to the daytime hours between 7 a.m. and 6 p.m., and all construction equipment shall be properly muffled and maintained." Operation of construction equipment outside of these daytime hours or at any time on a weekend day or legal holiday is prohibited (Merced County 2022a).

E.3.7.2 Vibration

Section 18.41.090 of the Merced County Code states that no use shall create any disturbing ground vibration based on typical human reaction beyond the boundaries of the site (Merced County 2022a)

E.3.7.3 Geology, Seismicity, and Soils

The Merced County Code Title 16, Chapter 16.16 requires construction projects within the county's jurisdiction to follow the International Building Code standards and California State Amendments to the code (Ord. 1856 Section 2, 2009). Among other important specifications, the International Building Code includes requirements and standards for geotechnical investigations (Section 1803); excavation, grading, and fill (Section 1804); structural design (Chapter 16); and earthquake loads (Section 1613).

Chapter 18.43 establishes the county's surface mining and reclamation ordinance. Merced's ordinance was certified in 1997. The purpose of the county's ordinance is to regulate surface mining and reclamation operations consistent with the county general plan and the SMARA at the State level. The county's SMARA ordinance was certified by the SMGB in 1997.

Chapter 18.41 of the county code sets performance standards to ensure compatibility between land uses by limiting such things as fumes, odor, noise, and dust. Section 030 covers dust mitigation from construction activities including clearing, grading, earth moving and other site preparation activities. The ordinance requires the application of water to prevent dust from leaving the project site.

E.3.8 Merced County Office of Environmental Services

Emergency preparedness, coordination and direction of wide-scale disasters and emergencies are provided by the Merced County Office of Environmental Services (OES). The Merced County OES coordinates planning, response, recovery, and mitigation activities with many partners including incorporated and unincorporated cities, special districts, and some private agencies. The Merced County OES and their partner agencies coordinate and maintain Emergency Operations Plans according to the National Incident Management System for the County. Contained within the Merced County Emergency Operations Plan is guidance for handling and managing large-scale incidents and disasters including public health threats (Merced County 2022b).

E.3.9 San Joaquin County General Plan

As required by state law, San Joaquin County has developed its own general plan. The following goals and policies are relevant to the DMC Subsidence Correction Project resources. The *San Joaquin County General Plan*, adopted in 2016, has established the year 2035 as the plan's time horizon (San Joaquin County 2016).

E.3.9.1 Visual Resources

The Community Development Element of the *San Joaquin County General Plan* (2016) contains the following goals and policies that pertain to visual resources:

- **Goal LU-8:** Protect open space for its recreational, agricultural, safety, and environmental value and provide adequate parks and open space areas throughout the County.
    - **Policy LU-**8.3: Waterway Conservation and Restoration - The County shall encourage the conservation and restoration of rivers, creeks, and sloughs as multi-functional open space corridors that complement adjoining development and connect city and County recreation facilities (e.g., parks).

The Natural and Cultural Resources Element of the *San Joaquin County General Plan* (2016) contains the following goals and policies that pertain to visual resources:

- **Goal NCR-7:** To protect and enhance the unique scenic features of San Joaquin County.
    - **Policy NCR-7.1:** Scenic Roadways – The County shall protect the visual character of designated scenic roadways.
    - **Policy NCR-7.2:** Views from Public Lands and Roadways - The County shall ensure that views of waterways, hilltops, and oak groves from public land and public roadways are protected and public access is provided to them whenever possible.
    - **Policy NCR-7.3:** Designate Scenic Routes - The County shall preserve scenic views from roadways by designating scenic routes based on the following criteria: leads to a recreational area; provides a representative sampling of the scenic diversity within the County; exhibits unusual natural or man-made features of interest; provides opportunities to view activities outside the normal routine of most people; provides a route for people to view the Delta waterways; and links two scenic routes or connects with scenic routes of cities or other towns.
    - **Policy NCR-7.7:** Reducing Light Pollution - The County shall encourage project designs, lighting configurations, and operational practices that reduce light pollution and preserve views of the night sky.

E.3.9.2 Noise and Vibration

The Public Health and Safety Element of the *San Joaquin County General Plan* (2016) outlines noise level standards in the county. Table E-8 summarizes the noise level standards for noise-sensitive uses (such as residential development, lodging, hospitals, nursing homes, schools, and day care centers) at outdoor activity areas affected by non-transportation noise sources in the County.

Table E-8. Non-Transportation Noise Level Performance Standards for Noise-Sensitive Uses at Outdoor Activity Areas[1]

Noise Level Descriptor	Daytime (7 a.m. to 10 p.m.)	Nighttime (10 p.m. to 7 a.m.)
Hourly Leq dB	50	45
Maximum Level, dB	70	65

Source: San Joaquin County 2016

Notes: These standards apply to new or existing residential areas affected by new or existing non-transportation sources. Each of the noise level standards specified shall be reduced by 5 dB for impulsive noise, single tone noise, or noise consisting primarily of speech or music.

[1] Where the location of outdoor activity areas is unknown or not applicable, the noise standard shall be applied at the property line of the receiving land use. When determining the effectiveness of noise mitigation measures, the standards shall be applied on the receiving side of noise barriers or other property line noise mitigation measures.

Key: dB =decibel; Leq = sound level

E.3.9.3 Hazards/ Hazardous Materials

The Public Health and Safety Element of the *San Joaquin County General Plan* (2016) provides the following goals and policies that are relevant to hazards and hazardous materials:

- **Goal PHS-1:** To maintain a level of disaster preparedness necessary for the protection of public and private property, and the health, safety, and welfare of people living and working in San Joaquin County.
  - **Policy PHS-1.1**: The County shall maintain adequate facilities equipment and staffing to respond effectively to emergencies.
  - **Policy PHS-1.3**: The County shall maintain and implement the following emergency and hazard mitigation plans to provide emergency planning, mitigation, response, and recovery activities to the community:
    - Emergency Operations Plan
    - Mountain House Community Emergency Operations Plan
    - Multi-Hazard Functional Plan
    - Local Hazard Mitigation Plan, and
    - Flood Safety Plan and Contingency Mapping
- **Goal PHS-4**: To minimize the risk of wildland and urban fire hazards.
  - **Policy PHS-4.1**: The County shall maintain and implement the Community Wildfire Protection Plan as a mechanism for community input and identification of areas with high fire hazard risk.

- **Policy PHS-4.3**: The County shall implement State recommendations for fire prevention in Fire Hazard Severity Zones and require new and/or existing development to provide clearance around structures, use fire-resistant ground cover, build with fire-resistant roofing materials, participate in fuel load reduction, and take other appropriate measures.
- **Policy PHS 4.6**: The County shall encourage well-organized and efficient coordination among fire agencies, CalFire, and the County.

- **Goal PHS-7**: To protect County residents, visitors, and property from hazardous materials and wastes.
  - **Policy PHS-7.3**: The County shall require the use, storage, and disposal of hazardous materials and wastes to comply with local, State, and Federal Safety standards.
  - **Policy PHS-7.4**: The County shall maintain and implement the County Hazardous Waste Management Plan.
  - **Policy PHS-7.6**: The County shall require businesses that use or store materials and wastes on-site to prepare Hazardous Materials Management Plans (Business Plans) that map and inventory all hazardous materials and contain contingency plans for accidents, designate an individual or individuals as emergency coordinator(s), and ensure that all employees understand the potential for accidents and the appropriate response. Plans must follow the requirements for Federal, State, and/or local defined special flood hazard areas.
  - **Policy PHS-7.7**: The County shall maintain and implement the County Hazardous Materials Area Plan for emergency response to a release or threatened release of hazardous material within the unincorporated County.
  - **Policy PHS-7.13**: The County shall provide areas for hazardous waste disposal facilities sufficient to meet the needs of the county residents and businesses.

E.3.9.4 Biological Resources

The main goals and policies governing biological resources falls under the natural and cultural resources element at the regional or local level in San Joaquin County and are outlined in the 2016 *San Joaquin County General Plan* (San Joaquin County 2016). The most inclusive of these is Goal NCR-2, which addresses preservation and protection of wildlife habitat areas for the maintenance and enhancement of biological diversity and ecological integrity.

E.3.9.5 Geology and Soils

The Public Health and Safety Element of the *San Joaquin County General Plan* (2016) contains the following goals and policies that pertain to geology, seismicity, and soils:

- **Goal PHS-3:** To protect life and property from seismic and geologic hazards.
  - **Policy PHS-3.5:** Subsidence or Liquefaction - The County shall require that all proposed structures, utilities, or public facilities within County-recognized areas of near-surface subsidence or liquefaction be located and constructed in a manner that minimizes or eliminates potential damage.
  - **Policy PHS-3.6:** Subsidence in the Delta – The County shall promote regional and local efforts to reduce subsidence in the Delta.

- **Policy PHS-3.7:** Erosion Control: The County shall encourage the planting of vegetation to decrease loss of soil by erosion.
- **Policy PHS-3.8:** Soil Conservation and Restoration – the County shall support soil conservation and restoration efforts of the U.S. Soil Conservation Service and the Resource Conservation Districts.

E.3.9.6 Utilities and Power

The Public Facilities and Services Element of the *San Joaquin County General Plan* (2016) contains the following goals and policies that pertain to geology, seismicity, and soils:

- **Goal IS-1:** To provide residents and businesses quality, cost-effective, and sustainable public facilities and services.
  - **Policy IS-1.2:** Infrastructure Standards - The County shall require new developments that include improvements to existing infrastructure or new infrastructure to meet the requirements and standards of the County or other agencies providing services.
- **Goal IS-3:** To increase efficiency of County facilities, services, and operations to conserve resources and reduce greenhouse gas emissions.
  - **Policy IS-3.2:** Sustainable Plans and Operations - The County shall integrate sustainability concepts, greenhouse gas reduction strategies, and climate change resiliency planning into County facility and service plans and operations.
  - **Policy IS-3.5**: New Fleet and Equipment Purchases - The County shall purchase lower-emission and/or electric vehicles and energy efficient equipment when purchasing new fleet vehicles and maintenance/construction equipment.
  - **Policy IS-3.6:** Clean Energy and Fuel Sources - The County shall use available clean energy and fuel sources where feasible to operate its buildings, vehicles, and maintenance/construction equipment.
- **Goal IS-4:** To ensure reliable supplies of water for unincorporated areas to meet the needs of existing and future residents and businesses, while promoting water conservation and the use of sustainable water supply sources.
  - **Policy IS-4.1:** Water Agency Support - The County shall support efforts of local water agencies, special district, and water conservation districts to ensure that adequate high-quality water supplies are available to support existing and future residents and businesses.
  - **Policy IS-4.2:** Interagency Cooperation - The County shall work with local water agencies to address existing and future water needs for the County.
  - **Policy IS-4.11**: Integrated Regional Water Management - The County shall support and participate in the development, implementation, and update of an integrated regional water management plan.
  - **Policy IS-4.13:** Water Quality Standards - The County shall require that water supplies serving new development meet State water quality standards. If necessary, the County shall require that water be treated to meet State standards and that a water quality monitoring program be in place prior to issuance of building permits.

- **Goal IS-5:** To maintain an adequate level of service in the water systems serving unincorporated areas to meet the needs of existing and future residents and businesses, while improving water system efficiency.
    - **Policy IS-5.1:** Adequate Water Treatment and Distribution Facilities - The County shall ensure, through the development review process, that adequate water, treatment and distribution facilities are sufficient to serve new development and are scalable to meet capacity demands when needed. Such needs shall include capacities necessary to comply with water quality and public safety requirements.
- **Goal IS-6:** To ensure wastewater treatment facilities and septic systems are available and adequate to collect, treat, store, and safely dispose of wastewater.
    - **Policy IS-6.1:** Wastewater System Maintenance and Expansion - The County shall encourage public wastewater system operators to maintain and expand their systems to meet the development needs of the County.
    - **Policy IS-6.3:** Adequate Wastewater Facilities - The County shall ensure through the development review process that wastewater collection, treatment, and disposal facilities are sufficient to serve existing and new development and are scalable to meet capacity demands when needed.
    - **Policy IS-6.6:** Wastewater Treatment System Standards - The County shall require that the development, operation and maintenance of wastewater treatment systems meet the requirements and standards of the wastewater treatment agency and the County, including the requirements and standards of the County Environmental Health Department.
- **Goal IS-7:** To manage stormwater from existing and future development using methods that reduce potential flooding, maintain natural water quality, enhance percolation for groundwater recharge, and provide opportunities for reuse.
    - **Policy IS-7.1**: Adequate Stormwater Facilities - The County shall require that stormwater drainage facilities are properly designed, sited, constructed, and maintained to efficiently capture and dispose of runoff and minimize impacts to water quality.

The Public Health and Safety Element of the *San Joaquin County General Plan* (2016) contains the following goals and policies that pertain to utilities and power:

- **Goal PHS-4:** To minimize the risk of wildland and urban fire hazards.
    - **Policy PHS-4.6:** Fire Protection Coordination - The County shall encourage well-organized and efficient coordination among fire agencies, CalFire, and the County.

E.3.10 San Joaquin County Development Title

The San Joaquin County Development Title presents noise provisions that all land uses, and properties shall be subject to within the county. Section 9-1025.9, Part C states that noise sources associated with construction, provided such activities do not take place before 6 a.m. or after 9 p.m. on any day, are excluded from the other noise provisions laid out in the chapter.

E.3.11 San Joaquin Valley Air Pollution Control District Air Quality Management Plans

The SJVAPCD has jurisdiction over the San Joaquin Valley Air Basin, which includes O_3, PM_{10}, and $PM_{2.5}$ nonattainment areas.

The air districts have adopted a series of air quality management plans to meet the CAAQS and NAAQS. These plans require, among other emissions-reducing activities, control technology for existing sources; control programs for area sources and indirect sources; a permitting system designed to ensure no net increase in emissions from any new or modified permitted sources of emissions; transportation control measures; sufficient control strategies to achieve a five percent or more annual reduction in emissions (or 15 percent or more in a three-year period) for volatile organic compound (VOC), nitrogen oxides (NO_x), CO, and PM_{10}; and demonstration of compliance with CARB's established reporting periods for compliance with air quality goals.

E.3.12 San Joaquin Valley Air Pollution Control District Programs

The SJVAPCD is the local agency that is primarily responsible for regulating emissions from stationary sources. It also develops plans and implements control measures as required by State and federal requirements. To assist the Lead Agency with analyzing GHG emission and climate change impacts under CEQA, the SJVAPCD adopted two policies:

- "Addressing GHG Emission Impacts for Stationary Source Projects Under CEQA When Serving as the Lead Agency" (SJVAPCD 2009a)
- "Guidance for Valley Land-use Agencies in Addressing GHG Emission Impacts for New Projects under CEQA" (SJVAPCD 2009b)

The SJVAPCD has not adopted a quantitative threshold for evaluating the significance of GHG emissions; however, the SJVAPCD's guidance document for Valley land-use agencies (2009b) would be most relevant for assessing GHG-related impacts from the proposed restoration activities. In this guidance document, the SJVAPCD relies on the implementation of best performance standards (BPS), defined as the most effective achieved-in-practice means of reducing or limiting GHG emissions from a GHG emissions source, for evaluating a project's significance. Projects implementing BPS would be determined to have less than significant individual and cumulative impacts on global climate change.

If a project does not implement BPS, then quantification of project-specific GHG emissions would be required. If project-related emissions would be reduced or mitigated by at least 29 percent compared to business as usual,[25] then the project would be determined to have a less than significant individual and cumulative impact for GHG.

E.3.13 Stanislaus County General Plan

As required by state law, Stanislaus County has developed its own general plan. The following goals and policies from the *Stanislaus County General Plan* are relevant to the DMC Subsidence Correction

[25] Business as usual is referenced in the CARB's AB 32 Scoping Plan as the business-as-usual emissions occurring in 2020 if the average baseline emissions during the 2002-2004 period were grown to 2020 levels, without controls. Therefore, 2002–2004 emissions factors, on a unit of activity basis, multiplied by the activity expected to occur in 2020, is an appropriate representative of 2020 business as usual (BAU)." (SJVAPCD 2009b).

Project resources. The *Stanislaus County General Plan* was adopted in 2016 and has an estimated time horizon of 15 to 30 years (Stanislaus County 2016).

E.3.13.1 Visual Resources

The Conservation/Open Space Element of the *Stanislaus County General Plan* (2016) contains the following goals and policies that pertain to visual resources:

- **Goal 1:** Encourage the protection and preservation of natural and scenic areas throughout the County.
    - **Policy 2:** Assure compatibility between natural areas and development.

E.3.13.2 Geology and Soils

The Land Use Element of the *Stanislaus County General Plan* (2016) contains the following goals, policies, and implementation measures that pertain to soils, geology, and/or seismicity:

- **Policy 4:** Urban development shall be discouraged in areas with growth-limiting factors such as high water table or poor soil percolation, and prohibited in geological fault and hazard areas, flood plains, riparian areas, and airport and private airstrip hazard areas, unless measures to mitigate the problems are included as part of the application.
    - **Implementation Measure 2:** Applications for development in areas with growth-limiting factors such as high water table, poor soil percolation, geological fault areas, flood plains, and airport hazard areas shall include measures to mitigate the problems.

The Conservation/Open Space Element of the *Stanislaus County General Plan* (2016) contains the following policies and implementation measures that pertain to soils, geology, and/or seismicity:

- **Policy 6:** Preserve natural vegetation to protect waterways from bank erosion and siltation.
    - **Implementation Measure 2:** Continue to encourage best management practices for agriculture and coordinate with soil and water conservation efforts of Stanislaus County Farm Bureau, Resource Conservation Districts, the U.S. Soil Conservation Service, and local irrigation districts.
- **Policy 16:** Discourage development on lands that are subject to flooding, landslide, faulting, or any natural disaster to minimize loss of life and property.
    - **Implementation Measure 1:** Enforce the provisions of the Alquist-Priolo Earthquake Fault Zoning Act.
    - **Implementation Measure 3:** Development proposals in an area identified as having unstable soils (bluff, landslide areas in the foothills, etc.) shall include measures for mitigating possible hazards.
    - **Implementation Measure 4:** The County shall enforce the subdivision ordinance requirement for soils reports, which may be required to include a geologic report.
    - **Implementation Measure 5:** The County shall utilize the CEQA process to ensure that development does not occur that would be subject to natural disasters.
    - **Implementation Measure 6:** Development proposals shall be reviewed for conformance with all applicable Hazard Mitigation Plans and consistency with policies of the Safety Element.

The Safety Element of the *Stanislaus County General Plan* (2016) contains the following policies and implementation measures that pertain to soils, geology, and/or seismicity:

- **Policy 3:** Development should not be allowed in areas that are particularly susceptible to seismic hazard.
    - **Implementation Measure 1:** The County shall enforce the Alquist-Priolo Earthquake Fault Zoning Act.
    - **Implementation Measure 2:** Development in areas of geologic hazard shall be considered for approval only where the development includes an acceptable evacuation route.

The Agricultural Element of the *Stanislaus County General Plan* (2016) contains the following policies and implementation measures that pertain to soils, geology, and/or seismicity:

- **Policy 3.7:** The County shall encourage the conservation of soil resources.
    - **Implementation Measure 1:** The County shall continue to provide soil management information and coordinate with soil conservation efforts of local, state, and federal agencies.
    - **Implementation Measure 3:** The County shall continue to refer proposed developments whenever appropriate to Resource Conservation Districts and irrigation districts for their review and analysis of impacts on soil resources.

E.3.13.3 Utilities and Power

The Land Use Element of the *Stanislaus County General Plan* (2016) contains the following goals, policies, and implementation methods that pertain to utilities and power:

- **Goal 4:** Ensure that an effective level of public service is provided in unincorporated areas.
    - **Policy 24:** Future growth shall not exceed the capabilities/capacity of the provider of services such as sewer, water, public safety, solid waste management, road systems, schools, health care facilities, etc.
        - **Implementation Measure 9:** The County will coordinate development with existing irrigation, water, utility, and transportation systems by referring projects to appropriate agencies and organizations for review and comment.

The Conservation/Open Space Element of the *Stanislaus County General Plan* (2016) contains the following goals, policies, and implementation methods that pertain to utilities and power:

- **Goal 7:** Support efforts to minimize the disposal of solid waste through source reduction, reuse, recycle, composting, and transformation activities.
    - **Policy 22:** The County will support the solid waste management hierarchy established by the California Public Resources Code, Section 40051, and actively promote the goals and objectives specified in the Countywide Integrated Waste Management Plan.
    - **Policy 23:** The County will protect existing solid waste management facilities, including the waste-to-energy plant and the Fink Road landfill, against encroachment by land uses that would adversely affect their operation or their ability to expand.

E.3.14 Stanislaus County Code of Ordinances

E.3.14.1 Noise

The Stanislaus County Code[26] sets exterior noise level standards for the county. General limitations state that no sound source should exceed the noise level standards, as described in Table E-9, when measured at any property situated in either the incorporated or unincorporated area of the county. In the event that the measured ambient noise level exceeds the applicable noise level standard above, the ambient noise level shall become the applicable exterior noise level standard.

Table E-9. Exterior Noise Level Standards

Designated Noise Zone	Maximum A-Weighted Sound Level as Measured on a Sound Level Meter (LMAX)	
	Daytime (7 a.m. to 9:59 p.m.)	Nighttime (10 p.m. to 6:59 a.m.)
Noise Sensitive	45	45
Residential	50	45
Commercial	60	55
Industrial	75	75

Source: Stanislaus County 2022

Note: Noise level standards set forth in this table shall be reduced by 5 dBA for pure tone noises, noises consisting primarily of speech or music, or recurring impulsive noise. The noise zone definition of any parcel not located within the four designated noise zones shall be determined by the director of Stanislaus County planning and community development department, or designee, based on the permitted uses of the land use zoning district in which the parcel is located.
Key: Commercial = parcels located within a commercial or highway frontage land use zoning district; Industrial = all parcels located within an industrial land use zoning district; Noise Sensitive = any public or private school, hospital, church, convalescent home, cemetery, sensitive wildlife habitat, or public library regardless of its location within any land use zoning district; Residential = all parcels located within a residential land use zoning district.

Section 10.46.060 of the Stanislaus County Code, which details additional noise standards that apply to some sound sources, states that no person shall operate any construction equipment so as to cause an average sound level greater than 75 dB between the hours of 7 p.m. and 7 a.m. at or beyond the property line of any property upon which a dwelling unit is located.

Section 10.46.080J of the Stanislaus County Code states that the Noise Control provisions outlined in Chapter 10.46 shall not apply to construction or maintenance activities performed by or at the direction of any public entity or public utility.

E.3.14.2 Vibration

Section 10.46.070 of the Stanislaus County Code states that the operation or permit of operation of any device that creates vibration above the vibration perception threshold of any individual at or beyond the property boundary of the source if on private property, or at 150 feet from the source if on a public space is prohibited. "Vibration perception threshold" refers to the minimum ground-borne or structure-borne vibration motion necessary to cause a reasonable person to be aware of the vibration by such direct means as sensation by touch, visual observation of moving objects, a measured motion velocity of 0.01 inches per second over the range of 1 to 100 Hz, or by another means.

[26] Section 10.46.050.

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Delta-Mendota Canal Subsidence Correction Project Environmental Assessment/Initial Study

Appendix F: Existing Conditions Supporting Information

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Appendix F Existing Conditions Supporting Information

This appendix presents the existing conditions for the following resources in the study area: visual quality, hazardous materials, recreation, geology, seismicity, and soils, and utilities and power.

F.1 Visual Quality

The activities described by the Proposed Action would primarily take place within the Delta-Mendota Canal (DMC) right-of-way (ROW), but it is important to consider how those activities would impact the visual character of the landscape surrounding the ROW. The landscape is mostly composed of rural agricultural lands, grassy rolling hills, fields, and roads; occasional structures (industrial, commercial, or residential) are also present along its length, or visible in the distance. Figure F-1 presents a view of the canal and its context in the surroundings.



Source: Numan Mizyed. Taken October 2020

Figure F-1. Bridge at Mile Post 26.21

The DMC's location in the midst of agricultural land makes it prone to low viewership; most of the DMC's viewers are travelers on nearby roads, typically moving at relatively high velocities and therefore not receptive to small visual details. Roads that approach close to the DMC are typically low-trafficked, traveled by people who live or work on the land nearby and not frequented by people driving to or from recreational activities. Interstate 580 (I-580) and Interstate 5 (I-5) are the exceptions to this, as these routes are heavily trafficked.

F.1.1 California State Scenic Highways

There are four segments of designated State Scenic Highways (SSHs) that may be in viewing range of the DMC, and therefore may be impacted by the construction that would occur as a result of the Proposed Action. Because the four segments of SSHs are connected sequentially, they will be referred to collectively as one SSH. The SSH (sections of I-580 and I-5) is located in Alameda, San Joaquin, Stanislaus, and Merced Counties and run parallel to the DMC for approximately 58.8 miles (Caltrans 2018).

To evaluate the relevance of the SSH in the visual resources impact evaluation, a desktop survey was conducted using Microsoft Bing maps to determine the distance of the SSH from the DMC, and whether the DMC is an integral part of the conserved viewshed associated with the SSH. At two-mile intervals along the SSHs, beginning just south of the intersection of I-580 and Interstate 205 (I-205) where the designated SSH originates, the distance from the SSH to the DMC (determined by drawing a perpendicular line from the SSH until it intersected the DMC) was recorded and a qualitative visual analysis was performed using the "streetside view" feature of Google maps. The survey found that the DMC and its associated infrastructure is not clearly visible from any of the 31 sites evaluated along the SSH, and the average distance from the SSH to the DMC is 3,895 feet (0.74 mile). The closest distance between the SSH and the DMC is 593 feet (0.11 mile) at mile 42 of the SSH, and the furthest distance between them is 10,296 feet (1.95 miles) at mile 14 of the SSH.

Although not captured in the desktop survey that recorded visual data every two miles on the SSH, there were two locations found along the length of the SSH at which the DMC is clearly visible. These two locations are the points where the DMC crosses under the SSH. At these locations, the DMC and associated infrastructure is clearly visible before it quickly veers away from the SSH to be hidden from view. Combined, these two locations at which the DMC span approximately 0.24-mile total, which is approximately 0.01 percent of the SSH length.

F.2 Hazards and Hazardous Materials

F.2.1 Hazardous Materials and Waste

A search for hazardous waste, water dischargers, toxin releases, Superfund sites, Brownfields, and Toxic Substances Control Act site was conducted via the U.S. Environmental Protection Agency's (USEPA's) National Environmental Policy Act (NEPA) Assist tool. Within the study area (0.5-mile radius from Project activities), there are at least 50 hazardous waste sites and 10 water discharger sites (USEPA 2022a). Hazardous waste sites are sites that are required, under the RCRA, to provide information about their activities and contain generators, transporters, treaters, storers, or disposers of hazardous waste. Because the area surrounding the DMC is composed primarily of agricultural land, many hazardous waste sites in the vicinity of the study area are associated with agricultural production activities and may include contaminants such as fertilizers, pesticides, or herbicides. Other hazardous waste areas are related to gasoline/petroleum due to the study area's location parallel to I-5, a major highway. Water dischargers are sites such as municipal and industrial wastewater treatment facilities whose discharge of pollutants is tracked by the USEPA through a permitting program. No toxin release, Superfund, Brownfields, or Toxic Substances Control Act sites are present in the study area (USEPA 2022a).

Underground storage tanks (USTs) can pose a risk of hazardous material leakage. Even a small amount of petroleum or hazardous substance leaking from a UST can contaminate surface water, soil, or groundwater. USEPA has developed a UST Finder that contains a national map of

underground storage tanks and leaking underground storage tanks. According to this tool, there are seven USTs within the study area (USEPA 2022b). Table F-1 describes these UST facilities and their statuses. There are no currently active leaking underground storage tank cleanup sites within the study area (California State Water Resources Control Board 2022).

Table F-1. Underground Storage Tanks Within the Study Area

Facility Name	Facility ID	Distance from DMC ROW (miles)	Facility Status	Land Use	County/City
Patterson Mobil	CA10731430	0.15	Open UST	Developed, Open Space	Stanislaus/Patterson
Patterson Valero	CA10788715	0.14	Open UST	Developed, Medium Intensity	Stanislaus/Patterson
Rania Oil Company	CA10178527	0.14	Open UST	Developed, Medium Intensity	Stanislaus/Patterson
Chevron Patterson	CA10178541	0.2	Open UST	Non-Developed	Stanislaus/Patterson
Pilot 1080 – Patterson	CA10712407	0.4	Open UST	Developed, Open Space	Stanislaus/Patterson
Chevron #2	CA10497520	0.37	Open UST	Non-Developed	Merced/Gustine
Gustine Shell	CA10497526	0.38	Open UST	Non-Developed	Merced/Gustine

Source: USEPA 2022b
Key: UST = Underground Storage Tank

F.2.2 Wildfire

The study area is located within the San Joaquin Valley, which is at low to moderate risk for wildfire and is mostly not located in a state responsibility area fire hazard severity zone (California Department of Forestry and Fire Protection 2020). The highest potential for wildfire is in the foothills and mountainous areas west of the study area (the Coast Range), which have steep terrain and conditions conducive to volatile wildfires. The topography of the study area is relatively flat, reducing the risk of fast-spreading wildfire. The study area is located almost entirely within non-wildland/non-urban areas, though the potential for a wildfire to occur is present due to its proximity to wildland areas with moderate to high risk of fire.

F.2.3 Airports Tracy Municipal Airport

The Tracy Municipal Airport is owned by the City of Tracy and operated as a Division of the Parks and Recreation Department. The facility is a General Aviation Airport which serves private, business, and corporate tenants and customers within the Central Valley and I-5 corridor (City of Tracy 2022). From February 2019 to February 2020, the facility fielded operations of an average of 161 aircrafts per day. Approximately two-thirds of these operations were transient general aviation, one-third were local general aviation, and less than one percent were air taxi operations (AirNav 2022).

F.3 Recreation

Recreational facilities are located within Stanislaus County, Merced County, and Fresno County. Figure F-2 shows the immediate and surrounding recreation facilities along the DMC. The only recreational facility within the DMC ROW that has the potential to be impacted by Project activities is the Mendota Pool Park, located at the terminus of the DMC in Fresno County. Mendota Pool Park includes 20.3 acres of trail and a main picnic area spanning approximately 0.5 miles. The primary activities available at the park include trail walking, picnicking, and fishing (Mapcarta n.d.). In addition to the Mendota Pool Park, there are several reservoirs offering recreational activities that may be impacted by changes to operations under the Proposed Action. These reservoirs are described below:

Folsom Lake

Folsom Lake State Recreation Area is located in the Sierra-Nevada foothills about 25 miles east of Sacramento. The lake and recreation areas offer opportunities for hiking, biking, camping, horseback riding, and water-based recreation: swimming, water-skiing, boating, and fishing. The lake has a surface area of 11,500 acres and 75 miles of shoreline (California Department of Parks and Recreation [CDPR] 2022a).

Lake Oroville

Lake Oroville is located five miles northeast of the City of Oroville within the Lake Oroville State Recreation area in the western foothills of the Sierra Nevada. The lake and recreation area offers opportunities for camping, hiking, horseback riding, and water-based recreation: swimming, water-skiing, boating, and fishing. At its maximum elevation, the lake includes approximately 15,500 surface acres for recreation and 167 miles of shoreline (CDPR 2022b).

Shasta Lake

The Shasta Unit is one of three units that comprise Whiskeytown – Shasta-Trinity National Recreation Area. Shasta Lake, located 10 miles north of Redding, forms the core of the Shasta Unit and offers recreationists opportunities for hiking, camping, mountain biking, and water-based recreation: water-skiing, boating, swimming, and fishing. Shasta lake has a surface area of 30,000 acres with 370 miles of shoreline (United States Department of Agriculture, United States Forest Service 2022).

San Luis Reservoir

San Luis Reservoir State Recreation Area is located five miles west of Interstate-5 in the hills of the western San Joaquin Valley near Pacheco Pass. San Luis Reservoir offers opportunities for camping, picnicking, hiking, boating, and fishing. San Luis Reservoir has a surface area of 12,700 acres with 65 miles of shoreline (CDPR 2022c).

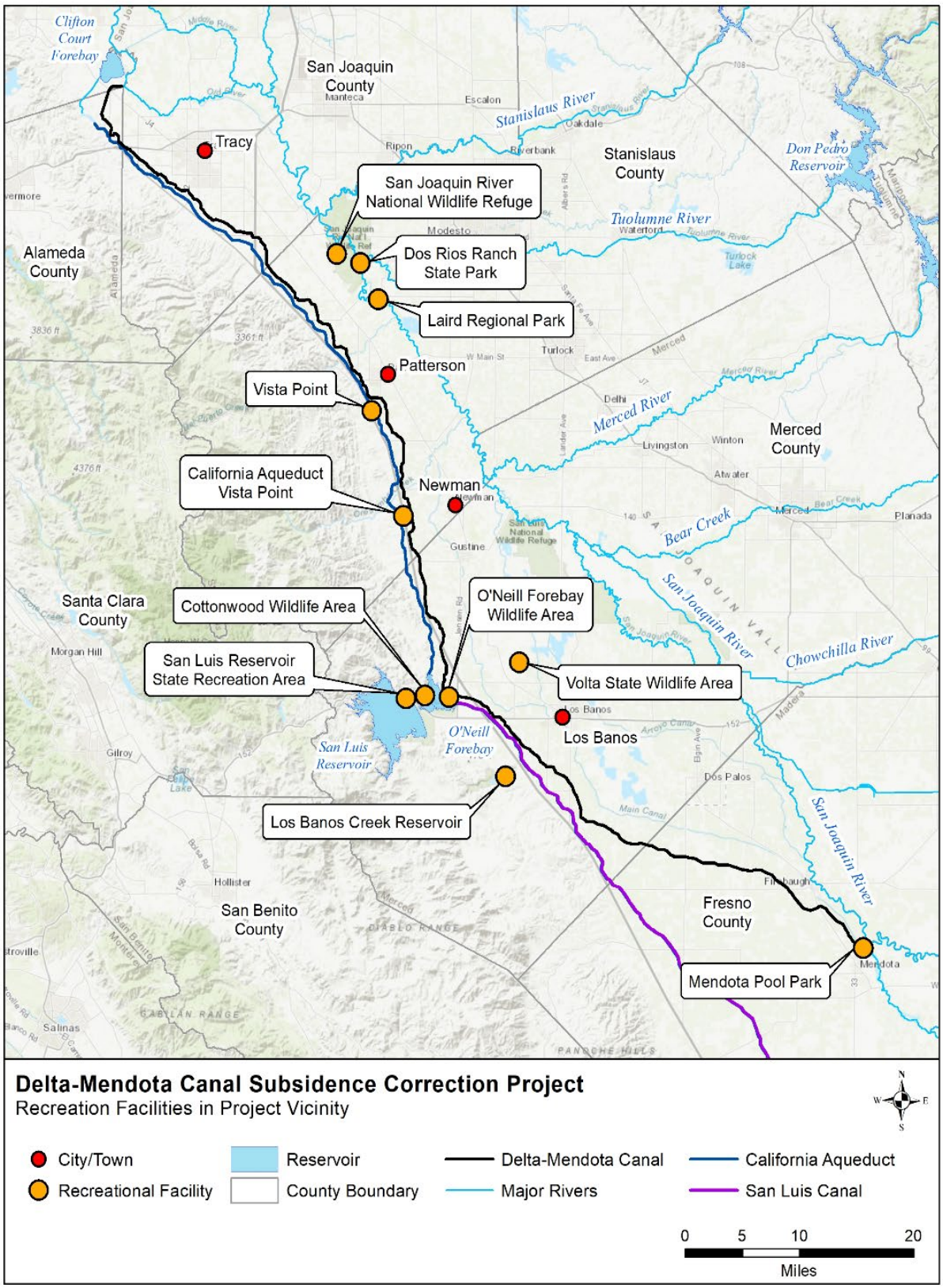


Figure F-2. Recreation Facilities Near the Delta-Mendota Canal

F.4 Geology, Seismicity, and Soils

F.4.1 Geology

The DMC is located in the Great Valley geomorphic province and is bordered on the east by the Sierra Nevada geomorphic province and on the west by the Coast Ranges geomorphic province. The Great Valley is an alluvial plain of two major rivers – the San Joaquin and Sacramento Rivers – and their tributaries, about 50 miles wide and 400 miles long in the central part of California. The northernmost part of the Great Valley is termed the Sacramento Valley and its southernmost part is the San Joaquin Valley. The Great Valley is a trough in which sediments have been deposited almost continuously since the Jurassic era (about 160 million years ago). Oil fields have been found in the southern part of the San Joaquin Valley and along anticlinal uplifts on its southwestern margin (California Geological Survey [CGS] 2002).

The geology of the Great Valley is mostly composed of marine and continental sedimentary rocks that date back to the Pleistocene-Holocene era. The geology of the Project area, which lies within the Great Valley, is characterized by formations of alluvium, lake, playa, and terrace deposits that are unconsolidated and semi-consolidated, in addition to Pliocene and/or Pleistocene sandstone, shale and gravel deposits that are loosely deposited (CGS 2015a).

F.4.1.1 Paleontological Resources

As defined in the Paleontological Resources Preservation Act of 2009, the term "paleontological resource" refers to any fossilized remains, traces, or imprints of organisms, preserved in or on the earth's crust, that are of paleontological interest and that provide information about the history of life on earth. In general, fossils are greater than 5,000 years old (middle Holocene) and are typically preserved in sedimentary rock, although preservation in low-grade metamorphic rocks and volcanic rocks can occur under certain conditions. Paleontological sensitivity is defined as the potential for a geologic unit to produce scientifically significant fossils. This is determined using a qualitative measurement of fossil data, including rock type, history of the geologic unit in producing significant fossils, and fossil localities that are recorded from that geologic unit. In areas of high sensitivity, full-time monitoring by a professionally trained paleontologist is recommended during any type of ground disturbance (Society of Vertebrate Paleontology [SVP] 2010).

A record search of the University of California Museum of Paleontology (UCMP) databases found that there have been many invertebrate fossils found in Alameda, San Joaquin, Stanislaus, Merced, and Fresno counties at varying distances from the DMC (UCMP 2022). Because there have been fossils discovered in the vicinity of the canal and the canal is located in an area characterized by formations of alluvium deposited during the Pleistocene-Holocene era, the Project area is considered to be in a moderately high paleontologically sensitive area based on sensitivity evaluation techniques described by the SVP (SVP 2010).

F.4.2 Soil

The Project area is located within the San Joaquin Valley, which has a history of significant regional land subsidence; between 1926 and 1970, land subsidence exceeding 27 feet (8.5 meters) was recorded in the most affected regions of the valley (Poland et al. 1975). Between 2003-2010, the northern portion of the DMC remained relatively stable whereas the southern portion was impacted by a large subsidence feature south of the town of El Nido. The most affected area extends from around Merced to Mendota, and the maximum subsidence was at least half a meter between the years of 2008-2010 (United States Geological Survey [USGS] 2013). According to the Bureau of

Reclamation's *Delta-Mendota Canal Subsidence Project – Feasibility Study of Structural Alternatives*, completed in 2021, regional groundwater use is anticipated to allow for an additional two feet of inelastic subsidence in the Central Valley until full implementation of the Sustainable Groundwater Management Act (SGMA), with residual elastic subsidence forecast to continue through the design life of the canal. Thus, the conveyance capacity of the DMC is expected to continue decreasing as a result of regional land subsidence until at least 2040.

F.4.2.1 Expansive Soils

Expansive properties, or linear extensibility, refer to a soil's potential to experience considerable changes in volume, either shrinking or swelling, with changes in moisture content (Mokhtari and Dehghani 2012). Therefore, the expansive nature of soils is characterized by their shrink-swell capacity. Changes in soil volume/linear extensibility are often expressed as a percentage, and in soil surveys the percentage represents the overall change for the whole soil.

Soils composed primarily of sand and gravel are not considered expansive (i.e., the soil volume does not change with a change in moisture content). Soils containing clay may possess expansive characteristics. The magnitude of shrink-swell capacity in expansive soils is influenced by the amount of expansive silt or clay in the soil, thickness of the expansive soil zone, climate, and thickness of the active zone (depth at which the soils are not affected by dry or wet conditions). When expansive soils swell, the change in volume can have significant impacts of the loads that are placed on them, such as buildings, and can result in structural distress or damage (Mokhtari and Dehghani 2012).

Soils are classified as having low, moderate, high, and very high potential for volume changes. The linear extensibility is expressed by percentages; the range of valid values is from zero to 30 percent (U.S. Department of Agriculture [USDA] Natural Resources Conservation Service [NRCS] 2022). Table F-2 summarizes shrink-swell classes and the associated linear extensibility percentage. If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures (USDA NRCS 2022).

Table F-2. Shrink-Swell Classes

Shrink-Swell Class	Linear Extensibility
Low	<3%
Moderate	3-6%
High	6-9%
Very High	>9%

Source: USDA NRCS 2022

Soils in the Project area are mostly in the moderate to very high shrink-swell classes due to the high amount of clay that is present; see Section F.4.2.3 for more details. These classifications are strongly correlated with the land subsidence occurrences that characterize the San Joaquin Valley; the expansive properties of the soils in this Project area are highly susceptible to volume changes and therefore conducive to subsidence.

F.4.2.2 Soil Stability

Soil stability refers to the capacity of land to limit the redistribution and loss of soil resources by wind and water. Land that experiences little soil movement is characterized as being stable; land that experiences some soil movement is characterized as moderately stable; and land that undergoes large amounts of soil movement is characterized as unstable (Deng and Du 2011).

Wind Erodibility Index

The wind erodibility index, as reported by USDA NRCS, is a numerical value indicating the susceptibility of soil to wind erosion, measured in the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion. Soils are typically vulnerable to wind erosion when: the soil is dry, loose, and finely granulated; the soil surface is smooth with little or no vegetation present; fields are sufficiently large, and therefore susceptible to erosion; and there is sufficient wind velocity to move soil. Soils that are fall into these categories and are most vulnerable to windblown erosion are coarser textured soils like sandy loams, loamy sands, and sands. Usually soils that have high wind erodibility have lower linear extensibility, and vice versa (USDA NRCS 2022). Table F-3 summarizes the wind erodibility class and associated tons per acre per year that are lost to wind erosion.

Table F-3. Wind Erodibility Classes

Wind Erodibility Class	Wind Erosion (tons per acre per year)
Low	0 - 56
Moderate	57 - 180
High	181 – 310
Very High	>310

Source: USDA NRCS 2022

F.4.2.3 Soils Within the Project Area

Upper Reach of the Delta-Mendota Canal: Alameda, Contra Costa, San Joaquin, Stanislaus, and Merced Counties

The upper reach of the DMC (the portion north of San Luis Reservoir) passes through the southeastern corner of Contra Costa County, the northeastern corner of Alameda County, San Joaquin County, Stanislaus County, and Merced County. These areas are characterized by mostly loamy clay, gravelly clay loam, and clay soils, which fall into the moderate to very high shrink-swell classes but have relatively low wind erodibility. These soils are not flooded frequently and are moderately well drained. Table F-4 describes the main soil types that characterize the upper reach of the DMC.

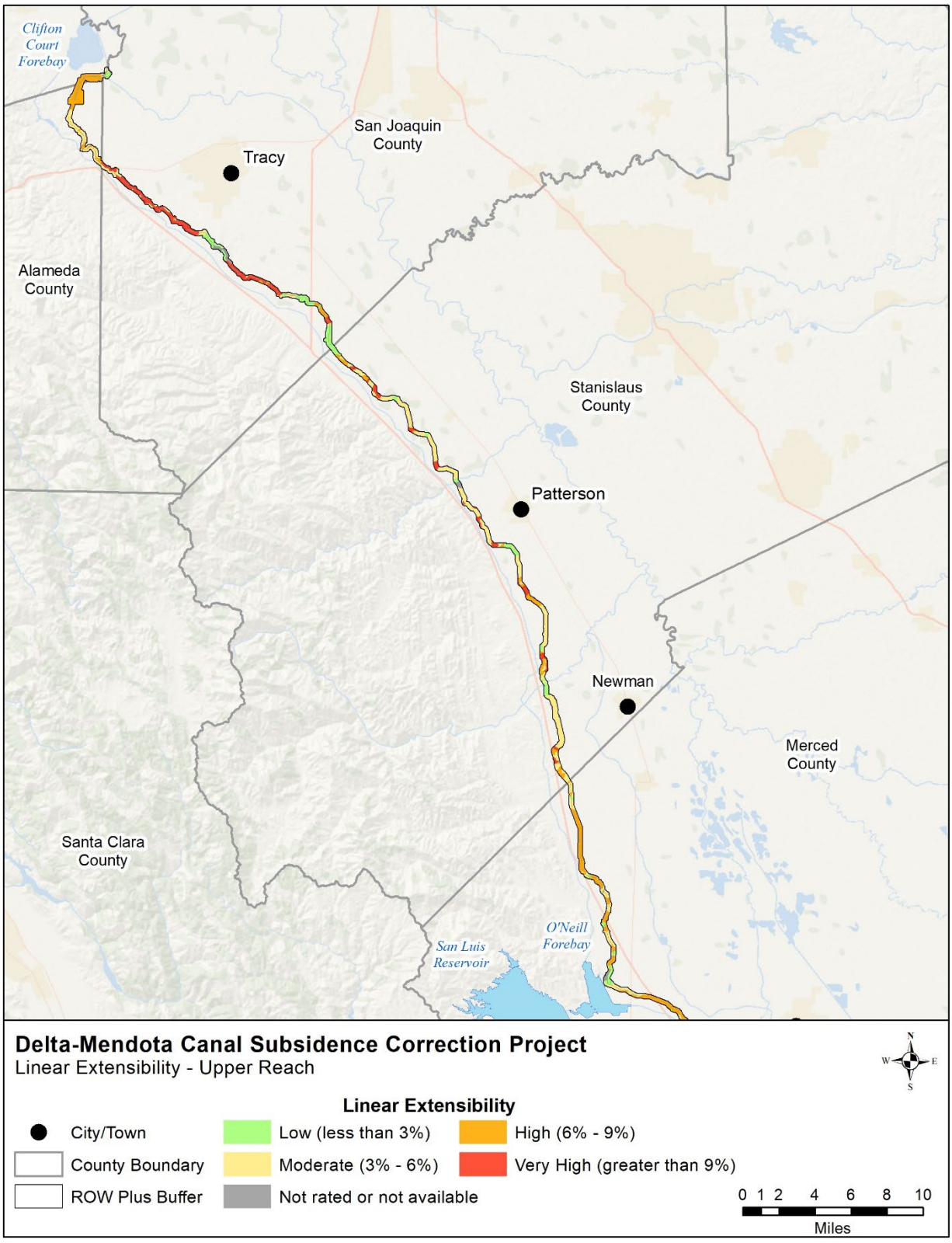
Table F-4. Predominant Soil Types of the Upper Delta-Mendota Canal Area

Map Unit Symbol	Description	Linear Extensibility (%)/Shrink-Swell Class	Wind Erodibility (tons per acre per year)
118	Capay clay	10.4 (Very High)	86 (Moderate)
282	Zacharias gravelly clay loam	4.5 (Moderate)	38 (Low)
120	Vernalis-Zacharias complex	4.5 (Moderate)	48 (Low)
253	Stanislaus clay loam	7.5 (High)	86 (Moderate)
277	Woo clay loam	4.5 (Moderate)	48 (Low)
301	Damluis clay loam	7.5 (High)	86 (Moderate)
130	Stomar clay loam	7.5 (High)	48 (Low)
125	Vernalis clay loam	4.5 (Moderate)	48 (Low)
156	El Solyo clay loam	5.0 (Moderate)	48 (Low)
161	Damluis clay loam	7.5 (High)	86 (Moderate)

Source: USDA NRCS 2022

Note: Organized in the order of greatest percentage within the Project area. Only the 10 most prevalent soil types are listed here, although many more exist in small amounts in this area.

Figure F-3 depicts the linear extensibility properties of soils in the upper DMC area.



Source: USDA NRCS 2022

Figure F-3. Upper Reach of the Delta-Mendota Canal: Soil Linear Extensibility

Lower Reach of the Delta-Mendota Canal: Merced and Fresno Counties

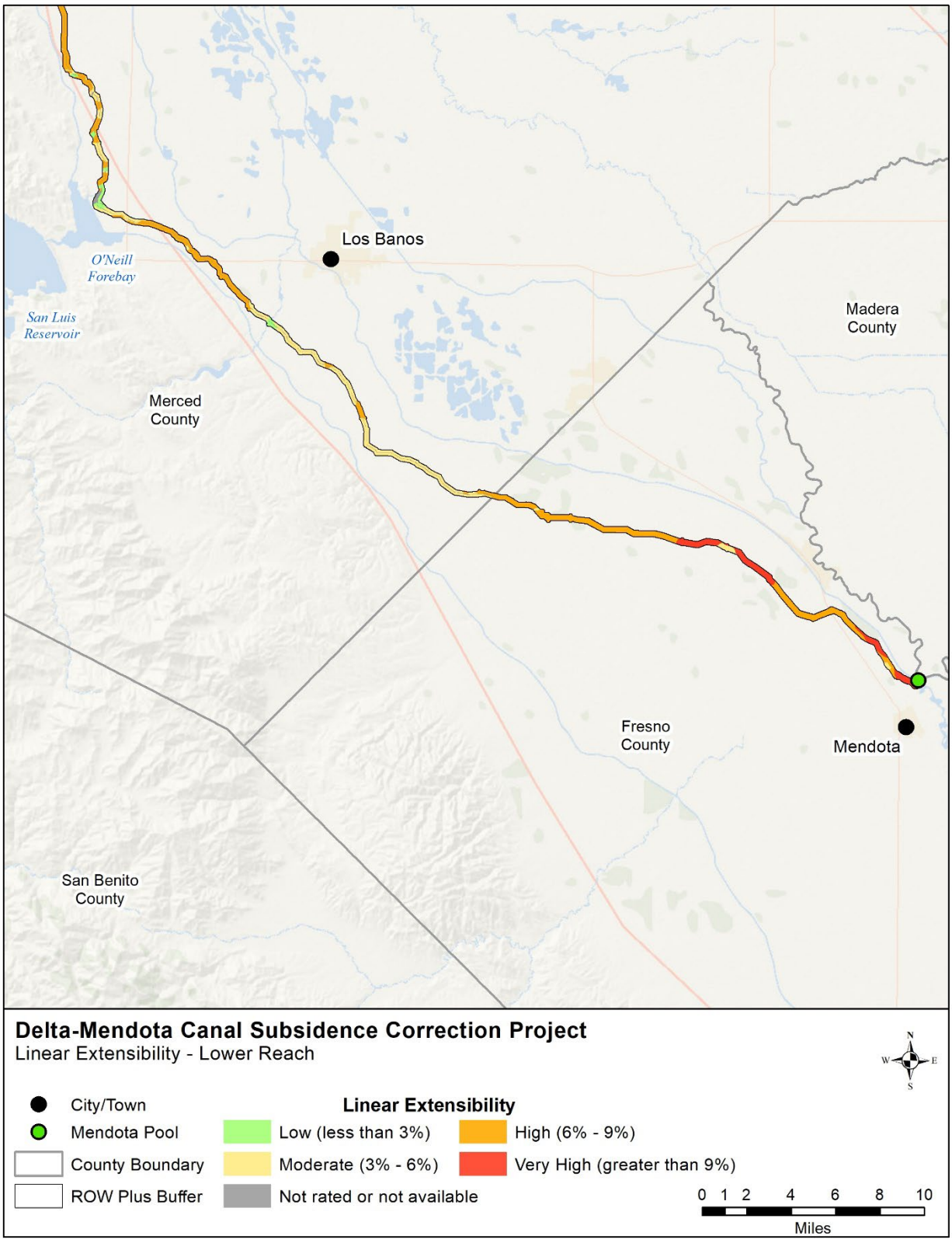
The lower reach of the DMC (the portion south of San Luis Reservoir) passes through central Merced County and the northwestern portion of Fresno County. Soils in this area are mostly saline-sodic soils (soils with excessive levels of soluble salt in the soil water), clay, and clay loam soils. These soils are characterized as being highly expansive, as the majority of the soils are in the high or very high shrink-swell classes with low to moderate wind erodibility indices. Table F-5 describes the predominant soil types that characterize the lower reach of the DMC. Figure F-4 depicts the linear extensibility properties of soils in the lower DMC area.

Table F-5. Predominant Soil Types of the Lower Delta-Mendota Canal Area

Map Unit Symbol	Description	Linear Extensibility (%)/Shrink-Swell Class	Wind Erodibility (tons per acre per year)
285	Tranquility-Tranquility, wet, complex, saline-sodic	11.0 (Very High)	86 (Moderate)
470	Chateau clay, partially drained	8.0 (High)	86 (Moderate)
167	Deldota clay, partially drained	7.5 (High)	86 (Moderate)
472	Wekoda clay, partially drained	12.0 (Very High)	86 (Moderate)
280	Woo clay	7.5 (High)	86 (Moderate)
277	Woo clay loam	4.5 (Moderate)	48 (Low)
468	Deldota clay, partially drained	8.0 (High)	86 (Moderate)
282	Tachi clay	15.1 (Very High)	86 (Moderate)
253	Stanislaus clay loam	7.5 (High)	86 (Moderate)
148	Carranza-Woo	4.5 (Moderate)	38 (Low)

Source: USDA NRCS 2022

Note: Organized in the order of greatest percentage within the Project area. Only the ten most prevalent soil types are listed here, although many more exist in small amounts in this area.



Source: USDA NRCS 2022

Figure F-4. Lower Reach of the Delta-Mendota Canal: Soil Linear Extensibility

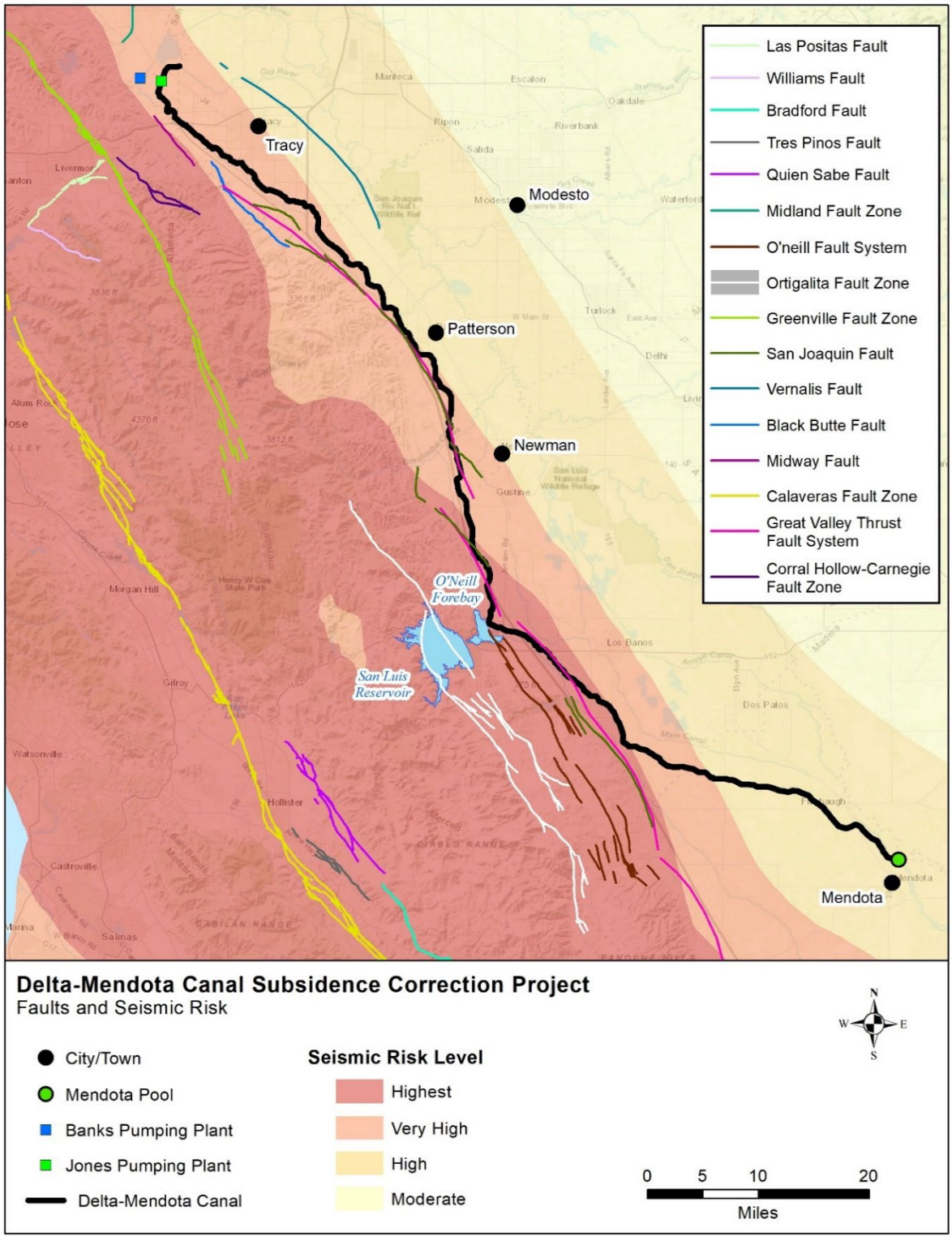
F.4.3 Seismicity

Seismic hazards are earthquake fault ground rupture and ground shaking (primary hazards) and liquefaction and earthquake-induced slope failure (secondary hazards).

F.4.3.1 Faults

The DMC, especially the upper reach, is located in one of the most seismically active regions of the United States. Major earthquakes have occurred in this vicinity of the Project area in the past and can be expected to occur again in the future. Although the faults closest to the Project area are not of the highest probability to experience a major earthquake, the region is susceptible to less severe impacts caused by more severe earthquakes likely to occur northwest of the Project area (USGS 2003).

The Alquist-Priolo Earthquake Fault Zoning Act (Alquist-Priolo Act) was signed into California law in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. As defined under the Alquist-Priolo Act, an active fault is one that has had surface displacement within the Holocene time (about the last 11,000 years). An early Quaternary fault is one that has had surface displacement during the Quaternary time (the last 1.6 million years) (Hart and Bryant 2007). While none of the designated Alquist-Priolo Faults intersect the DMC, there are three that are within a 20-mile radius of it (Hart and Bryant 2007). Relevant faults, both designated by the Alquist-Priolo Act and not designated, are mapped in Figure F-5.



Source: USGS 2022a, Hart and Bryant 2007

Note: Fault zones that have been designated by the Alquist-Priolo Act are the Calaveras Fault Zone, Greenville Fault Zone, and Ortiga Fault Zone. All faults listed in the table are classified as Class A, meaning that there is geologic evidence that demonstrates the existence of each fault.

Figure F-5. Fault Lines in the Project Area

F.4.3.2 Seismic Hazards

The California Seismic Hazards Program delineates areas prone to ground failure and other earthquake-related hazards including soil liquefaction, earthquake-induced landslides, surface fault ruptures, and tsunami inundation. Earthquake fault zones identify areas in which buildings for human occupancy are not permitted to be constructed; liquefaction zones identify where the stability of foundation soils must be investigated, and require countermeasures to be undertaken in the design and construction of buildings for human occupancy; and landslide zones identify where the stability of hillslopes must be evaluated, and require countermeasures to be undertaken in the design and construction of buildings for human occupancy (California Department of Conservation [DOC] 2019).

Liquefaction

Liquefaction is a phenomenon in which the strength and stiffness of unconsolidated sediments are reduced by earthquake shaking or other rapid loading. Soils that are considered the most susceptible to liquefaction are poorly consolidated, water-saturated fine sands and silts having low plasticity and groundwater sources located within 50 feet of the ground surface. Along the upper reach of the DMC (within Contra Costa, Alameda, San Joaquin, and Stanislaus counties), nearby groundwater levels are mostly between 100 to 200 feet below the land's surface; however, in the lower reach of the DMC (within Merced and Fresno counties), nearby groundwater levels range from zero to 100 feet below the land's surface (California's Groundwater Live 2022). Although some groundwater sources surrounding the lower DMC are located within 50 feet of the ground's surface, the analysis of soil types in the Project area, as discussed in Section F.4.2.3, demonstrated that fine sands and silts are not present in significant amounts and, therefore, liquefaction susceptibility is expected to be low.

Landslides

A landslide is the movement of a mass of rock, debris, or earth down a slope. The term encompasses five modes of slope movement: falls, topples, slides, spreads, and flows. Most landslides occur as a result of multiple causes; causes include factors that increase the effects of down-slope forces and factors that contribute to low or reduced strength. Examples of these kinds of factors include rainfall, snowmelt, changes in water level, stream erosion, changes in groundwater, earthquakes, volcanic activity, disturbance by human activities, or any combination of these factors (USGS 2022b). Because the presence of a slope is necessary for a landslide to occur, the Project area is at low risk of experiencing the impacts of a landslide due to its location away from dramatic slopes. Additionally, the DOC has not identified any landslides that have occurred within 10 miles of the Project area (CGS 2015b).

F.5 Public Utilities

There are multiple facilities along the DMC that either use power to pump water, generate power by releasing water, or perform a combination of the two. These facilities include the C.W. "Bill" Jones Pumping Plant, O'Neill Pumping-Generating Plant, San Luis/W.R. Gianelli Pumping-Generating Plant, and the DMC / California Aqueduct Intertie Pumping Plant. Most residents of the areas immediately surrounding the DMC rely on water diverted from the DMC or water from private groundwater wells as their primary water supply.

There are 20 landfills located within a 40-mile radius of the DMC. Table F-6 presents the names, available capacity and/or dumping requirements, and distance from the DMC of the relevant landfills near the Project area.

Table F-6. Landfills in the Vicinity of the Project Area

County	Landfill Name	Available Capacity and/or Dumping Restrictions	Anticipated Ceased Operation Date	Distance to Nearest Point of DMC (miles)
Contra Costa	Brentwood Transfer Station	800 CY* per day	Not Available	20
Alameda	Altamont Landfill and Resource Recovery	65,400,000 CY available as of June 30, 2016. Limited to dumping 22,300 CY* per day	December 1, 2070	4
Alameda	Vasco Road Sanitary Landfill	7,379,000 CY as of October 31, 2016. Limited to dumping 5,036 CY* per day	December 31, 2022	8
Alameda	Pleasanton Garbage Service	1,440 CY* per day	Not Available	16
San Joaquin	Tracy Material Recovery & Transfer Station	Max Permit Capacity: 40,000 CY	Not Available	<1
San Joaquin	Lovelace Transfer Station	3,918 CY* per day	Not Available	17
Stanislaus	Fink Road Landfill	7,184,701 CY as of March 1, 2017. Limited to dumping 4,800 CY* per day	December 1, 2023	1
Stanislaus	Bertolotti Transfer and Recycling Center	2,500 CY* per day	Not Available	13
Merced	Billy Wright Landfill	11,370,000 CY as of September 30, 2010. Limited to dumping 3,000 CY* per day	December 31, 2054	2
San Benito	John Smith Road Landfill	1,921,000 CY as of April 30, 2021	August 1, 2025	29
Madera	Mammoth Recycling Facility and Transfer Station	1,000 CY* per day	Not Available	22

County	Landfill Name	Available Capacity and/or Dumping Restrictions	Anticipated Ceased Operation Date	Distance to Nearest Point of DMC (miles)
Fresno	Road Maintenance Area One, Firebaugh	3,900 CY per year	Not Available	<1
Fresno	Mid Valley Disposal	9,200 CY* per year	Not Available	18
Fresno	Road Maintenance Area Four, Biola	3,900 CY per year	Not Available	19
Fresno	Allan Company	2,500 CY* per day	Not Available	33
Fresno	Mid Valley Recycling (Elm Avenue)	4,000 CY* per day	Not Available	34
Fresno	Cedar Avenue Recycling and Transfer Center	6,200 CY* per day	Not Available	34
Fresno	Rice Road Recyclery and Transfer Station	1,200 CY* per day	Not Available	34
Fresno	Kroeker Inc. Recycling Facility	15,000 CY* per day	Not Available	36
Fresno	Green Valley Recycling	2,500 CY* per day	Not Available	36

Source: California Department of Resources Recycling and Recovery (CalRecycle) 2019

Note: Asterisk indicates that CY was calculated based on the number of tons permitted. The conversion factor between tons and CY was based on the Federal Emergency Management Act (FEMA) Debris Estimating Field Guide (Federal Emergency Management Act [FEMA] 2010), where 1 ton of construction and demolition debris is equal to 2 CY.

Key: CY = cubic yard, inc. = incorporated

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Delta-Mendota Canal Subsidence Correction Project Environmental Assessment/Initial Study

Appendix G: Water Supply Technical Appendix

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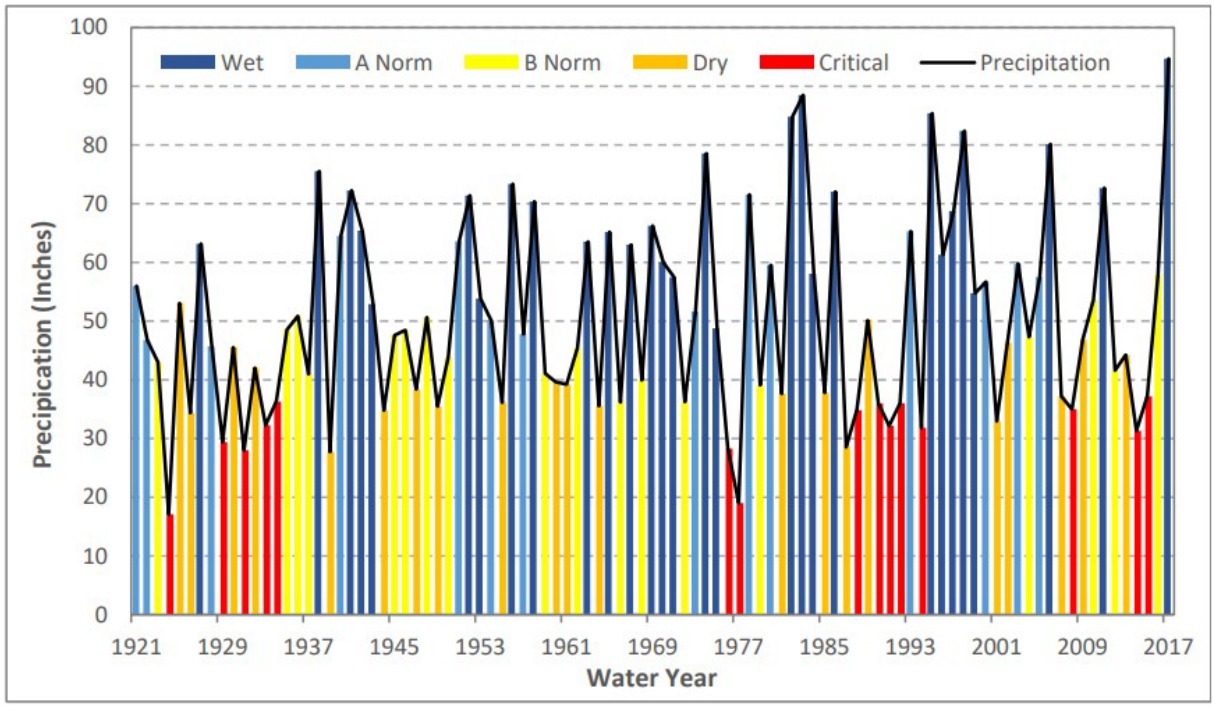
Appendix G Water Supply Technical Appendix

This appendix documents the water supply technical analysis to support the impact analysis in the Environmental Assessment/Initial Study (EA/IS) and describes the water supply resources that could be potentially affected by the implementation of the No Action/No Project Alternative (subsequently identified as the No Action Alternative) or the Proposed Action/Proposed Project (subsequently identified as the Proposed Action) considered by the EA/IS. Effects on water supply resulting from the construction and operation associated with the Proposed Action may occur in the federal and state water contractors' service areas.

G.1 Existing Conditions

G.1.1 Water in California

The total volume of water California receives from precipitation can vary dramatically between dry and wet years. The state may receive less than 100 million acre-feet (MAF) of water during a dry year and more than 300 MAF in a wet year (Department of Interior, Bureau of Reclamation [Reclamation] 2019). The majority of California's precipitation occurs between November and April, while most of the state's demand for water is in the summer months (Reclamation 2019). In addition, most precipitation falls in the northern portion of the state and much of the demand comes from central and southern portions of the state where major agricultural and population centers are located. Over time, annual precipitation trends have been changing and continue to change, as shown in Figure G-1.



Source: Reclamation 2019

Figure G-1. Sacramento River Hydrologic Region Precipitation Trends

The federal and state governments constructed the Central Valley Project (CVP) and State Water Project (SWP) in pursuit of maximizing use of the state's water supplies and providing flood control. The CVP has over 270 water contracts for delivery of CVP water (Reclamation 2019). The SWP currently has contracts to deliver supplies to 29 water suppliers across the state. Because C.W. "Bill" Jones Pumping Plant (Jones Pumping Plant) is operated as an integral component of the CVP, changes in pumping at Jones Pumping Plant due to restoration of Delta-Mendota Canal (DMC) capacity would affect operations of a majority of CVP and SWP facilities. Therefore, although the Project area is confined to the DMC right-of-way, the study area for this water supply analysis is broader. The study area captures the CVP and SWP contractors that may be impacted by changes to the operation of the DMC and evaluates the water supply impacts that the construction and operation of the DMC Subsidence Correction Project (Project) would have on deliveries to the entirety of the study area.

G.1.2 Central Valley Project and State Water Project Facilities and Operations

G.1.2.1 Trinity River Division

The CVP Trinity River Division includes facilities to store and regulate water in the Trinity River, as well as facilities to divert water to the Sacramento-San Joaquin River Delta. The Trinity River Division includes the Trinity River and Dam, Lewiston Dam, Whiskeytown Reservoir and Dam, Clear Creek, and Spring Creek and Debris Dam. All releases from Trinity Dam are re-regulated downstream at Lewiston Lake to meet downstream flow requirements, and supply exports through Clear Creek tunnel and the Carr power plant to Whiskeytown Lake. Spring Creek tunnel and power plant convey water from Whiskeytown Lake to Keswick Lake, located on the Sacramento River below Shasta Dam (Reclamation 2019).

Trinity Dam forms Trinity Lake, which has a maximum storage capacity of approximately 2.4 MAF. Based on the Trinity River Mainstem Fishery Restoration Record of Decision, 369 thousand acre-feet (TAF) to 815 TAF is allocated annually for Trinity River flows. There is some flood storage space reserved in the winter months, and the minimum storage in Trinity Reservoir generally is maintained above 1,000 TAF for recreation and water temperature considerations. The reservoir normally is filled to the highest storage level in April through June and then is drawn down slightly by the end of September (Reclamation 2019).

G.1.2.2 Shasta Division

The Shasta Division includes Shasta Dam, Lake, and Power Plant; Keswick Dam, Reservoir, and Power Plant; and the Shasta Temperature Control Device. Shasta Lake, a CVP facility on the Sacramento River formed by Shasta Dam, has a maximum storage capacity of 4.5 MAF. Water in Shasta Lake is released through or around the Shasta Power Plant to the Sacramento River, where it is re-regulated downstream by Keswick Dam. Maximum Shasta Reservoir storage occurs in April through June. A large portion of the maximum storage is reserved for flood control space between November and March. Storage usually increases from January through April and decreases from June through October (Reclamation 2019).

G.1.2.3 Lake Oroville

Lake Oroville is a major SWP storage reservoir, with a maximum capacity of about 3.5 MAF. The reservoir stores winter and spring runoff, which is released into the Feather River to meet the SWP's needs, Sacramento-San Joaquin River Delta (Delta) requirements, and fish and wildlife protection. The Oroville Complex also provides power generation (including pumpback operations) flood

control storage, and recreation opportunities. California Department of Water Resources (DWR) maintains a minimum flow of 600 cubic feet per second (cfs) within the Feather River Low Flow Channel, as required by the 1983 California Department of Fish and Wildlife Agreement (Reclamation 2019).

G.1.2.4 Folsom Lake

Folsom Dam impounds a maximum of about 967 TAF and is a multipurpose reservoir that provides flood control and seasonal water storage for recreation, power, water supply, and minimum fish protection flows in the American River and to the Delta. About 400 TAF of storage is reserved for flood control space between December and March. Maximum Folsom Lake storage usually occurs in May through June (Reclamation 2019).

G.1.2.5 San Luis Reservoir

San Luis Reservoir is an off-stream storage reservoir in Merced County. Reclamation owns and jointly operates San Luis Reservoir with DWR to provide seasonal storage for the CVP and the SWP. San Luis Reservoir is capable of receiving water from both the DMC and the California Aqueduct, which enables the CVP and SWP to pump water into the reservoir during the wet season (October through March) and release water into the conveyance facilities during the dry season (April through September) when demands are higher. Deliveries from San Luis Reservoir also flow west through Pacheco Pumping Plant and Conduit to the San Felipe Division of the CVP (Reclamation 2019).

G.1.2.6 Other CVP Facilities

Reclamation operates the CVP, which uses the Jones Pumping Plant to pump water into the DMC. The DMC is a 116-mile-long canal that delivers water to contractors in the Central Valley and to and from San Luis Reservoir for storage. Water conveyed through the DMC to San Luis Reservoir is pumped from the canal to the O'Neill Forebay where it connects with the California Aqueduct and the San Luis Canal. The DMC continues east from the O'Neill Forebay to the Mendota Pool (Reclamation 2019). The Jones Pumping Plant, the DMC, and certain other CVP facilities are operated and maintained by the San Luis & Delta-Mendota Water Authority (SLDMWA) under a Transfer Agreement with Reclamation (Reclamation 2019).

The Jones Pumping Plant, about five miles north of Tracy, consists of six pumps with a maximum rated capacity of about 5,100 cfs. The Jones Pumping Plant is located at the end of an earth-lined intake channel about 2.5 miles long. At the head of the intake channel, "louver" screens that are part of the Tracy Fish Collection Facility intercept fish, which are then collected and transported by tanker truck to release sites away from the pumps. The water is pumped about 200 feet into the DMC, which has a maximum design capacity of about 4,600 cfs (Reclamation 2019).

G.1.2.7 Other SWP Facilities

DWR operates the SWP, which diverts water from the Delta through the Harvey O. Banks Pumping Plant (Banks Pumping Plant) into Bethany Reservoir. The California Aqueduct is 444 miles long and delivers water from Bethany Reservoir south to the Central Valley and Southern California. The California Aqueduct flows south 60 miles to O'Neill Forebay at San Luis Reservoir (DWR 2020). At O'Neill Forebay, the California Aqueduct becomes the San Luis Canal, which is managed jointly by Reclamation and DWR and serves both the CVP and SWP. The San Luis Canal is federally built and extends 103 miles from O'Neill Forebay southeast to just past Kettleman City (Reclamation 2019).

At this location the canal becomes the California Aqueduct again, an SWP facility that delivers water over the Tehachapi Mountains to southern California (Reclamation 2019).

The DMC/California Aqueduct Intertie (Intertie Pumping Plant) is a shared federal-state water system improvement, connecting the DMC and the California Aqueduct via two 108-inch-diameter pipes and pumping capacity of 467 cfs (900 cfs gravity flow from California Aqueduct to DMC). The Intertie Pumping Plant provides redundancy in the water distribution systems, allows for maintenance and repair activities that are less disruptive to water deliveries, and provides the flexibility to respond to CVP and SWP emergencies (Reclamation 2021).

G.1.3 CVP Contractors

The CVP has several different types of contracts, including Repayment Contracts, Exchange Contracts, Refuge Contracts, Settlement Contracts, Friant Division Contracts, and Water Service Contracts for delivery of CVP water (Reclamation 2021). These water contracts are subject to reductions, depending on the amount of water available each year. Water forecasting starts in the fall of the previous year when storage and hydrologic conditions are assessed. Annual water allocation for the CVP is generally announced early in the calendar year for the following growing season and updated monthly.

CVP water allocations for agricultural, municipal and industrial (M&I), and Refuge Contractors vary based on factors such as hydrology, runoff forecast, prior water right commitments, reservoir storage, required water quality releases, required environmental releases, and operational limitations. Each year Reclamation determines the amount of water that can be allocated to each CVP contractor based on contract types and entitlements and conditions for that year. In most cases, these allocations are expressed as a percentage of CVP contractors' contract total (for contracts that allow use of both agricultural and M&I water) or historical use (for M&I only contracts).

North of the Delta, there are 42 Water Service or Repayment Contractors across three CVP divisions that deliver water to agricultural contractors, M&I contractors, or both agricultural and M&I contractors. In the Delta and south of the Delta, there are 31 Water Service or Repayment Contractors across three CVP Divisions and one unit that deliver water to agricultural contractors, M&I contractors, or both agricultural and M&I contractors. South-of-Delta CVP Water Service and Repayment Contractors are located south of the Delta and consist of the Delta Division, San Felipe Division, and San Luis Unit. Other CVP contractors located south of the Delta include south-of-Delta Settlement Contractors, San Joaquin River Exchange Contractors, and Friant Division[1] / Cross Valley Canal contractors.

G.1.3.1 San Joaquin River Exchange Contract

The San Joaquin River Exchange Contractors (Exchange Contractors) hold some of the oldest water rights in the state, dating back to the late 1800s, for diversion of water from the San Joaquin and Kings rivers (Reclamation 2021). The operation of the CVP's Friant Division depended upon water being diverted from the San Joaquin River and conveyed to the east side of the valley via the Friant-Kern Canal and Madera Canal. To accomplish this, Reclamation and the Exchange Contractors entered into an agreement whereby the Exchange Contractors agreed to not exercise their rights to

[1] CVP Friant Division contractors receive deliveries from Friant Dam through the San Joaquin River, Madera Canal and the Friant Kern Canal. As such, they are separate from the CVP south of Delta Contractors that receive CVP deliveries from the Sacramento River and its tributaries or the Delta.

divert water from the San Joaquin River in exchange for Reclamation providing substitute water, generally coming from the Sacramento River and delivered via the DMC. During all calendar years, except critical, Reclamation is responsible for delivering an annual substitute water supply of up to 840,000 acre-feet. In critical years, the annual substitute water supply is reduced to 650,000 acre-feet (Reclamation 2021).

G.1.3.2 Friant Division Contractors

Friant Division contractors, located on the east side of the San Joaquin Valley, receive water stored behind Friant Dam and delivered through the Friant-Kern and Madera Canals. In years in which Reclamation is otherwise unable to make contracted deliveries to Exchange Contractors, Reclamation can make a call on water stored in Millerton Reservoir, thereby requiring releases from Friant Dam (U.S. Congressional Research Service [CRS] 2022).

G.1.3.3 South of Delta Settlement Contracts

After Reclamation started operating Friant Dam, contractors near Mendota Pool began experiencing difficulties in diversion since the San Joaquin River water was no longer reaching the Mendota Pool in quantities necessary to meet their irrigation demands. South of Delta Settlement Contractors receive a quantity of CVP water through the DMC (or Millerton if DMC supplies are not sufficient) at no charge in replacement of their water rights water, which is diverted and sold to the Friant Division contractors (Reclamation 2021).

G.1.3.4 Water Service and Repayment Contracts

Water Service contracts are used in instances, such as the CVP, where the project includes multiple individual multipurpose facilities benefiting different project functions and construction and a final cost allocation have not been completed. For such projects, costs are allocated to, and recovered from, appropriate beneficiaries based on the annual number of acre-feet of water diverted (Reclamation 2021). Repayment contracts are used when specific cost obligations can be readily assigned to beneficiaries, such as when a specific facility is constructed for the sole benefit of a single contractor. Repayment contracts generally provide for 40 fixed annual payments to repay a fixed repayment amount (Reclamation 2021).

G.1.3.5 Refuge Water Supply Program

The Central Valley Project Improvement Act (CVPIA), enacted in 1992, authorized a Refuge Water Supply Program to acquire approximately 555 TAF annually in water supplies for 19 Central Valley refuges (CRS 2022). Authorized refuge water supply under CVPIA is divided into two categories: Level 2 and Level 4 supplies. Level 2 supplies are the historical average of water deliveries to the refuges prior to enactment of CVPIA. Reclamation is obligated to acquire and deliver this water under CVPIA, and costs are 100 percent reimbursable by CVP contractors through a fund established by the act. Level 4 supplies are the additional increment of water beyond Level 2 supplies for optimal wetland habitat development. This water must be acquired by Reclamation through voluntary measures and is funded as a 75 percent federal cost and 25 percent state cost. In most cases, the Level 2 requirement is met; however, Level 4 supplies have not always been provided in full for a number of reasons, including a shortage of supplies and a lack of willing sellers (CRS 2022).

G.1.3.6 San Luis & Delta-Mendota Water Authority

SLDMWA was formed in 1992 to take over the operation and maintenance responsibilities of several CVP facilities and support the information and representative needs of its members (SLDMWA 2021). SLDMWA has 27 member agencies, 25 of which contract with Reclamation for CVP water (Table G-1). SLDMWA's members' service areas extend from the City of Tracy in San Joaquin County in the north to Kettleman City in Kings County in the south. The service areas cover approximately 3,300 square miles on the west side of the San Joaquin Valley.

Table G-1. SLDMWA Member Agencies

Upper Delta-Mendota Canal	San Luis Canal	Exchange Contractors and Refuges	San Felipe Division	Lower Delta-Mendota Canal and Mendota Pool
Banta-Carbona Irrigation District	Panoche Water District	Central California Irrigation District	San Benito County Water District	Broadview Water District
Byron-Bethany Irrigation District	San Luis Water District	Columbia Canal Company (a friend)	Santa Clara Valley Water District	Eagle Field Water District
City of Tracy	Westlands Water District	Firebaugh Canal Water District		Fresno Slough Water District
Del Puerto Water District		Grassland Water District		James Irrigation District
Patterson Water District		Henry Miller Reclamation District #2131		Laguna Water District
West Stanislaus Irrigation District				Mercy Springs Water District
				Oro Loma Water District
				Pacheco Water District
				Reclamation District 1606
				Tranquillity Irrigation District

Water supplies for SLDMWA member agencies include CVP and SWP water, groundwater, local surface water, recycled water, purified water, and transfer water. The DMC delivers an average of approximately 3.0 MAF of CVP water annually within the SLDMWA service area. Approximately 2.5 MAF of the water is used to irrigate 1.2 million acres of agricultural lands in the Central Valley and Santa Clara and San Benito Counties, while 150 to 250 TAF is used for M&I purposes, and 250 to 300 TAF is used for environmental purposes including wildlife habitat management in the San Joaquin Valley (SLDMWA 2021).

G.1.3.7 CVP Water Allocations

Hydrology and state-imposed conditions on Reclamation's water rights are the two primary drivers of CVP allocations. In the past, Reclamation has made significant cutbacks to water deliveries for many CVP contractors because of drought and regulatory restrictions, among other factors, as shown in Table G-2. In 2016, a dry water year, south-of-Delta CVP allocations were five percent for agricultural contractors and 55 percent for M&I contractors. In February 2020, south-of-Delta CVP agricultural Water Service Contractors received an initial allocation of 20 percent of contracted supplies, and south-of Delta M&I contractors initially received a 70 percent allocation. In May 2021, CVP M&I contract allocations were reduced to 25 percent of their historic water use. At a minimum, Reclamation works to deliver the amount of water needed to meet the public health and safety need, the amount of water determined to be necessary to sustain public health and safety, to CVP M&I contractors. In April 2022, because of critically dry hydrologic conditions, water supply allocations for all CVP M&I contractors were reduced to public health and safety levels (Reclamation 2022). In both 2021 and 2022, south-of-Delta CVP agricultural contractors received zero percent allocations.

Table G-2. Water Allocations for South-of-Delta CVP Contractors, 2016-2022 (Percentage of Maximum Contract Allocation)

	2016	2017	2018	2019	2020	2021	2022
Agricultural	5%	100%	50%	75%	20%	0%	0%
M&I	55%	100%	75%	100%	70%	25%[1]	PHS[2]
Exchange Contractors	100%	100%	100%	100%	100%	75%	75%
Refuges (Level 2)[3]	100%	100%	100%	100%	100%	75%	75%
Eastside Division	0%	100%	100%	100%	100%	100%	TBD

Source: Reclamation 2022

Notes:

[1] Percentage of historic use.

[2] The amount of water determined to be necessary to sustain public health and safety according to the CVP M&I Water Shortage Policy Guidelines and Procedures.

[3] Refuge water supplies are categorized into Level 2 and Incremental Level 4. Level 2 represents the historical average amount of water deliveries prior to the Central Valley Project Improvement Act enactment in 1992 and is the baseline water required for wildlife habitat management. Incremental Level 4 represents the additional increment of water required for optimal wetland habitat development.

Key: M&I- municipal and industrial, PHS – Public Health and Safety; TBD – To Be Determined

G.1.4 SWP Contractors

The SWP delivers water to 29 public water agencies in Northern, Central and Southern California that hold long-term contracts for surface water deliveries (see Table G-3 below for a list of south-of-Delta agencies with SWP contracts). The agencies deliver water for both urban and agricultural use, representing over 25 million municipal contractors and 750,000 acres of irrigated farmland. Five of the agencies use the SWP water primarily for agricultural uses and the remaining 24 use the SWP water primarily for municipal use. Water supplies for agencies include imported SWP water, groundwater, local surface water, and for some agencies other imported supplies. The agencies collectively have received deliveries ranging from approximately 1.4 MAF in dry water years to approximately 4.0 MAF in wet years.

Similar to CVP south-of-Delta deliveries, SWP exports from the Delta and the corresponding south-of-Delta deliveries have decreased over time. In the period between 2005 and 2013, average annual SWP exports have fallen by 12 percent (DWR 2020).

Table G-3. South-of-Delta SWP Contractors

Alameda County Flood Control & Water Conservation District - Zone 7	Metropolitan Water District of Southern California
Alameda County Water District	Mojave Water Agency
Antelope Valley-East Kern Water Agency	Oak Flat Water District
Castaic Lake Water Agency	Palmdale Water District
Coachella Valley Water District	San Bernardino Valley Municipal Water District
County of Kings	San Gabriel Valley Municipal Water District
Crestline-Lake Arrowhead Water Agency	San Gorgonio Pass Water Agency
Desert Water Agency	San Luis Obispo County Flood Control and Water Conservation District
Dudley Ridge Water District	Santa Barbara County Flood Control and Water Conservation District
Empire-West Side Irrigation District	Santa Clara Valley Water District
Kern County Water Agency	Tulare Lake Basin Water Storage District
Littlerock Creek Irrigation District	Ventura County Watershed Protection District

G.2 Assessment Methodology

Water operations modeling of the CVP/SWP system was performed using CalSim II. CalSim II is a planning model designed to simulate operations of CVP and SWP reservoirs and water delivery systems. CalSim II modeling was developed from a baseline model provided by Reclamation to the Project team. Effects of the Project are determined by comparing CalSim II model scenarios that assume full design capacity to a corresponding no action/no project model scenario, as detailed in Appendix D. As discussed in Chapter 2 of the EA/IS, under the California Environmental Quality Act (CEQA), existing conditions serve as the baseline to determine potential impacts of the Proposed Action. The existing condition CalSim II simulation was completed using historic hydrology from 1927 through 2003 and the current DMC capacity for existing conditions. This CEQA approach differs from that of the National Environmental Policy Act (NEPA), where the No Action Alternative reflects expected future conditions in the Project area if no action is taken. The future no action CalSim II simulation was completed using future projected 2035 hydrology with climate change and the projected 2035 reduced DMC capacity.

The CalSim II model monthly simulation of an actual daily (or even hourly) operation of CVP and SWP results in several limitations in use of model results. Model results must be used in a comparative manner to reduce effects of use of monthly and other assumptions that are indicative of real-time operations, but do not specifically match real-time observations. CalSim II model output is based upon a monthly time step. CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches. Therefore, if quantitative changes between

the Proposed Action and the No Action Alternative are five percent or less, conditions under the Proposed Action would be considered to be "similar" to conditions under the No Action Alternative.

Under extreme hydrologic and operational conditions where there is not enough water supply to meet all requirements, CalSim II uses a series of operating rules to reach a solution to allow for continuation of the simulation. It is recognized that these operating rules are a simplified version of very complex decision processes that CVP and SWP operators would use in actual extreme conditions. Therefore, model results and potential changes under these extreme conditions should be evaluated on a comparative basis between alternatives and are approximations of extreme operational conditions.

As previously stated in Section G.1.3, each year Reclamation determines the amount of water that can be allocated to each CVP contractor based on contract types and entitlements and conditions for that year. There would be no change to CVP contracts or maximum contract quantities under the Proposed Action and, therefore, changes in water supply deliveries modeled and analyzed in this assessment would be consistent with the existing CVP contracts and operations.

G.3 Significance Criteria

The significance criteria described below were developed with guidance from CEQA Guidelines to determine the significance of potential impacts on water supply that could result from implementation of the Project. Impacts on water supply would be considered potentially significant if the Proposed Action would reduce the annual supply of water available to the CVP, SWP, or other contractors. As previously discussed, CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches. Therefore, if quantitative changes between the Proposed Action and the No Action Alternative are a reduction of five percent or greater, deliveries would be substantially reduced and conditions under the Proposed Action would be considered significant.

The significance criteria described above apply to all water supplies that could be affected by the Project. Water supply has the potential to be impacted both during construction of the Proposed Action and during operation of the Proposed Action. Both periods are analyzed in the Project impacts section.

G.4 Project Impacts and Mitigation Measures

G.4.1 No Action Alternative

G.4.1.1 Impact WS-1: Would construction of the alternative change CVP and SWP deliveries to CVP and SWP contractors?

Under the No Action Alternative, no actions would be taken to restore, or otherwise offset, conveyance capacity lost in the DMC. No drawdown or partial outage of the DMC would be needed to repair the canal. **There would be no construction-generated impacts to CVP or SWP surface water supply under this alternative.**

G.4.1.2 Impact WS-2: Would operation of the alternative change CVP deliveries to CVP contractors?

Under the No Action Alternative, no actions would be taken to restore, or otherwise offset, conveyance capacity lost in the DMC. Under the No Action Alternative and consistent with the CVP M&I Water Shortage Policy, Reclamation would distribute Delta supplies to both south-of-Delta CVP contractors and north-of-Delta CVP contractors. However, because of the reduced capacity of the DMC, Reclamation would continue to deliver any south-of-Delta CVP supplies that are not able to be delivered via the DMC to north-of-Delta CVP contractors. The reduced capacity of the DMC under the No Action Alternative would also continue to limit the ability of the CVP to export their share of Delta excess, as defined under the 2018 Coordinated Operations Agreement Addendum. The reduced capacity of the DMC could limit the ability of Reclamation to meet CVP Exchange Contractor or settlement contractor delivery requirements, which could result in a reduction in deliveries to other south-of-Delta CVP contractors to meet CVP Exchange Contractor or settlement contractor delivery requirements, which could result in a reduction in deliveries to Friant Division contractors.

Subsidence would further decrease the capacity of the DMC until full implementation of the Sustainable Groundwater Management Act (SGMA) in 2040, with residual elastic subsidence forecast to continue through the design life of the canal. Under future no action conditions, total average annual south-of-Delta CVP agricultural deliveries are expected to decrease up to 17 percent, or 280 TAF, under certain water year types compared to existing conditions. Table G-4 summarizes the change in delivery of south-of-Delta CVP agricultural water under the Proposed Action compared to existing conditions. Under future no action conditions, total average annual south-of-Delta CVP M&I deliveries are expected to decrease up to 10 percent, or 26 TAF, under certain water year types compared to existing conditions. Table G-5 summarizes the change in delivery of south-of-Delta CVP agricultural water under the Proposed Action compared to existing conditions. Therefore, CVP deliveries would be reduced compared to existing conditions. **Reduced capacity in the DMC has the potential to cause significant impacts on CVP water supply deliveries under the No Action Alternative.**

Table G-4. Averaged Modeled Difference in Total South-of-Delta CVP Agricultural Deliveries between Existing Conditions and Future No Action by Water Year Type (1,000 acre-feet)

Sacramento River Water Year Type	Total Average Existing Conditions	Future No Action	Difference from Existing Conditions	Percent Change
Wet	2,534	2,342	-192	-8%
Above Normal	2,204	1,878	-326	-15%
Below Normal	2,051	1,731	-320	-16%
Dry	1,625	1,345	-280	-17%
Critical	1,033	986	-47	-5%
All	1,984	1,756	-228	-11%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling.
CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.

Table G-5. Averaged Modeled Difference in Total South-of-Delta CVP M&I Deliveries between Existing Conditions and Future No Action by Water Year Type (1,000 acre-feet)

Sacramento River Water Year Type	Total Average Existing Conditions	Future No Action	Difference from Existing Conditions	Percent Change
Wet	270	262	-8	-3%
Above Normal	254	233	-21	-8%
Below Normal	247	222	-26	-10%
Dry	212	201	-10	-5%
Critical	176	171	-4	-2%
All	237	225	-13	-5%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling.
CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.

G.4.1.3 Impact WS-3: Would operation of the alternative change SWP deliveries to SWP contractors?

Under the No Action Alternative, SWP contractors could continue to export the CVP's share of Delta excess beyond the SWP share that is defined under the 2018 Coordinated Operations Agreement Addendum. **As such, there would be a beneficial effect to SWP surface water supply deliveries as a result of the decreased capacity of the DMC under the No Action Alternative.**

G.4.1.4 Impact WS-4: Would operation of the alternative change other water deliveries?

Under the No Action Alternative, the reduced capacity of the DMC would continue to limit the short-term conveyance of non-Project water and/or transferred water[2] to south-of-Delta CVP water contractors or other contractors reliant on the DMC for water conveyance. **Reduced capacity in the DMC has the potential to cause significant impacts on water supply deliveries to south of Delta CVP water contractors or other contractors under the No Action Alternative.**

G.4.2 Proposed Action

G.4.2.1 Impact WS-1: Would construction of the alternative change CVP deliveries to CVP contractors?

Construction of the Proposed Action is expected to last approximately seven and a half years. Some drawdowns of the canal water surface are needed to support construction activities, however no partial outages are required, thus providing flexibility in completing construction activities. During construction, the Intertie Pumping Plant could be used to maintain CVP deliveries in the upper DMC consistent with existing operations, in coordination with DWR. It is anticipated that with use of the Intertie Pumping Plant, impacts to water supply deliveries in the upper DMC during construction of the Proposed Action would be minimal.

[2] Environmental compliance for the transfer actions including sellers making water available and the conveyance of transferred water to south-of-Delta CVP contractors is analyzed outside this EA/IS in separate environmental compliance documents, including but not limited to the Long-Term Water Transfers environmental document, available here: https://www.usbr.gov/mp/nepa/nepa_project_details.php?Project_ID=18361.

The proposed modification of check structures along the lower DMC would require flows to be held at two thirds of current capacity (66 percent of current capacity) between November through February of the construction duration. In the past five years, flows in the lower DMC have been lower than 60 percent of current capacity during the low-flow work months (October through May). Consequently, proposed modifications to check structures would be completed without impacting deliveries to contractors receiving supplies from the lower DMC and Mendota Pool. Repairs and stabilization activities along the earthen-lined segment of the lower DMC would require water levels to be drawn down by up to six feet, holding conveyance levels to approximately two thirds of the canal's current capacity (66 percent of current capacity) in that segment. This work is scheduled to occur between November-February when flow levels in the earthen-lined segment of the lower DMC are on average approximately 25 percent of current capacity and have been lower than 60 percent of current capacity in all year types. During these construction actions, scheduled to occur between November through February, limits on water levels in the earthen-lined segment of the lower DMC of up to six feet could result in a water surface elevation in the pool higher than the DMC. If these conditions occur during construction, water will be pumped from the DMC into Mendota Pool to avoid impacts to water supply to all water users receiving deliveries from Mendota Pool, including CVP Exchange Contractors and settlement contractors. The scheduling of construction actions requiring limits on DMC conveyance capacity to periods with lower demands and lower flows in the canal will support uninterrupted deliveries to water users (including CVP Exchange Contractors and settlement contractors) from the DMC. Consequently, construction of the Proposed Action is not expected to require the release of water from Friant Dam to meet CVP Exchange Contractor or settlement contractor delivery requirements, which could result in a reduction in deliveries to Friant Division contractors. In addition, Reclamation and SLDMWA would coordinate water delivery schedules during construction times to adjust water delivery as needed. **Therefore, construction of the Proposed Action would have a less than significant impact on CVP deliveries.**

G.4.2.2 Impact WS-2: Would operation of the alternative change CVP deliveries to CVP contractors?

Deliveries to North-of-Delta CVP Contractors Restored conveyance capacity under the Proposed Action would allow Reclamation to distribute contract deliveries more evenly to all CVP contractors according to the CVP M&I Water Shortage Policy, which could result in an average annual decrease to north-of-Delta CVP contractors. Under operation of the Proposed Action, the average change in total annual north-of-Delta CVP deliveries is expected to minimal, decreasing less than one percent under all water year types compared to existing and future no action conditions. Compared to existing conditions, the average change in total annual north-of-Delta CVP deliveries would decrease up to five TAF under certain water year types. Table G-6 summarizes the change in delivery of north-of-Delta CVP agricultural water under the Proposed Action compared to existing conditions. Compared to future no action conditions, the average change in total annual north-of-Delta CVP deliveries would decrease up to four TAF under certain water year types. Table G-7 summarizes the change in delivery of north-of-Delta CVP agricultural water under the Proposed Action compared to future no action conditions. As was noted in Section G.3, CalSim II relies on assumptions and approaches that contribute to minor fluctuations of up to five percent, Project changes of less than five percent are not identified as an adverse or beneficial water supply effect. Changes to average annual north-of-Delta CVP deliveries would be a less than one percent total change on average and operation of the Proposed Action is not expected to have a significant impact on north-of-Delta

CVP deliveries. In addition, all operations affecting Delta exports would be required to meet Delta water quality standards (e.g., D-1641) and meet the requirements of the 2019 U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) Biological Opinions and other current and future regulatory requirements for the long-term coordinated operations of the CVP and SWP. **Therefore, operating the Proposed Action would have a less than significant impact on north-of-Delta CVP contractors compared to existing and future no action conditions**.

Table G-6. Averaged Modeled Difference in Total North-of-Delta CVP Deliveries between Existing Conditions and the Proposed Action by Water Year Type (1,000 acre-feet)

Sacramento River Water Year Type	Total Average Existing Conditions	Proposed Action	Difference from Existing Conditions	Percent Change
Wet	2,294	2,294	0	0%
Above Normal	2,282	2,282	0	0%
Below Normal	2,309	2,305	-4	0%
Dry	2,183	2,178	-5	0%
Critical	1,794	1,789	-5	0%
All	2,197	2,195	-3	0%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling.
Modeling Period 1922-2003, Data results from CalSim II modeling. CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.

Table G-7. Averaged Modeled Difference in Total North-of-Delta CVP Deliveries between Future No Action and the Proposed Action by Water Year Type (1,000 acre-feet)

Sacramento River Water Year Type	Total Average Future No Action	Proposed Action	Difference from Future No Action	Percent Change
Wet	2,273	2,272	0	0%
Above Normal	2,276	2,276	0	0%
Below Normal	2,282	2,279	-3	0%
Dry	2,147	2,144	-3	0%
Critical	1,798	1,794	-4	0%
All	2,178	2,176	-2	0%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling.
CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.

Agricultural Deliveries to South-of-Delta CVP Contractors Under operation of the Proposed Action, average annual south-of-Delta CVP agricultural deliveries are expected to be restored up to 86 TAF, a four percent change, under certain water year types compared to existing conditions. Table G-8 summarizes the change in delivery of south-of-Delta CVP agricultural water under the Proposed Action compared to existing conditions. Average annual south-of-Delta CVP agricultural deliveries are expected to be restored up to 138 TAF, an eight percent change, under certain water year types compared to future no action conditions. Table G-9 summarizes the change in delivery of south-of-Delta CVP agricultural water under the Proposed Action compared to future no action conditions. In addition, consistent with the restoration of average annual total south-of-Delta CVP agricultural

deliveries, Reclamation would most likely be able to meet CVP Exchange Contractor deliveries without impacting other south-of-Delta CVP contractors. **Therefore, operating the Proposed Action would have a beneficial effect on south-of-Delta CVP agricultural deliveries compared to existing and future no action conditions**.

Table G-8. Averaged Modeled Difference in Total South-of-Delta CVP Agricultural Deliveries between Existing Conditions and the Proposed Action by Water Year Type (1,000 acre-feet)

Sacramento River Water Year Type	Total Average Existing Conditions	Proposed Action	Difference from Existing Conditions	Percent Change
Wet	2,534	2,577	43	2%
Above Normal	2,204	2,275	71	3%
Below Normal	2,051	2,137	86	4%
Dry	1,625	1,699	74	5%
Critical	1,033	1,052	19	2%
All	1,984	2,042	58	3%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling.
CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.

Table G-9. Averaged Modeled Difference in Total South-of-Delta CVP Agricultural Deliveries between Future No Action and the Proposed Action by Water Year Type (1,000 acre-feet)

Sacramento River Water Year Type	Total Average Future No Action	Proposed Action	Difference from Future No Action	Percent Change
Wet	2,342	2,422	80	3%
Above Normal	1,878	2,008	130	7%
Below Normal	1,731	1,871	138	8%
Dry	1,345	1,438	94	7%
Critical	986	1,016	30	3%
All	1,756	1,849	92	5%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling.
CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.

Municipal and Industrial Deliveries to South-of-Delta CVP Contractors Under operation of the Proposed Action, average annual south-of-Delta CVP M&I deliveries are expected to be restored up to five TAF, a two percent change, under certain water year types compared to existing conditions. Table G-10 summarizes the change in delivery of CVP water under this option compared to existing conditions. Average annual south-of-Delta CVP M&I deliveries are expected to fluctuate up three TAF, a one percent change, under certain water year types compared to future no action conditions. Table G-11 summarizes the change in delivery of CVP water under this option compared to future no action conditions. Overall, average annual south-of-Delta CVP M&I deliveries would change by less than one percent, and as noted above in Section G.2, projected changes of less than five percent are not identifies as an adverse or beneficial water supply effect. **Therefore, operating the**

Proposed Action would have a less than significant impact on south-of-Delta CVP M&I contractors compared to existing and future no action conditions.

Table G-10. Averaged Modeled Difference in Total South-of-Delta CVP M&I Deliveries between Existing Conditions and the Proposed Action by Water Year Type (1,000 acre-feet)

Sacramento River Water Year Type	Total Average Existing Conditions	Proposed Action	Difference from Existing Conditions	Percent Change
Wet	270	271	1	0%
Above Normal	254	259	5	2%
Below Normal	247	249	1	0%
Dry	212	214	2	1%
Critical	176	175	-1	0%
All	237	239	1	1%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling.
CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.

Table G-11. Averaged Modeled Difference in Total South-of-Delta CVP M&I Deliveries between Future No Action and the Proposed Action by Water Year Type (1,000 acre-feet)

Sacramento River Water Year Type	Total Average Future No Action	Proposed Action	Difference from Future No Action	Percent Change
Wet	262	261	-2	-1%
Above Normal	233	235	2	1%
Below Normal	222	223	2	1%
Dry	201	198	-3	-1%
Critical	171	170	-2	-1%
All	225	224	-1	0%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling.
CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.

Deliveries to South-of-Delta CVP Refuges Under operation of the Proposed Action, there would be no change to south-of-Delta CVP Level 2 refuge deliveries. Reclamation would continue its obligation to acquire and deliver this water under CVPIA. **Therefore, operating the Proposed Action would have a no impact on south-of-Delta CVP Level 2 refuge deliveries compared to existing and future no action conditions.**

G.4.2.3 Impact WS-3: Would construction of the alternative change SWP deliveries to SWP contractors?

Construction duration for the Proposed Action is expected to last approximately seven and a half years. Some drawdowns of the canal water surface are needed to support construction activities, however no partial outages are required, thus providing flexibility in completing construction activities. During construction, the Intertie Pumping Plant would continue to be used to maintain CVP deliveries consistent with existing operations. It is anticipated that because no outages would

be needed, there would be no impact to SWP water supply deliveries during construction of the Proposed Action. Any adaptive management measures or restrictions imposed on SLDMWA, Reclamation, or the CVP through permits or other regulatory approvals issued for construction of the Proposed Action will be coordinated with DWR consistent with the rights and obligations of and between Reclamation and DWR agreed to in other independent agreements. **Construction of the Proposed Action would have no impact on SWP deliveries**.

G.4.2.4 Impact WS-4: Would operation of the alternative change SWP deliveries to SWP contractors?

Deliveries to SWP Contractors The CalSim II model tracks three categories of SWP deliveries – Table A contract allocations (i.e., firm), Article 21 (i.e., surplus or interruptible), and Article 56 (i.e., carryover). The water supply contracts set forth the maximum amount of SWP water a contractor may request, known as the Table A amount. Article 21 water is available to SWP contractors when SWP storage in San Luis Reservoir is full and there is excess water in the Delta. Article 56 water, referred to as carryover water, is Table A water allocated to a contractor in one year but held in San Luis Reservoir until it was delivered in the following calendar year.

Restored conveyance capacity under the Proposed Action would allow the CVP to export its share of excess, as defined under the 2018 Coordinated Operations Agreement Addendum, and therefore would reduce the SWP export of unused CVP share. Under operation of the Proposed Action, average annual south-of-Delta SWP Table A deliveries are expected to decrease up to 23 TAF, a one percent change, under certain water year types compared to existing conditions. Table G-12 summarizes the change in delivery of Table A SWP water under the Proposed Action compared to existing conditions. Table G-13 summarizes the change in delivery of Table A SWP water under the Proposed Action compared to future no action conditions. Average annual south-of-Delta SWP Table A deliveries are expected to decrease up to 42 TAF, a five percent change, under certain water year types compared to future no action conditions. As previously mentioned, under the Proposed Action the CVP would be able to export their share of Delta excess consistent with the 2018 Coordinated Operations Agreement Addendum. Therefore, the slight reduction in Table A SWP deliveries under the Proposed Action is not identified as an adverse water supply effect.

Table G-12. Averaged Modeled Difference in Total Table A SWP Deliveries between Existing Conditions and the Proposed Action by Water Year Type (1,000 acre-feet)

Sacramento River Water Year Type	Total Average Existing Conditions	Proposed Action	Difference from Existing Conditions	Percent Change
Wet	2,848	2,833	-16	-1%
Above Normal	2,610	2,592	-18	-1%
Below Normal	2,556	2,533	-23	-1%
Dry	1,533	1,518	-14	-1%
Critical	985	974	-11	-1%
All	2,202	2,186	-16	-1%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling.
CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.

Table G-13. Averaged Modeled Difference in Total Table A SWP Deliveries between Future No Action and the Proposed Action by Water Year Type (1,000 acre-feet)

Sacramento River Water Year Type	Total Average Future No Action	Proposed Action	Difference from Future No Action	Percent Change
Wet	2,771	2,751	-20	-1%
Above Normal	2,474	2,458	-16	-1%
Below Normal	2,378	2,361	-17	-1%
Dry	1,354	1,328	-26	-2%
Critical	913	871	-42	-5%
All	2,080	2,056	-23	-1%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling.
CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.

In addition, the Proposed Action could reduce potential surplus water supply (Article 21) and carryover water supply (Article 56) deliveries to SWP contractors as CVP deliveries are restored compared to existing conditions. The availability of this surplus and carryover water in any particular year is uncertain, and contractors do not base long-term water supply decisions based on the availability, or lack thereof, of this water. Both change in surplus and carryover water supply are presented in the context of total SWP deliveries, including Table A deliveries, because surplus and carryover water is delivered in addition to Table A deliveries. Table G-14 summarizes the change in delivery of Article 21 and Article 56 SWP water under the Proposed Action compared to existing conditions. Table G-15 summarizes the change in delivery of Article 21 and Article 56 SWP water under the Proposed Action compared to future no action conditions. Under operation of the Proposed Action, average annual south-of-Delta SWP deliveries with surplus and carryover water supply are expected to decrease up to 37 TAF, a one percent change, under certain water-year types compared to existing conditions and are expected to decrease up to 42 TAF, a four percent change, under certain water-year types compared to future no action conditions. All operations affecting Delta exports would be required to meet Delta water quality standards (e.g., D-1641) and meet the requirements of the 2019 USFWS and NMFS Biological Opinions and other current and future

regulatory requirements for the long-term coordinated operations of the CVP and SWP. **Therefore, operating the Proposed Action would have a less than significant impact on south-of-Delta SWP contractors compared to existing and future no action conditions.**

Table G-14. Averaged Modeled Difference in Total Article 21 and Article 56 SWP Deliveries between Existing Conditions and the Proposed Action (1,000 acre-feet)

Sac Yr Type	Total Average Existing Conditions			Difference from Existing Conditions			Total Difference	Percent Change
	Table A	Article 21	Article 56	Table A	Article 21	Article 56		
W	2,833	230	338	-16	-5	-2	-22	-1%
AN	2,592	75	234	-18	-16	-2	-37	-1%
BN	2,533	77	218	-23	-1	3	-22	-1%
D	1,518	34	202	-14	3	3	-9	0%
C	974	38	96	-11	6	-11	-16	-1%
All	2,186	110	237	-16	-3	-1	-20	-1%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling.
CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.
Key: AN – Above Normal; BN – Below Normal; C – Critical; D – Dry; Sac Yr Type – Sacramento River Water Year Type; W – Wet

Table G-15. Averaged Modeled Difference in Total Article 21 and Article 56 SWP Deliveries between Future No Action and the Proposed Action by Water Year Type (1,000 acre-feet)

Sac Yr Type	Total Average Future No Action			Difference from Future No Action			Total Difference	Percent Change
	Table A	Article 21	Article 56	Table A	Article 21	Article 56		
W	2,771	279	293	-20	-6	-14	-40	-1%
AN	2,474	76	156	-16	-6	-22	-43	-2%
BN	2,378	48	227	-17	-5	1	-20	-1%
D	1,354	21	135	-26	0	4	-22	-1%
C	913	13	106	-42	5	-5	-42	-4%
All	2,080	116	202	-23	-3	-7	-33	-1%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling.
CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.
Key: AN – Above Normal; BN – Below Normal; C – Critical; D – Dry; Sac Yr Type – Sacramento River Water Year Type; W – Wet

G.4.2.5 Impact WS-5: Would operation of the alternative change other water deliveries?

The restored conveyance capacity of the DMC under the Proposed Action could improve the storage and conveyance of non-Project water and transferred water. The Warren Act authorizes Reclamation to negotiate agreements to store or convey non-CVP water when excess capacity is available in federal facilities. Implementing the Proposed Action could increase the availability of excess capacity in the DMC that would support the delivery of additional non-CVP water in the DMC to south-of-Delta CVP water contractors or other contractors reliant on the DMC for water conveyance when compared to the No Action Alternative. **Therefore, operating the Proposed Action would have a beneficial impact on south-of-Delta CVP water contractors or other**

contractors reliant on the DMC for non-CVP water deliveries compared to existing and future no action conditions.

G.4.3 Mitigation Measures

No mitigation measures would be necessary to reduce impacts of the Proposed Action to the less than significant level.

G.5 References

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Delta-Mendota Canal Subsidence Correction Project Environmental Assessment/Initial Study

Appendix H: Water Quality Technical Appendix

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Appendix H Water Quality Technical Appendix

This appendix documents the water quality technical analysis to support the impact analysis in the Environmental Assessment/Initial Study (EA/IS) and describes the water quality resources that could be potentially affected by the implementation of the No Action/No Project Alternative (subsequently identified as the No Action Alternative) and the Proposed Action/Proposed Project (subsequently identified as the Proposed Action) considered by the EA/IS. This appendix also discusses water quality in the San Joaquin-Sacramento Delta (Delta) and includes water quality monitoring and water quality modeling results.

H.1 Clean Water Act Section 303(d)-Listed Water Bodies

The 2018 Section 303(d) list approved by the United States Environmental Protection Agency (USEPA) under the Clean Water Act (CWA) identifies impaired water bodies for certain constituents of concern. CWA Section 303(d) requires states to identify water bodies that do not meet applicable water quality standards after the application of certain technology-based controls on point source discharges. As defined in the CWA and federal regulations, water quality standards include the designated beneficial uses of a water body, the adopted water quality criteria necessary to protect those uses, and an antidegradation policy. As defined in the Porter-Cologne Water Quality Control Act, water quality standards are associated with designated beneficial uses of a water body, the established water quality objectives (both narrative and numeric), and California's nondegradation policy (State Water Resources Control Board [SWRCB] Resolution No. 68-16). Appendix E contains a description of the CWA and the Section 303(d) listing process.

While the Delta-Mendota Canal (DMC) is not listed, the Delta, Mendota Pool, Newman Wasteway, O'Neill Forebay, San Luis Reservoir, and Westley Wasteway are listed as water quality limited (impaired) for several of the constituents of concern. Table H-1 presents the 2018 Section 303(d) listed constituents of concern for these water bodies. Some water quality constituents are also of concern with respect to drinking water. Section H.2 provides information on the constituents of concern listed in Table H-1.

Table H-1. Section 303(d) Listed Water Bodies Within the Area of Analysis and Associated Constituents of Concern

Name	Constituent	Estimated Area Affected[1]	Proposed TMDL Completion Year/ USEPA Approved Date	Region
Sacramento-San Joaquin River Delta	Chlordane	41,736 acres	2029	Contra Costa, Sacramento, San Joaquin, Solano, and Yolo Counties
	DDT	41,736 acres	2013	
	Dieldrin	41,736 acres	2013	
	Dioxin compounds (including 2,3,7,8-TCDD) Furan Compounds	41,736 acres	2019	
	Invasive Species	41,736 acres	2019	
	Mercury	41,736 acres	2019	
	PCBs	41,736 acres	2/12/20082	
	PCBs (dioxin-like)	41,736 acres	3/29/20102	
	Selenium	41,736 acres	3/29/20102	
		41,736 acres	8/23/20162	
Mendota Pool	Mercury	3,045 acres	2027	Fresno County
	Selenium	3,045 acres	2027	
Newman Wasteway	Salinity	8 miles	2021	Merced County
	Dissolved Oxygen	8 miles	2021	
	Indicator Bacteria	8 miles	2021	
	DDE	8 miles	2021	
O'Neill Forebay	Mercury	2,254 acres	2012	Merced County
	PCBs	2,254 acres	2027	
San Luis Reservoir	Mercury	13,007 acres	2027	Merced County
	PCBs	13,007 acres	2027	
	Total DDT	13,007 acres	2027	
	Chlordane	13,007 acres	2027	
Westley Wasteway	Indicator Bacteria	4 miles	2027	Stanislaus County
	Dimethoate	4 miles	2027	
	Chlorpyrifos	4 miles	20262	

Source: SWRCB 2022

Notes:

[1] Estimated area affected is given as the surface area (acres) of lakes or estuaries or length (river miles) for river systems.

[2] Being addressed with USEPA approved TMDL.

Key: DDE = Dichlorodiphenyldichloroethylene, DDT – dichlorodiphenyltrichloroethane, PCB – polychlorinated biphenyl, TCDD – tetrachlorodibenzodioxin, TMDL – total maximum daily load, Total DDT = sum of 4,4'- and 2,4'- isomers of DDT, DDE, and DDD

H.2 Constituents of Concern

H.2.1 Chlordane

Chlordane is a manufactured chemical that was used as a pesticide in the United States until 1988 when USEPA banned all uses (Agency for Toxic Substances and Disease Registry [ATSDR] 2018). Chlordane sticks strongly to soil particles at the surface and is not likely to enter groundwater. Most chlordane leaves soil by evaporation to the air, where it breaks down slowly. Chlordane does not dissolve easily in water, and it builds up in the tissues of fish, birds, and mammals. The construction and operation of the DMC Subsidence Correction Project would not involve the use of chlordane and would not impact levels of chlordane in the Project area.

H.2.2 Chlorpyrifos

Chlorpyrifos is an organophosphate insecticide, acaricide, and miticide used to control foliage and soil-borne insect pests. It has been used as a pesticide since 1965 in both agricultural and non-agricultural areas. In 2021, USEPA released the Final Tolerance Rule for Chlorpyrifos, which revokes all tolerances for chlorpyrifos food-related uses (USEPA 2022). The construction and operation of the Project would not involve the use of chlorpyrifos and would not impact levels of chlorpyrifos in the Project area.

H.2.3 DDT and DDE

Dichlorodiphenyltrichloroethane (DDT) is a pesticide once widely used to control insects in agriculture and insects that carry diseases such as malaria, and dichlorodiphenyldichloroethylene (DDE) is a chemical similar to DDT that contaminate commercial DDT preparations. DDE has no commercial use (ATSDR 2021). The use of DDT in the United States was banned in 1972 because of damage to wildlife, but it is still used in some countries. DDT sticks strongly to soil. Only a small amount will go through the soil into groundwater, and it does not dissolve easily in water. DDT builds up in plants and in fatty tissues of fish, birds, and other animals. The construction and operation of the Project would not involve the use of DDT or DDE and would not impact levels of DDT or DDE in the Project area.

H.2.4 Dieldrin

From the 1950s until 1970, dieldrin was a widely used pesticide for crops like corn and cotton. Because of concerns about damage to the environment and potentially to human health, USEPA banned all uses of dieldrin in 1987 (ATSDR 2022a). Dieldrin binds tightly to soil and slowly evaporates to the air. Dieldrin in soil and water breaks down slowly. Plants take in and store dieldrin from the soil. The construction and operation of the Project would not involve the use of dieldrin and would not impact levels of dieldrin in the Project area.

H.2.5 Dimethoate

Dimethoate is an organophosphorus insecticide that was registered for use in the United States in 1962 and used on several field-grown agricultural crops (leafy greens, citrus, melons), tree crops, and ornamentals. Residential and non-agricultural uses were cancelled in 2000. Use on alfalfa, wheat, cotton, and corn crops accounts for more than 60 percent of the total dimethoate use in the United States. Dimethoate is nonvolatile, water soluble, and not mobile in soil (Center for Disease Control and Prevention [CDC] 2017). The construction and operation of the Project would not involve the use of dimethoate and would not impact levels of dimethoate in the Project area.

H.2.6 Dioxin and Furan Compounds

Dioxin and furan are the abbreviated or short names for a family of toxic substances that all share a similar chemical structure. The chlorinated dibenzo-p-dioxins (CDDs) are a class of compounds that are loosely referred to as dioxins. There are 75 possible dioxins. CDDs may be formed during the chlorine bleaching process at pulp and paper mills and during chlorination by waste and drinking water treatment plants. CDDs are released into the air in emissions from municipal solid waste and industrial incinerators (ATSDR 2011). When released in waste waters, some CDDs are broken down by sunlight and some evaporate to air, but most attach to soil and settle to the bottom sediment in water. CDD concentrations may build up in the food chain, resulting in measurable levels in

animals. The construction and operation of the Project would not create dioxins and furans and would not impact levels of dioxins and furans in the Project area.

H.2.7 Dissolved Oxygen

Dissolved oxygen is a measure of how much oxygen is dissolved in the water that is available to living aquatic organisms. Rapidly moving water tends to contain a lot of dissolved oxygen, whereas stagnant water contains less. As the amount of dissolved oxygen in a waterbody decreases, the waterbody is less able to support aquatic life (United States Geological Survey (USGS) 2018). Low levels of dissolved oxygen in freshwater systems can be associated with biotoxin problems, or harmful algal blooms, which can reduce the quality of water for human use (USEPA 2012). The construction and operation of the Project would not create the potential to decrease the levels of dissolved oxygen in the Project area.

H.2.8 Indicator Bacteria

Indicator bacteria are surrogates used to measure the potential presence of fecal material and associated fecal pathogens in water. Common indicator bacteria include fecal coliform and enterococcus, which are part of the intestinal flora of warm-blooded animals. These bacteria can enter waterways from both man-made sources (such as sewer overflows, failing sewer lines, meat processing facilities, and more) and natural sources (such as wildlife). Serious illnesses are caused by swallowing water or food contaminated by indicator bacteria (USEPA 2012). The construction and operation of the Project would not create the potential for the introduction of indicator bacteria in the Project area.

H.2.9 Invasive Species

The introduction of invasive species is the leading cause of biodiversity loss in aquatic systems. There are several different ways invasive species are introduced into freshwater environments, including ballast water, hull fouling, aquaculture escapes, and accidental or intentional introductions, among others (USEPA 2016). Exotic species include plants, fishes, algae, mollusks, crustaceans, bacteria, and viruses. Many exotic species become invasive or otherwise cause harm to the economy, environment, or human health in their nonnative environment. The construction and operation of the Project would not create the potential for the introduction of invasive species in the Project area.

H.2.10 Mercury

Mercury is a naturally occurring metal that has several forms. Mercury is primarily used in the manufacturing of electronics, fluorescent lighting, and production of chlorine-caustic soda (ATSDR 2022b). Inorganic mercury (metallic mercury and inorganic mercury compounds) enters the air from mining ore deposits, burning coal and waste, and manufacturing plants. It enters the water or soil from natural deposits, disposal of wastes, and volcanic activity. Methylmercury may be formed in water and soil by bacteria. It bioaccumulates and biomagnifies in food chains. The construction and operation of the Project would not generate or release mercury and would not impact levels of mercury in the Project area.

H.2.11 Polychlorinated Biphenyls

Polychlorinated biphenyls (PCBs) are made up of up to 209 individual chlorinated compounds known as congeners. Manufacturing of PCBs was stopped in the United States because of links to harmful effects in 1977. During their manufacture, use and disposal, PCBs entered the air, water and soil caused from accidental spills and leaks during their transport, and from leaks or fires in products

containing PCBs. Because PCBs do not break down easily, they may remain in the environment for long periods of time. Most PCBs in water stick to organic particles and bottom sediments, however, a few may remain dissolved. They will bind strongly with soil. PCBs accumulate in fish and marine mammals and may reach levels many thousands of times higher than in water (ATSDR 2014a). The construction and operation of the Project would not generate or release PCBs and would not impact levels of PCBs in the Project area.

H.2.12 Salinity

Salinity refers to the presence of minerals (salts) that dissolve in water. High levels of salinity can be toxic to freshwater plants and animals and make water unusable for drinking, irrigation, and livestock. Road de-icing, human and industrial wastewater, fertilizer applications, mining and drilling, and repeated use of irrigation water can contribute to high levels of salts in freshwater bodies (USEPA 2012). The construction and operation of the Project would not increase salinity levels in the Project area.

H.2.13 Selenium

Selenium is a metal commonly found in rocks and soil. Small selenium particles in the air settle to the ground or are taken out of the air in rain. Selenium dust can enter the air from burning coal and oil. Soluble selenium compounds in agricultural fields can leave the field in irrigation drainage water and can enter water from rocks, soil, and industrial waste. Some compounds dissolve in water and some will settle to the bottom as particles. Selenium can accumulate up the food chain (ATSDR 2014b). The construction and operation of the Project would not generate selenium and would not impact levels of selenium in the Project area.

H.3 Beneficial Uses

Application of water quality objectives (i.e., standards) to protect designated beneficial uses is critical to water quality management in California. State law defines beneficial uses to include "...domestic; municipal; agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves" (Water Code Section 13050(f)). Protection and enhancement of existing and potential beneficial uses are primary goals of water quality planning. Significant points concerning the concept of beneficial uses are:

1. All water quality problems can generally be stated in terms of whether there is water of sufficient quantity or quality to protect or enhance beneficial uses (Central Valley Regional Water Quality Control Board [CVRWQCB] 2018).
2. Beneficial uses do not include all of the reasonable uses of water. For example, disposal of wastewaters is not included as a beneficial use. This is not to say that disposal of wastewaters is a prohibited use; it is merely a use that cannot be satisfied to the detriment of beneficial uses. Similarly, the use of water for the dilution of salts is not a beneficial use although it may, in some cases, be a reasonable and desirable use of water (CVRWQCB 2018).
3. The protection and enhancement of beneficial uses require that certain quality and quantity objectives be met for surface and ground waters (CVRWQCB 2018).
4. Fish, plants, and other wildlife and humans use water beneficially.

The Porter-Cologne Water Quality Control Act defines water quality objectives as, "…the limits or levels of water quality constituents or characteristics which are established for the reasonable protections of the beneficial uses of water or the preventions of nuisance within a specified area" (Water Code 13050(H)). The basin plans present water quality objectives in numerical or narrative format for specified water bodies or for protection of specified beneficial uses throughout a specific basin or region.

Beneficial use designation (and water quality objectives) must be reviewed at least once during each 3-year period for the purpose of modification as appropriate (40 Code of Federal Regulations [CFR] 131.20). The beneficial uses and abbreviations listed below are standard basin plan designations (CVRWQCB 2018).

Municipal and Domestic Supply (MUN) – Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

Agricultural Supply (AGR) – Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation (including leaching of salts), stock watering, or support of vegetation for range grazing.

Industrial Service Supply (IND) – Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well repressurization.

Industrial Process Supply (PRO) – Uses of water for industrial activities that depend primarily on water quality.

Groundwater Recharge (GWR) – Uses of water for natural or artificial recharge of groundwater for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

Freshwater Replenishment (FRSH) – Uses of water for natural or artificial maintenance of surface water quantity or quality.

Navigation (NAV) – Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

Hydropower Generation (POW) – Uses of water for hydropower generation.

Water Contact Recreation (REC-1) – Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, canoeing, white water activities, fishing, or use of natural hot springs.

Noncontact Water Recreation (REC-2) – Uses of water for recreational activities involving proximity to water, but where there is generally no body contact with water, nor any likelihood of ingestion of water. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Commercial and Sport Fishing (COMM) – Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

Aquaculture (AQUA) – Uses of water for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, or harvesting of aquatic plants and animals for human consumption or bait purposes.

Warm Freshwater Habitat (WARM) – Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Cold Freshwater Habitat (COLD) – Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Estuarine Habitat (EST) – Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

Wildlife Habitat (WILD) – Uses of water that support terrestrial or wetland ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats or wetlands, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Preservation of Biological Habitats of Special Significance (BIOL) – Uses of water that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, or Areas of Special Biological Significance, where the preservation or enhancement of natural resources requires special protection.

Rare, Threatened, or Endangered Species (RARE) – Uses of water that support aquatic habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened or endangered.

Migration of Aquatic Organisms (MIGR) – Uses of water that support habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.

Spawning, Reproduction, and/or Early Development (SPWN) – Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

Shellfish Harvesting (SHELL) – Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sports purposes.

The beneficial uses designated for the surface waters in the Project area are presented in Table H-2. The beneficial uses designated for any specifically identified water body generally also apply to its tributary streams. In some cases, a beneficial use may not be applicable to the entire body of water. In these cases, CVRWQCB judgment is applied. Water bodies within the basins that do not have beneficial uses designated are assigned municipal and domestic supply designations per the provisions of SWRCB Resolution No. 88-63. These municipal and domestic supply designations in no way affect the presence or absence of other beneficial uses in these water bodies.

Table H-2. Beneficial Uses of Water Bodies in the Project Area

Beneficial Use Designation	Delta-Mendota Canal	O'Neill Forebay	Sacramento-San Joaquin River Delta	San Luis Reservoir
Municipal and Domestic Supply (MUN)	X	X	X	X
Agricultural Supply – Irrigation (AGR)	X	X	X	X
Industrial Process Supply (PRO)			X	
Industrial Service Supply (IND)			X	X
Groundwater Recharge (GWR)			X	
Freshwater Replenishment (FRSH)				
Navigation (NAV)			X	
Hydropower Generation (POW)				X
Water Contact Recreation (REC-1)	X	X	X	X
Noncontact Water Recreation (REC-2)	X	X	X	X
Shellfish Harvesting (SHELL)			X	
Commercial and Sport Fishing (COMM)			X	
Aquaculture (AQUA)				
Warm Freshwater Habitat (WARM)	X	X	X	X
Cold Freshwater Habitat (COLD)			X	
Migration of aquatic organisms (MIGR)			X	
Spawning, Reproduction, and/or Early Development (SPWN)			X	
Estuarine Habitat (EST)			X	
Wildlife Habitat (WILD)	X		X	X
Rare, Threatened, or Endangered Species (RARE)			X	

Source: CVRWQCB 2018

H.4 Delta Region Water Quality

The Delta region forms the low-lying outlet of the Central Valley, which comprises the channels of the Sacramento and San Joaquin Rivers, including from about the I-Street Bridge in Sacramento on the Sacramento River and Vernalis on the San Joaquin River, west to Martinez, and includes Suisun Bay and the Suisun Marsh. West of Martinez is the Carquinez Strait and San Pablo and San Francisco Bays. Estuarine areas occur from the Delta to San Francisco Bay depending on season of the year and outflow conditions.

Water quality in the Delta region is governed in part by Delta hydrodynamics, which are highly complex. The principal factors affecting Delta hydrodynamic conditions are (1) river inflows from the San Joaquin and Sacramento River systems, (2) daily tidal inflows and outflows through the San Francisco Bay, and (3) pumping from the southern Delta through the Harvey O. Banks Pumping Plant, C.W. "Bill" Jones Pumping Plant (Jones Pumping Plant), and other smaller diversions throughout the Delta. These Delta hydrodynamic conditions are primarily measured using the

parameters of Sacramento and San Joaquin River flows, Delta outflow, Delta inflow, location of the low salinity zone, Old and Middle River flows, and Delta exports.

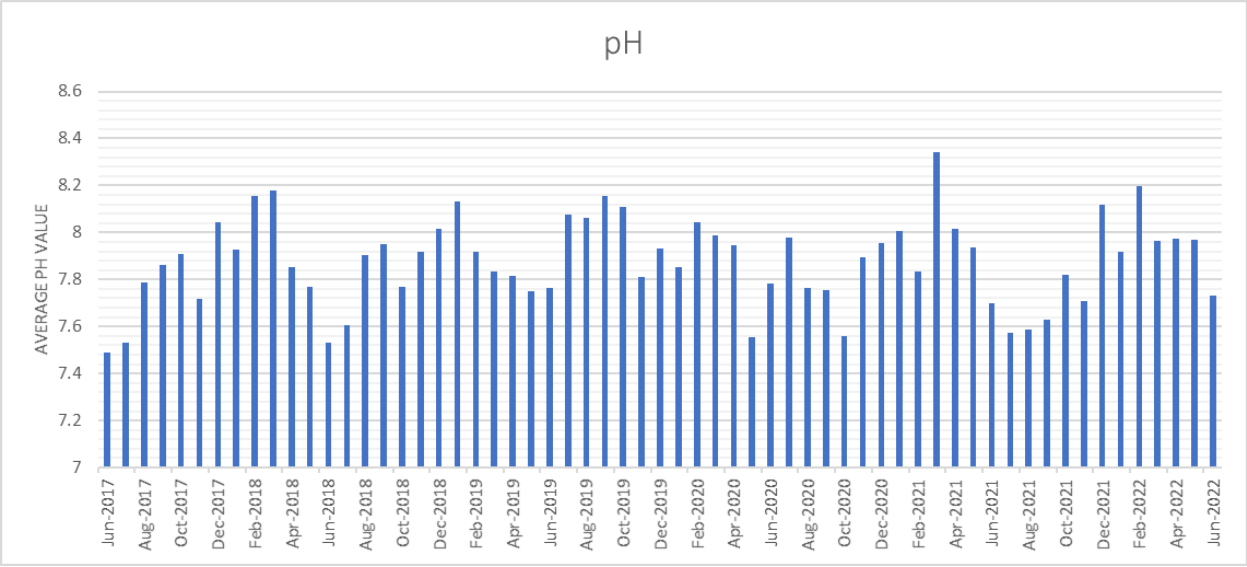
The transition area between saline waters and fresh water, frequently referred to as the low salinity zone[1] (LSZ), is typically located within Suisun Bay and the western Delta. Changes in the location of the LSZ are commonly measured by the position of X2, which is controlled by parameters such as daily tidal flows, Delta inflow, and Delta exports. Aquatic organisms have different salinity tolerances and preferences, and as such, changes in the position of the LSZ and X2 are commonly used to characterize likely changes in species distribution and other ecological parameters. The location of X2 is an indicator of the extent of saltwater intrusion into the Delta and thus is used to indicate changes to salinity concentrations within the Delta.

The existing water quality constituents of concern in the Delta can be categorized broadly as metals, pesticides, nutrient enrichment and associated eutrophication, constituents associated with suspended sediments and turbidity, salinity, bromide, and organic carbon. The relative concentrations of these constituents over time are closely related to hydrodynamic conditions, including the position of X2, described above. Other physical parameters, including pH, temperature, and electrical conductivity can interact with water quality constituents of concern to increase or decrease their effects on aquatic organisms and other beneficial uses. Water quality is closely monitored in the Delta to better understand water quality issues and track the improvement or decline in water quality in the Delta region. Figure H-1 through Figure H-3 present historical data from 2017 through 2022 for pH, temperature, and EC in Clifton Court Forebay. Clifton Court Forebay is located south of the City of Stockton and collects Delta water to be pumped into the California Aqueduct.

The Jones Pumping Plant diverts water from the Delta into the DMC that conveys Central Valley Project (CVP) water to users in the Central Valley and includes San Luis Reservoir as a storage feature. Similar to the Delta region, water quality constituents of concern in the DMC can be categorized broadly as metals, pesticides, constituents associated with suspended sediments and turbidity, salinity, bromide, and organic carbon.

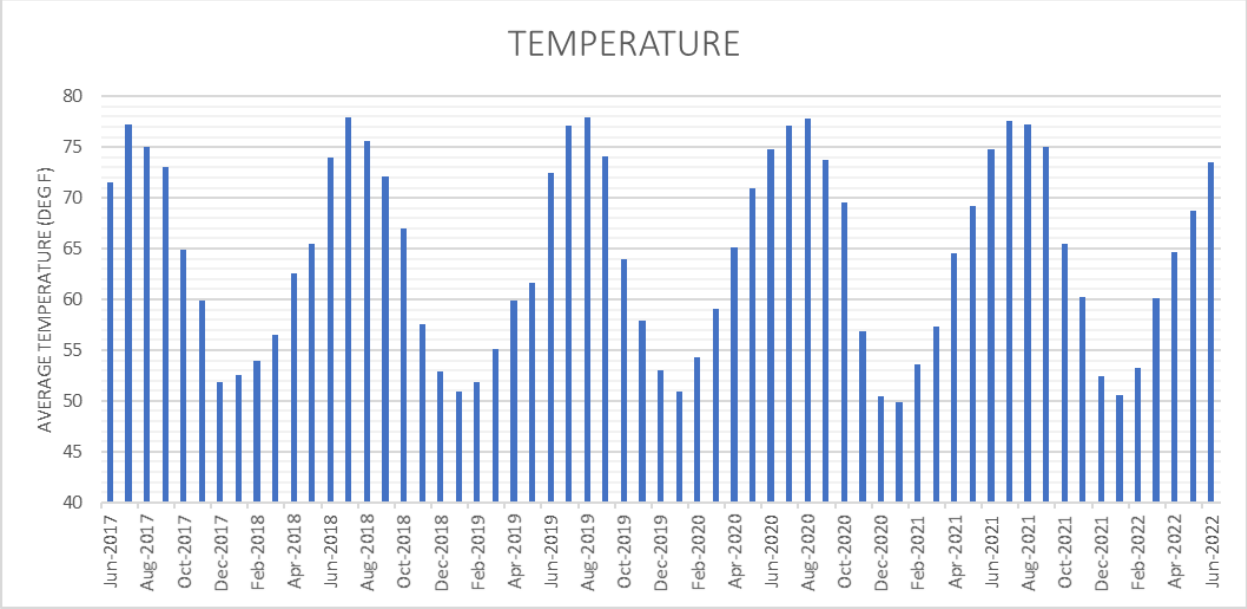
The Banks Pumping Plant diverts water from the Delta into Bethany Reservoir and then the California Aqueduct. Water diverted to the California Aqueduct is conveyed south to State Water Project (SWP) water contractors via the O'Neill Forebay and San Luis Reservoir. Water quality constituents of concern in the south-of-Delta SWP, similar to the Delta region and DMC, include metals, pesticides, constituents associated with suspended sediments and turbidity, salinity, bromide, and organic carbon.

[1] The low salinity zone is often referenced by X2, which is the distance upstream, in kilometers, from the Golden Gate Bridge where tidally averaged salinity is equal to two parts per thousand (ppt). X2 is largely determined by Delta outflow (Kimmerer 2004).



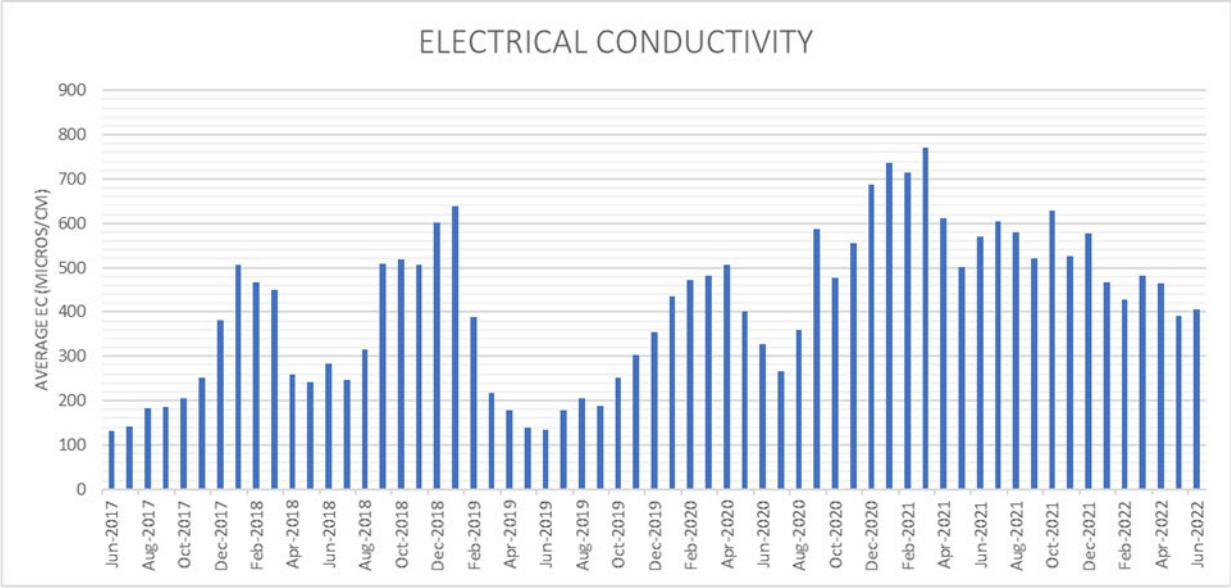
Source: DWR California Data Exchange Center (CDEC) 2022

Figure H-1. pH in Clifton Court Forebay



Source: DWR CDEC 2022

Figure H-2. Water Temperature in Clifton Court Forebay



Source: DWR CDEC 2022

Figure H-3. Electrical Conductivity in Clifton Court Forebay

H.5 Assessment Methodology

Water quality monitoring data and CalSim II modeling were used to aid in evaluating potential impacts within the Delta, San Luis Reservoir, and the DMC. Temporary construction-related effects and long-term operational effects to water quality were considered as part of this evaluation. Effects to the DMC are primarily expected to occur during construction. Temporary construction-related impacts were evaluated qualitatively based on anticipated construction practices, materials, locations, and duration of construction and related activities. Impacts outside the Delta, San Luis Reservoir, and the DMC were not considered since CalSim II modeling showed little to no changes in reservoir and stream flow levels. Effects to the Delta water quality from potential changes to CVP and SWP exports are discussed below. Because water from the Delta is pumped into the DMC, water quality within the Delta is a good indicator of water quality within the DMC. As noted previously, the Proposed Action would restore conveyance capacity in the DMC back to its original design capacity. Operation of the Proposed Action would conform to the existing operating rules identified in the 2019 USFWS and NMFS Biological Opinions (USFWS 2019; NMFS 2019).

As discussed in Chapter 2 of the EA/IS, under the California Environmental Quality Act (CEQA), existing conditions serve as the baseline to determine potential impacts of the Proposed Action. The existing condition CalSim II simulation was completed using historic hydrology from 1927 through 2003 and the current reduced DMC capacity. This CEQA approach differs from that of the National Environmental Policy Act (NEPA), where the No Action Alternative reflects expected future conditions in the Project area if no action is taken. The future no action CalSim II simulation was completed using future projected 2035 hydrology with climate change and the projected 2035 reduced DMC capacity.

The CalSim II model's monthly simulation of an actual daily (or even hourly) operation of CVP and SWP results in several limitations in use of model results. Model results must be used in a comparative manner to reduce effects of use of monthly data and other assumptions that are

indicative of real-time operations but do not specifically match real-time observations. CalSim II model output is based upon a monthly time step. CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches. Therefore, if quantitative changes between the Proposed Action and the No Action Alternative are five percent or less, conditions under the Proposed Action would be considered "similar" to conditions under the No Action Alternative.

Under extreme hydrologic and operational conditions where there is not enough water supply to meet all requirements, CalSim II utilizes a series of operating rules to reach a solution to allow for continuation of the simulation. It is recognized that these operating rules are a simplified version of complex decision processes that CVP and SWP operators would use in actual extreme conditions. Therefore, model results and potential changes under these extreme conditions should be evaluated on a comparative basis between alternatives and approximate extreme operational conditions.

H.5.1 X2 Results

X2 calculations were completed to provide an indication of changes to salinity throughout the Delta. The X2 water quality parameter represents the distance from the Golden Gate to the location of two parts per thousand (ppt) salinity concentration in the Delta. Larger values indicate that the salinity concentrations are increasing in the Delta because of reductions in outflow and the movement of the salinity zone further into the Delta, and smaller values indicate lower salinity concentrations as the salinity zone is pushed further out of the Delta.

H.5.2 South-of-Delta Export and Outflow Results

As noted above, water quality in the Delta and the south-of-Delta CVP and SWP is closely related to changes in hydrodynamics. Changes in south-of-Delta exports are directly linked to hydrodynamic conditions and can impact water quality conditions (e.g., salinity and total dissolved solids [TDS] levels) in the central and southern Delta and in south-of-Delta CVP and SWP water supplies. Greater exports during winter and spring, particularly during storm events, could draw turbidity and TDS from the Sacramento and San Joaquin Rivers into the central and southern Delta. Greater exports during the summer and spring, lower Delta inflow months, could draw salinity further into the central and southern Delta. Like the X2 analysis above, Delta outflow can be used as an indicator of potential changes to salinity concentrations resulting from the Proposed Action.

H.6 Significance Criteria

The significance criteria described below were developed with guidance from California Environmental Quality Act (CEQA) Guidelines to determine the significance of potential impacts on water quality that could result from implementation of the Project. Impacts would be significant if they resulted in one or more of the following conditions or situations:

1. Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or groundwater quality.

2. Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner that would: (a) result in substantial erosion or siltation on- or off-site or (b) create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff.
3. Conflict with or obstruct implementation of a water quality control plan.

The DMC is not located within a flood hazard, tsunami, or seiche zone. Therefore, risk of pollutants due to Project inundation within a flood hazard, tsunami, or seiche zone does not exist and has not been evaluated under the Proposed Action.

H.7 Project Impacts and Mitigation Measures

H.7.1 No Action Alternative

As discussed in Section 2.1 of the EA/IS, the No Action Alternative presents conditions in the absence of the Proposed Action. Under NEPA, the No Action Alternative reflects expected future conditions in the Project area if no action is taken. This EA/IS uses future projected CalSim II hydrology and the estimated reduced DMC capacity as a result of future subsidence for the future no action. This differs under CEQA, where existing conditions serve as the baseline to determine potential impacts of the alternatives. This EA/IS uses historic CalSim II hydrology and the current reduced DMC capacity for existing conditions.

H.7.1.1 Impact WQ-1: Would the alternative violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or groundwater quality?

Under the No Action Alternative, no actions would be taken to restore, or otherwise offset, conveyance capacity lost in the DMC. No physical modifications, operational or institutional changes would occur under this alternative that would degrade existing water quality conditions. Water quality conditions within the area of analysis would remain similar to existing and future no action conditions. **This alternative would have no impact on water quality.**

H.7.1.2 Impact WQ-2: Would the alternative substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces?

Under the No Action Alternative, no actions would be taken to restore, or otherwise offset, conveyance capacity lost in the DMC. No physical modifications, operational or institutional changes would occur under this alternative that would alter existing drainage patterns or create or contribute runoff water. Water quality conditions within the area of analysis would remain similar to existing and future no action conditions. **This alternative would have no impact on water quality.**

H.7.1.3 Impact WQ-3: Would the alternative conflict with or obstruct implementation of a water quality control plan?

Under the No Action Alternative, no actions would be taken to restore, or otherwise offset, conveyance capacity lost in the DMC. As discussed in Section H.7.1.1, water quality conditions within the area of analysis would remain similar to existing and future no action conditions. Therefore, this alternative would not conflict with or obstruct implementation of a water quality control plan. **This alternative would have no impact on water quality.**

H.7.2 Proposed Action

H.7.2.1 Impact WQ-1: Would the alternative violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or groundwater quality?

During construction, the exposure of bare soils, soil and material stockpiles, and the presence of fuels, lubricants, and solid and liquid wastes could cause short-term surface or groundwater water quality impacts to the DMC and adjacent water bodies if not managed properly. The proposed modification of the DMC under the Proposed Action would include adding fill material along the canal right-of-way and excavation of the earthen materials from the sides of the canal. Filling and dredging activities could degrade water quality during construction. **This impact would be significant.**

Implementation of Mitigation Measure (MM) WQ-1, as described in Section H.7.3, would require the preparation of a Stormwater Pollution Prevention Plan (SWPPP). Additionally, CVRWQCB would require Best Management Practices (BMPs), monitoring and other construction controls to protect water quality. **With the implementation of MM WQ-1, this impact would be less than significant.**

As noted under Section H.4, water quality in the Delta and the south-of-Delta CVP and SWP is closely related to changes in hydrodynamics. Changes in south-of-Delta exports are directly linked to changes in Delta outflow, which can impact water quality conditions (e.g., salinity and TDS levels) in the southern Delta and south-of-Delta CVP and SWP service areas.

X2 calculations were completed to determine the movement of salinity throughout the Delta under the Proposed Action. Table H-3 and Table H-4 summarize X2 results which modeled potential changes in salinity in comparison to the existing conditions. Table H-5 and Table H-6 summarize X2 results in comparison to the future no action. Positive values indicate movement of the salinity zone into the Delta while negative values indicate the zones movement out of the Delta. Under the Proposed Action there would be limited changes, less than one kilometer on average, in the position of the X2. Considering X2 moves several kilometers every few hours twice per day (Water Education Foundation 2014), this change would not be significant. Under the operation of the Proposed Action, X2 results indicate that there would be no changes to Delta salinity levels resulting from changes in Delta outflows.

Table H-3. Modeled Difference in Delta X2 between Existing Conditions and the Proposed Action (km change[1])

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.1	-0.3	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0
D	0.0	0.0	0.1	0.3	0.1	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
C	0.0	-0.1	0.1	0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
All	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes: Modeling Period 1922-2003, Data results from CalSim modeling.

[1] Positive values indicate movement of the salinity zone into the Delta while negative values indicate the zones movement out of the Delta.

Key: AN = Above Normal; BN = Below Normal; C = Critical; D = Dry; Sac Yr Type = Sacramento River Water Year Type; W = Wet

Table H-4. Modeled Difference in Delta X2 between Existing Conditions and the Proposed Action (percent change)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	0.0%	0.0%	0.2%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AN	0.0%	0.0%	0.1%	0.0%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.1%
BN	0.0%	0.2%	-0.3%	0.1%	0.2%	0.1%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%
D	0.0%	0.0%	0.1%	0.3%	0.2%	0.0%	0.0%	0.0%	-0.1%	0.0%	0.0%	0.0%
C	0.0%	-0.1%	0.1%	0.1%	-0.1%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
All	0.0%	0.0%	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling. CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.

Key: AN = Above Normal; BN = Below Normal; C = Critical; D = Dry; Sac Yr Type = Sacramento River Water Year Type; W = Wet

Table H-5. Modeled Difference in Delta X2 between Future No Action and the Proposed Action (km change[1])

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	0.0	0.0	0.3	0.1	0.2	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
AN	0.0	0.0	0.1	0.4	0.3	0.0	0.0	0.0	0.0	0.1	-0.2	-0.1
BN	-0.1	-0.5	0.7	0.5	0.3	0.4	0.1	0.1	0.0	0.0	0.0	-0.1
D	0.0	0.0	-0.4	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
C	-0.1	0.0	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
All	0.0	-0.1	0.1	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling.

[1] Positive values indicate movement of the salinity zone into the Delta while negative values indicate the zones movement out of the Delta.

Key: AN = Above Normal; BN = Below Normal; C = Critical; D = Dry; Sac Yr Type = Sacramento River Water Year Type; W = Wet

Table H-6. Modeled Difference in Delta X2 between Future No Action and the Proposed Action (percent change)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	0.0%	0.0%	0.4%	0.2%	0.3%	0.1%	0.0%	0.0%	0.1%	0.0%	-0.1%	-0.1%
AN	0.0%	0.0%	0.1%	0.5%	0.5%	0.0%	0.0%	0.0%	0.0%	0.1%	-0.3%	-0.2%
BN	-0.1%	-0.6%	0.8%	0.7%	0.4%	0.6%	0.2%	0.1%	0.0%	0.0%	-0.1%	-0.1%
D	0.0%	0.0%	-0.4%	0.2%	0.3%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
C	-0.1%	0.0%	-0.3%	-0.1%	0.0%	0.0%	-0.1%	0.0%	0.0%	0.0%	0.1%	0.0%
All	0.0%	-0.1%	0.1%	0.3%	0.3%	0.2%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling. CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.
Key: AN = Above Normal; BN = Below Normal; C = Critical; D = Dry; Sac Yr Type = Sacramento River Water Year Type; W = Wet

Under the Proposed Action, south-of-Delta exports are expected to increase, as operation of the DMC at design capacity would allow for the full use of Jones Pumping Plant. As shown in Table H-7 through Table H-10, this would be an approximately one percent total change on average compared to existing and future no action conditions and is not expected to have a measurable impact on water quality conditions in the Delta. In addition, the Proposed Action would be operated consistent with all environmental requirements pertaining to Delta operations, including the 2019 USFWS and NMFS Biological Opinions for CVP and SWP operations and any future biological opinions or requirements.

Table H-7. Modeled Difference in Total South-of-Delta Exports between Existing Conditions and the Proposed Action (1,000 AF)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	3	16	7	3	6	-6	-4	-1	0	7	7	4	44
AN	-3	13	11	0	-8	-1	1	0	-1	5	32	14	63
BN	2	-30	8	0	3	0	2	2	-1	19	20	0	24
D	3	-5	3	-1	-3	0	-1	-2	4	30	9	4	42
C	4	12	-1	-5	-1	-5	0	0	2	5	8	0	20
All	2	3	6	0	1	-3	-1	0	1	14	14	4	39

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling.
Key: AN = Above Normal; BN = Below Normal; C = Critical; D = Dry; Sac Yr Type = Sacramento River Water Year Type; W = Wet

Table H-8. Modeled Difference in Total South-of-Delta Exports between Existing Conditions and the Proposed Action (percent change)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	1%	3%	1%	1%	1%	-1%	-1%	0%	0%	1%	1%	1%	1%
AN	-1%	2%	2%	0%	-2%	0%	0%	0%	0%	1%	6%	2%	1%
BN	0%	-6%	2%	0%	1%	0%	1%	1%	0%	3%	3%	0%	0%
D	1%	-1%	1%	0%	-1%	0%	0%	-1%	2%	6%	3%	1%	1%
C	2%	5%	0%	-1%	0%	-2%	0%	0%	2%	4%	4%	0%	1%
All	0%	1%	1%	0%	0%	-1%	0%	0%	0%	3%	3%	1%	1%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling. CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.
Key: AN = Above Normal; BN = Below Normal; C = Critical; D = Dry; Sac Yr Type = Sacramento River Water Year Type; W = Wet

Table H-9. Modeled Difference in Total South-of-Delta Exports between Future No Action and the Proposed Action (1,000 AF)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	-2	21	7	11	4	-3	-3	-1	0	14	11	13	72
AN	-3	13	-16	1	-4	-3	0	1	-9	23	29	20	54
BN	-34	47	1	0	20	0	0	2	1	13	27	8	86
D	3	-30	-15	5	-2	-2	0	0	13	52	3	4	30
C	-5	-13	13	9	2	2	0	0	30	1	-5	6	38
All	-7	9	-1	6	4	-1	-1	0	6	22	12	10	58

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling.
Key: AN = Above Normal; BN = Below Normal; C = Critical; D = Dry; Sac Yr Type = Sacramento River Water Year Type; W = Wet

Table H-10. Modeled Difference in Total South-of-Delta Exports between No Future Action and the Proposed Action (percent change)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
W	0%	4%	1%	2%	1%	-1%	-1%	0%	0%	3%	2%	2%	1%
AN	-1%	3%	-3%	0%	-1%	-1%	0%	0%	-3%	5%	5%	4%	1%
BN	-7%	12%	0%	0%	4%	0%	0%	1%	0%	2%	5%	1%	2%
D	1%	-8%	-4%	1%	-1%	-1%	0%	0%	5%	16%	2%	1%	1%
C	-3%	-9%	4%	3%	0%	1%	0%	0%	26%	1%	-4%	3%	2%
All	-2%	2%	0%	1%	1%	0%	0%	0%	2%	5%	3%	2%	1%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling. CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.
Key: AN = Above Normal; BN = Below Normal; C = Critical; D = Dry; Sac Yr Type = Sacramento River Water Year Type; W = Wet

Under operation of the Proposed Action, Delta outflows are expected to decrease during winter months as the change in operations increase exports with the DMC operation at design capacity. Like the X2 analysis above, Delta outflow can be used as an indicator of potential changes to salinity concentrations as a result of the Proposed Action. Table H-11 through Table H-14 show the change in Delta outflow under the Proposed Action compared to existing and future no action conditions. As shown in Table H-12 and Table H-14, operation of the Proposed Action would result in a less than one percent change on average compared to existing and future no action conditions and is not expected to have a measurable impact on water quality conditions in the Delta.

Table H-11. Modeled Difference in Total Delta Outflow between Existing Conditions and the Proposed Action (cubic feet per second)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
-2	-10	-11	-5	-9	3	3	-1	0	0	-1	0	-2
1	-8	-14	-3	-12	0	-2	1	-2	0	-3	1	1
-10	19	-15	-4	-13	0	-10	-6	1	0	1	1	-10
-1	-6	-28	0	-3	-2	0	1	-1	0	1	0	-1
5	-8	0	6	-1	-1	0	0	-1	0	-2	0	5
-2	-4	-14	-2	-7	0	-1	-1	0	0	0	0	-2

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling.
Key: AN = Above Normal; BN = Below Normal; C = Critical; D = Dry; Sac Yr Type = Sacramento River Water Year Type; W = Wet

Table H-12. Modeled Difference in Total Delta Outflow between Existing Conditions and the Proposed Action (percent change)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	0%	-2%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
AN	0%	-2%	-1%	0%	0%	0%	0%	0%	0%	0%	-1%	0%
BN	-3%	3%	-1%	0%	-1%	0%	-1%	-1%	0%	0%	0%	1%
D	0%	-1%	-2%	0%	0%	0%	0%	0%	0%	0%	1%	0%
C	2%	-4%	0%	1%	0%	0%	0%	0%	0%	0%	-1%	0%
All	0%	-1%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling. CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.
Key: AN = Above Normal; BN = Below Normal; C = Critical; D = Dry; Sac Yr Type = Sacramento River Water Year Type; W = Wet

Table H-13. Modeled Difference in Total Delta Outflow between Future No Action and the Proposed Action (cubic feet per second)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	-2	-20	-15	-29	-2	5	3	-1	0	4	0	-1
AN	2	-15	2	-31	-7	14	-1	0	-5	19	-1	-3
BN	28	-65	-25	-4	-42	2	-5	2	-2	4	1	5
D	0	21	-23	-11	1	-13	2	-1	0	0	1	1
C	-3	17	-26	-10	4	0	0	0	1	-8	6	0
All	4	-13	-18	-18	-8	1	0	0	-1	3	1	0

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling.
Key: AN = Above Normal; BN = Below Normal; C = Critical; D = Dry; Sac Yr Type = Sacramento River Water Year Type; W = Wet

Table H-14. Modeled Difference in Total Delta Outflow No Future Action and the Proposed Action (percent change)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	0%	-3%	-1%	0%	0%	0%	0%	0%	0%	1%	0%	0%
AN	0%	-3%	0%	-1%	0%	0%	0%	0%	-1%	3%	0%	0%
BN	8%	-10%	-1%	0%	-2%	0%	0%	0%	0%	1%	0%	3%
D	0%	5%	-1%	-1%	0%	-1%	0%	0%	0%	0%	0%	0%
C	-1%	4%	-4%	-1%	0%	0%	0%	0%	0%	-3%	3%	0%
All	1%	-2%	-1%	-1%	0%	0%	0%	0%	0%	1%	0%	0%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling. CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.
Key: AN = Above Normal; BN = Below Normal; C = Critical; D = Dry; Sac Yr Type = Sacramento River Water Year Type; W = Wet

While there would be changes to Delta exports and outflows, changes in Delta water quality would not be measurably impacted. **Therefore, operation of the Proposed Action would not substantially degrade Delta water quality and would have a less than significant impact on water quality standards.**

The DMC is not an impaired water body listed on the Section 303(d) list and currently meets CWA water quality standards. Reclamation monitors and evaluates the quality of water in the DMC to ensure water is suitable for downstream agricultural and wetland use. The Proposed Action would restore conveyance capacity in the DMC back to its original design capacity. The DMC's operations after construction are expected to continue as they were executed following the original construction of the canal. **Therefore, no impact on water quality in the DMC is expected from the long-term operation the Proposed Action.**

San Luis Reservoir is capable of receiving water from the DMC, which enables the CVP to pump water into the reservoir during the wet season (October through March) and release water into the conveyance facilities during the dry season (April through September) when demands are higher. Operation of the Proposed Action would result in minor fluctuations of storage levels within San Luis Reservoir. Based on CalSim II modeling results, operation of the Proposed Action would lead to an average maximum change in elevation of four feet, or a less than one percent change,

compared to existing conditions. Operation of the Proposed Action would lead to an average maximum change in elevation of five feet, or a one percent change, compared to future no action conditions. Table H-15 through Table H-18 summarize the monthly change in total San Luis Reservoir elevation under the Proposed Action compared to existing and future no action conditions. As shown in Table H-16 and Table H-18, operation of the Proposed Action would result in a less than one percent change on average compared to existing and future no action conditions and is not expected to have a measurable impact on water quality conditions in San Luis Reservoir. **Therefore, there would be no impact on water quality in San Luis Reservoir from the long-term operation the Proposed Action.**

Table H-15. Modeled Difference in San Luis Reservoir Elevation between Existing Conditions and the Proposed Action (feet)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	-1	0	1	-1	0	0	-1	0	-2	-4	-3	-2
AN	-1	0	1	-1	0	0	0	-1	-4	-9	-3	-1
BN	-3	-5	-4	0	1	1	0	0	-2	-5	-4	-4
D	-1	-1	-1	1	1	1	1	1	-1	-1	-3	-1
C	1	3	2	-1	-1	-1	-1	-1	-1	-1	0	0
All	-1	-1	0	0	0	0	0	0	-2	-4	-3	-2

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling.
Key: AN = Above Normal; BN = Below Normal; C = Critical; D = Dry; Sac Yr Type = Sacramento River Water Year Type; W = Wet

Table H-16. Modeled Difference in San Luis Reservoir Elevation between Existing Conditions and the Proposed Action (percent change)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-1%	0%
AN	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-2%	-1%	0%
BN	-1%	-1%	-1%	0%	0%	0%	0%	0%	-1%	-1%	-1%	-1%
D	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	0%
C	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
All	0%	0%	0%	0%	0%	0%	0%	0%	0%	-1%	-1%	0%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling. CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.
Key: AN = Above Normal; BN = Below Normal; C = Critical; D = Dry; Sac Yr Type = Sacramento River Water Year Type; W = Wet

Table H-17. Modeled Difference in San Luis Reservoir Elevation between Future No Action and the Proposed Action (1,000 AF)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	-4	-1	0	-2	-1	-1	-1	-1	-2	-5	-6	-4
AN	-2	-1	-3	2	2	3	2	2	-3	-7	-4	-1
BN	-10	-4	-4	0	2	2	2	1	-2	-7	-8	-6
D	0	-4	-4	0	0	-1	-1	-1	-2	-1	-3	-2
C	-3	-5	-2	-6	-5	-5	-5	-5	-3	-4	-5	-4
All	-4	-3	-2	-1	0	0	0	-1	-2	-5	-5	-3

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling.
Key: AN = Above Normal; BN = Below Normal; C = Critical; D = Dry; Sac Yr Type = Sacramento River Water Year Type; W = Wet

Table H-18. Modeled Difference in San Luis Reservoir Elevation between Future No Action and the Proposed Action (percent change)

Sac Yr Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	-1%	0%	0%	0%	0%	0%	0%	0%	-1%	-1%	-1%	-1%
AN	0%	0%	-1%	0%	1%	1%	0%	0%	-1%	-2%	-1%	0%
BN	-2%	-1%	-1%	0%	0%	0%	0%	0%	0%	-2%	-2%	-2%
D	0%	-1%	-1%	0%	0%	0%	0%	0%	-1%	0%	-1%	0%
C	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%
All	-1%	-1%	0%	0%	0%	0%	0%	0%	-1%	-1%	-1%	-1%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling. CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.
Key: AN = Above Normal; BN = Below Normal; C = Critical; D = Dry; Sac Yr Type = Sacramento River Water Year Type; W = Wet

H.7.2.2 Impact WQ-2: Would the alternative substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces?

The proposed modification of the DMC under the Proposed Action would include adding fill material along the canal right-of-way and excavation of the earthen materials from the sides of the canal. Soil disturbance could result in localized surface erosion, minor changes in drainage patterns, and changes in erosion rates. Therefore, construction-related activities have the potential to degrade water quality and create additional sources of polluted runoff. **This impact would be significant.**

Implementation of MM WQ-1, as described in Section H.7.3, would require the preparation of a SWPPP. Additionally, CVRWQCB would require BMPs, monitoring and other construction controls to protect water quality. **With implementation of MM WQ-1, this impact would be less than significant.**

H.7.2.3 Impact WQ-3: Would the alternative conflict with or obstruct implementation of a water quality control plan?

Several different regional water quality control plans govern water bodies within the Project area (See Section E.2.22 in Appendix E). These plans establish water quality standards and requirements for parameters such as toxic chemicals, bacterial contamination, and other factors which have the potential to adversely affect beneficial uses or cause nuisance conditions (SWRCB 2018). Construction-related activities have the potential to degrade water quality under the Proposed Action, which could affect the ability to meet objectives in a water quality control plan. **This impact would be significant.**

Implementation of MM WQ-1, as described in Section H.7.3, would require the preparation of a SWPPP. Additionally, CVRWQCB would require BMPs, monitoring and other construction controls to protect water quality. **With implementation of MM WQ-1, this impact would be less than significant.**

As previously discussed in Section H.7.2.1, changes to Delta water quality as a result of the operation of the Proposed Action would be minimal and would not cause nuisance conditions or adversely affect beneficial use of the Delta. **Therefore, operation of the Proposed Action would not conflict with or obstruct implementation of a water quality control plan and would have a less than significant impact on water quality.**

H.7.3 Mitigation Measures

MM WQ-1: Prepare site-specific Stormwater Pollution Prevention Plan (SWPPP). The objectives of the SWPPP would be to: (1) identify pollutant sources that may affect the quality of stormwater associated with construction activity; and (2) identify, construct, and implement stormwater pollution prevention measures to reduce pollutants in stormwater discharges during and after construction. The SWPPP would also include details of how the sediment and erosion control practices, referred to as BMPs would be implemented. The implementation of the SWPPP would comply with state and federal water quality regulations.

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Delta-Mendota Canal Subsidence Correction Project Environmental Assessment/Initial Study

Appendix I1: Air Quality Technical Appendix

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Appendix I1 Air Quality Technical Appendix

This appendix documents the air quality technical analysis to support the impact analysis in the Environmental Assessment/Initial Study (EA/IS) and describes the potential air quality effects that could result from the implementation of the No Action/No Project Alternative (subsequently identified as the No Action Alternative) and the Proposed Action/Proposed Project (subsequently identified as the Proposed Action) considered by the EA/IS. Effects on air quality resulting from the construction and operation associated with the Proposed Action may occur in the San Joaquin Valley region alongside the Delta-Mendota Canal (DMC).

Air quality is affected by a combination of meteorological conditions that affect the dispersal of pollutants within a region and of the rate, quantity, and location of pollutant emissions throughout a region. Atmospheric conditions including wind speed and direction, and air temperatures, and local surface topography (i.e., the geographic features of a region) all play a role in the effect of air pollutant emissions on regional air quality.

I1.1 Existing Conditions

Although the Project area is confined to the DMC right-of-way (ROW), the study area for air quality is broader. The study area follows the route of the DMC, originating in Contra Costa County and passing through Alameda, San Joaquin, Stanislaus, and Merced Counties before terminating in Fresno County. No construction activities are planned to be undertaken within Contra Costa County under the Proposed Action; thus, Contra Costa County is excluded from the air quality study area. Alameda County is within the San Francisco Bay Area Air Basin (SFBAAB) where air pollution is regulated by the Bay Area Air Quality Management District (BAAQMD), while San Joaquin, Stanislaus, Merced, and Fresno counties are within the San Joaquin Valley Air Basin (SJVAB), regulated by the San Joaquin Valley Air Pollution Control District (SJVAPCD).

The SFBAAB is bordered on the west by the Coast Range and Pacific Ocean, and on the south and east by warmer inland valleys, including the SJVAB. The SJVAB is bordered on the west by the Coast Range, on the east by the Sierra Nevada Mountains, and on the south by the Tehachapi Mountains. The study area is highly susceptible to air pollutant accumulation because of the topographical boundaries of the mountain ranges to low atmospheric air currents.

The study area's low average wind speeds in winter months contribute to higher pollutant concentrations in the region. During summer months, winds driven by marine air currents typically flow in a south/southeasterly direction through the SFBAAB and SJVAB, originating through gaps in the Coast Range at the Golden Gate Strait and Carquinez Strait. These conditions contribute to persistent summer inversions, the trapping of cool marine air under a mass of warmer air in the atmosphere, that stymie the vertical dispersion of air pollutants.

The federal Clean Air Act requires the classification of all, or portions, of air basins based on the ambient pollutant concentrations relative to the National Ambient Air Quality Standards (NAAQS). Areas for which the NAAQS have been achieved are designated as attainment. For areas for which the NAAQS have not been achieved, states must prepare a State Implementation Plan detailing strategies to reduce air pollutant concentrations in the area and achieve the NAAQS. California, through the California Clean Air Act has adopted additional California Ambient Air Quality

Standards (CAAQS), applicable only to California, for which attainment must be classified in addition to the NAAQS. Table I1-1 presents the attainment status of the SFBAAB and SJVAB.

Table I1-1. Attainment Status for the SFBAAB and SJVAB

Pollutant	National Standards[1,2,3]	California Standards[1,2]
Ozone (O_3)	SFBAAB – Nonattainment (Marginal) SJVAB – Nonattainment (Extreme)	SFBAAB – Nonattainment SJVAB – Nonattainment
Carbon monoxide (CO)	SFBAAB – Attainment SJVAB - Attainment	SFBAAB – Unclassified SJVAB – Unclassified
Nitrogen dioxide (NO_2)	SFBAAB – Attainment SJVAB - Attainment	SFBAAB – Attainment SJVAB - Attainment
Sulfur dioxide (SO_2)	SFBAAB – Attainment SJVAB - Attainment	SFBAAB – Attainment SJVAB - Attainment
Inhalable particulate matter (PM_{10})	SFBAAB – Attainment SJVAB – Maintenance	SFBAAB – Nonattainment SJVAB – Nonattainment
Fine particulate matter ($PM_{2.5}$)	SFBAAB – Nonattainment (Moderate) SJVAB – Nonattainment (Serious)	SFBAAB – Nonattainment SJVAB – Nonattainment
Lead (Pb)	SFBAAB – Attainment SJVAB - Attainment	SFBAAB – Attainment SJVAB - Attainment

Source: California Air Resources Board (CARB) 2022a; United States Environmental Protection Agency (USEPA) 2022a
Notes:

[1] Nonattainment means that the area does not meet the ambient air quality standard for the given pollutant.

[2] Attainment means that the area meets the ambient air quality standards for the given pollutant.

[3] Maintenance means that the area has recently met the ambient air quality standard for the given pollutant and must provide the U.S. Environmental Protection Agency (USEPA) with information demonstrating that it is maintaining the standard before the area can be redesignated as attainment.

Key: SFBAAB = San Francisco Bay Area Air Basin; SJVAB = San Joaquin Valley Air Basin

Sensitive receptors are locations where individuals susceptible to poor air quality, such as children, elderly, and people with preexisting health problems, may reside or spend significant amounts of time. Examples of sensitive receptors include residences, schools, parks, daycare centers, convalescent homes, and medical facilities. Numerous sensitive receptors exist throughout the study area which would be affected by regional air pollution emitted by the Proposed Action activities. Table I1-2 summarizes the potential health effects of prolonged exposure to high concentrations of criteria air pollutants. Exposure to concentrations below the NAAQS and CAAQS would reduce these health effects to levels appropriate to protect the health of the most sensitive groups in populations.

Table I1-2. Criteria Pollutants and their Health Effects

Pollutant	Characteristics	Health Effects	Major Sources
O_3	Highly reactive photochemical pollutant created by the action of sunshine on O_3 precursors	• Cough and chest tightness pain upon taking a deep breath • Worsening of wheezing and other asthma symptoms • Reduced lung function • Increased hospitalizations for respiratory causes	Pollutants emitted from vehicles, factories, and other industrial sources; fossil fuels combustion; consumer products; and evaporation of paints
CO	Highly toxic odorless, colorless gas; formed by the incomplete combustion of fuels	• Impairment of oxygen transport in the bloodstream • Aggravation of cardiovascular disease • Fatigue, headache, and dizziness	Carbon-containing fuels like gasoline or wood
NO_2	Reactive, oxidizing gas formed during combustion	• Respiratory symptoms • Episodes of respiratory illness • Impaired lung function	High-temperature combustion processes, such as those occurring in trucks, cars, and power plants
SO_2	Colorless gas with pungent odor	• Wheezing, shortness of breath, and chest tightness • Pulmonary symptoms and disease • Decreased pulmonary function • Increased risk of mortality	Sulfur-containing fuel burned by locomotives, ships, and off-road diesel equipment, or industrial sources like petroleum refining and metal processing
PM_{10} and $PM_{2.5}$	Small particles measuring 10 microns or less are termed PM10 (fine particles less than 2.5 microns are termed PM2.5); solid and liquid particles of dust, soot, aerosols, smoke, ash, and pollen and other matter that is small enough to remain suspended in the air for a long period	• Increased risk of hospitalization for lung and heart-related respiratory illness • Increased risk of premature deaths • Reduced lung function • Increased respiratory symptoms and illness	Burning fuels like gasoline, oil, and diesel or wood ($PM_{2.5}$) and windblown dust (PM_{10})

Pollutant	Characteristics	Health Effects	Major Sources
Pb	Soft resilient metal	• Impaired blood formation and nerve conduction • Fatigue, anxiety, short-term memory loss, depression, weakness in extremities, and learning disabilities in children • Cancer	Various industrial activities

Source: USEPA 2022b

Key: O_3 = ozone; CO = carbon monoxide; NO_2 = nitrogen dioxide; SO_2 = sulfur dioxide; PM_{10} = inhalable particulate matter; $PM_{2.5}$ = fine particulate matter; Pb = lead

I1.2 Assessment Methodology

This section describes the general assessment methods used to analyze the potential air quality effects of the Proposed Action described in the EA/IS.

I1.2.1 Construction

Emissions from construction-related equipment engine exhaust were estimated using emission factors derived from emissions and activity data from the California Air Resources Board (CARB) EMFAC2017 on-road component of the CARB's web-based emissions model and the OFFROAD2021 off-road component of the CARB's web-based emissions model (CARB 2022b, 2022c). Although a more recent version of the on-road component (EMFAC2021) has been developed by CARB, that model has not yet been approved by the United States Environmental Protection Agency (USEPA) for use in regulatory purposes. In the estimation of construction equipment emission factors, only equipment of model year 2015 or newer, representative of USEPA Tier 4 final engine standard equipment, were considered. Hauling and delivery vehicles were also assumed to be of model year 2015 or newer.

Task-specific construction equipment, personnel, haul and excavation quantities, and scheduling information was derived from the Bureau of Reclamation's (Reclamation's) 2021 *Delta-Mendota Canal Subsidence Project: Feasibility Study of the Structural Alternatives*. It was assumed that 50 percent of necessary backfill material would be reused from materials excavated on-site. Haul trucks were assumed to be at least 10 cubic yards in capacity for all construction. Vendor delivery trip counts, if not provided in Reclamation's 2021 *Delta-Mendota Canal Subsidence Project: Feasibility Study of the Structural Alternatives* for a given element of action construction, were estimated based on the estimated typical square-footage of the construction element and default vendor delivery rates from the California Air Pollution Control Officers Association (CAPCOA) California Emissions Estimator Model (CalEEMod) version 2022.1. Haul route, worker commute, and vendor delivery distances were based on default regional values from the CAPCOA California Emissions Estimator Model (CalEEMod) version 2022.1 (California Air Pollution Control Officers Association [CAPCOA] 2022).

All equipment was assumed to operate over single, 10-hour shifts throughout the construction durations. Nonexhaust air pollutant emission from construction, such as those which would result from bulldozing, grading, earthen material handling, or the re-entrainment of paved or unpaved road dust by construction vehicles, were estimated using emission factors from the USEPA's Compilation

of Air Pollutant Emissions Factors (AP-42) resource and the equipment activities and material quantities discussed previously (USEPA 2022c).

A health risk screening assessment was conducted to assess construction-related TAC emissions. The assessment utilized SJVAPCD's Prioritization tool, with inputs modified to reflect the short-term and temporary exposure of construction activities.

I1.2.2 Operation

While the Proposed Action would modify the structure of the existing canal, these modifications would not be expected to result in an operational change to air pollutants emissions relative to the existing, or future no action, conditions. Therefore, emissions of air pollutants potentially attributable to canal operation were not quantified.

I1.3 Significance Criteria

The thresholds of significance for impacts address the environmental checklist items from Appendix G of the State California Environmental Quality Act Guidelines as well as federal air quality requirements. The Proposed Action would result in a significant impact to air quality if it would:

1. Result in emissions of air pollutants exceeding the General Conformity *de minimis* emission levels or the quantitative criteria promulgated by the applicable local air pollution control agency.
2. Expose sensitive receptors to substantial pollutant concentrations.
3. Result in other emissions, such as those leading to objectionable odors, adversely affecting a substantial number of people.

The environmental checklist from Appendix G of the State California Environmental Quality Act (CEQA) Guidelines indicates that a project would result in a significant impact on air quality if it would (1) would conflict with or obstruct implementation of the applicable air quality plan; (2) would result in a cumulatively considerable net increase of any criteria pollutant for which the project region is nonattainment under an applicable federal or state ambient air quality standard; (3) would expose sensitive receptors to substantial pollutant concentrations; or (4) would result in other emissions, such as those leading to objectionable odors, adversely affecting a substantial number of people. Quantitative significance criteria have been developed by the BAAQMD and SJVAPCD. These criteria were developed such that a project consistent with the criteria would not be expected to exceed the CAAQS or NAAQS and would not conflict with or obstruct implementation of the respective applicable regional air quality plans. The USEPA's quantitative General Conformity *de minimis* emission levels were developed to ensure that federal projects in nonattainment areas would not conflict with a region's attainment or progress toward attainment of the NAAQS. Although not nonattainment pollutants, volatile organic compounds (VOC)/reactive organic gases (ROG) and oxides of nitrogen (NO_X) are precursor compounds to O_3, which develops in the atmosphere and is not directly emitted by combustion sources. Therefore, significance criteria have been developed by the applicable agencies and USEPA for ROG and NO_X for the control of regional O_3 concentrations. Table I1-3 lists the General Conformity *de minimis* emission levels applicable to the SJVAB and SFBAAB. Table I1-4 lists the applicable emissions criteria of the BAAQMD and SJVAPCD. Criteria are presented in tons per year (tpy) or average pounds per day (lb./day). These quantitative criteria address the Proposed Action's consistency with items (1) and (2) of the CEQA checklist.

Table I1-3. General Conformity *de minimis* Emission Levels

Air Basin	VOC	CO	NO_X	SO_X	PM_{10}	$PM_{2.5}$
SFBAAB	100 tpy	n/a	100 tpy	n/a	n/a	100 tpy
SJVAB	10 tpy	n/a	10 tpy	n/a	100 tpy	70 tpy

Source: USEPA 2022d

Key: SFBAAB = San Francisco Bay Area Air Basin; CO = carbon monoxide; n/a = not applicable; NO_x = nitrous oxide; $PM_{2.5}$ = fine particulate matter PM_{10} = inhalable particulate matter; San Francisco Bay Area Air Basin; SJVAB = San Joaquin Valley Air Basin; SO_x = sulfur oxide; tpy = tons per year; VOC = volatile organic compound

Table I1-4. Quantitative Air Quality Significance Criteria for Construction

Air Agency	ROG	CO	NO_X	SO_X	PM_{10}	$PM_{2.5}$
BAAQMD	54 lb./day	n/a	54 lb./day	n/a	82 lb./day	54 lb./day
SJVAPCD	10 tpy	100 tpy	10 tpy	27 tpy	15 tpy	15 tpy

Source: Bay Area Air Quality Management District (BAAQMD) 2017; San Joaquin Valley Air Pollution Control District (SJVAPCD) 2015

Key: BAAQMD = Bay Area Air Quality Management District; CO = carbon monoxide; lb./day = pounds per day; n/a = not applicable; NO_x = nitrous oxide; $PM_{2.5}$ = fine particulate matter; PM_{10} = inhalable particulate matter; ROG = reactive organic gases; SJVAPCD = San Joaquin Valley Air Pollution Control District; SO_x = sulfur oxide; tpy = tons per year

I1.4 Project Impacts and Mitigation Measures

I1.4.1 No Action Alternative

I1.4.1.1 Impact AQ-1: Would the alternative result in emissions of air pollutants exceeding the General Conformity de minimis *emission levels or a quantitative threshold promulgated by the applicable local air pollution control agency?*

Under the No Action Alternative, no actions would be taken to restore, or otherwise offset, conveyance capacity lost in the DMC. Operational changes would occur to compensate for the effects of future land subsidence on the capacity of the DMC, but these changes would be minor and would not result in an appreciable change to regional air pollutant emissions. **Therefore, impacts to air quality relative to air pollutant emissions from the No Action Alternative would be less than significant**.

I1.4.1.2 Impact AQ-2: Would the alternative expose sensitive receptors to substantial pollutant concentrations?

Under the No Action Alternative, no action would be taken to restore, or otherwise offset, conveyance capacity lost in the DMC; therefore, there would be no short-term exposure of sensitive receptors to construction-related emissions of toxic air contaminants (TAC). Operational changes would occur to compensate for the effects of future land subsidence on the capacity of the DMC, but these changes would be minor and would not result in an appreciable change to localized concentrations of TAC. **Therefore, impacts to air quality relative to the exposure of sensitive receptors to substantial pollutant concentrations would be less than significant.**

I1.4.1.3 Impact AQ-3: Would the alternative result in other emissions, such as those leading to objectionable odors, adversely affecting a substantial number of people?

Under the No Action Alternative, no action would be taken to restore, or otherwise offset, conveyance capacity lost in the DMC; therefore, there would be no short-term dust or odors from construction activities. Operational changes would occur to compensate for the effects of future land subsidence on the capacity of the DMC, but these changes would be minor and would not result in an appreciable change to odors or dust associated with operation of the DMC. **Therefore, impacts to air quality relative to other emissions adversely affecting a substantial number of people would be less than significant.**

I1.4.2 Proposed Action

I1.4.2.1 Impact AQ-1: Would the alternative result in emissions of air pollutants exceeding the General Conformity de minimis *emission levels or a quantitative threshold promulgated by the applicable local air pollution control agency?*

Under the Proposed Action, construction would last for approximately seven and a half years, with the time spent at various locations along the canal. As shown in Table I1-5, construction activities along the canal would generate air pollutant emissions which would be less than the USEPA General Conformity *de minimis* levels and would be less than the BAAQMD and SVJAPCD quantitative thresholds. Operation of the DMC under the Proposed Action would not be expected to result in an appreciable change to regional air pollutant emissions relative to the existing, or future no action, conditions. **Therefore, impacts to air quality relative to air pollutant emissions from the Proposed Action would be less than significant**.

Table I1-5. Proposed Action Construction Emissions Compared to Local Air Pollution Control Agencies Criteria

Construction	ROG/VOCs	NOx	CO	SOx	PM_{10}	$PM_{2.5}$
BAAQMD						
Emissions (lb./day)	2.1	18.6	37.9	0.1	12.5	2.7
BAAQMD Significance Thresholds (lb./day)	54	54	n/a	n/a	82	54
Exceeds Thresholds?	No	No	n/a	n/a	No	No
Emissions (tpy)	0.3	2.4	5.0	<0.1	1.6	0.4
General Conformity *de minimis* (tpy)	100	100	n/a	n/a	n/a	100
Exceeds General Conformity?	No	No	n/a	n/a	n/a	No
SJVAPCD						
Emissions (tpy)	0.6	5.3	9.3	<0.1	3.6	0.8
SJVAPCD Significance Thresholds (tpy)	10	10	100	27	15	15
Exceeds Thresholds?	No	No	No	No	No	No
General Conformity *de minimis* (tpy)	10	10	n/a	n/a	100	70
Exceeds General Conformity?	No	No	n/a	n/a	No	No

Source: BAAQMD 2017; SJVAPCD 2015

Key: BAAQMD = Bay Area Air Quality Management District; CO = carbon monoxide; lb./day = pounds per day; n/a = not applicable; NOx = nitrogen oxides; PM_{10} = inhalable particulate matter; $PM_{2.5}$ = fine particulate matter; ROG = reactive organic gases; SJVAPCD = San Joaquin Valley Air Pollution Control District; SO_2 = sulfur dioxide; tpy = tons per year; VOCs = volatile organic compounds

I1.4.2.2 Impact AQ-2: Would the alternative expose sensitive receptors to substantial pollutant concentrations?

Under the Proposed Action, construction would last for approximately seven and a half years, with the time spent at various locations along the canal. Construction activities along the canal have the potential to emit TAC in the form of construction equipment engine exhaust, including diesel particulate matter (DPM);[1] however, construction impacts from construction of the Proposed Action would be temporary and highly mobile, occurring for short periods along various points of the 116-mile DMC. In addition to the short-term, highly mobile nature of construction under the Proposed Action, pollutant concentrations have been shown to drop up to 70 percent at a distance of 500 feet from a vehicle exhaust source and up to 80 percent by 1,000 feet (CARB 2005). A health risk screening assessment of project construction TAC emissions, included in Appendix I3, confirmed that construction TAC emissions would not be expected to result in significant health risks to sensitive receptors nearest to project activities. Operation of the DMC under the Proposed Action would not be expected to result in an appreciable change to local TAC concentrations relative to the existing, or future no action, conditions. Therefore, the exposure of sensitive receptors to DPM or other potential TAC would be minimal. **Impacts to air quality relative to the exposure of sensitive receptors to substantial pollutant concentrations would be less than significant.**

I1.4.2.3 Impact AQ-3: Would the alternative result in other emissions, such as those leading to objectionable odors, adversely affecting a substantial number of people?

Under the Proposed Action, construction of the Project would last for approximately seven and a half years, with the time spent at various locations along the canal. Construction of the canal would result in the emission of diesel engine exhaust, which may generate near-field odors that certain individuals may find objectionable. Earthmoving activities and operation of construction vehicles on paved and unpaved roadways would also result in the generation of fugitive dust. Construction impacts from the Proposed Action would be temporary and highly mobile, occurring for short periods along various points of the 116-mile DMC. In addition to the short-term, highly mobile nature of construction, the watering of construction areas during earthmoving activities would reduce emissions of fugitive dust up to 61 percent (CAPCOA 2022). The DMC ROW also passes through predominantly rural, sparsely populated countryside with most individuals who might experience construction activities being passersby in motor vehicles. Operation of the DMC under the Proposed Action would not be expected to result in an appreciable change to change to odors or dust associated with operation of the DMC relative to the existing, or future no action, conditions. Therefore, relatively few individuals would have the potential to experience odors or dust related to construction activities, exposure to construction-related odors or dust for individuals near construction would minimal. **Impacts to air quality relative to other emissions adversely affecting a substantial number of people would be less than significant.**

I1.4.2.4 Mitigation Measures

No mitigation measures would be necessary to reduce impacts of the Proposed Action to the less than significant level.

[1] DPM is listed by California Office of Environmental Health Hazard Assessment (OEHHA) as a carcinogen and contributes to noncancer chronic health effects. OEHHA has not established a hazard index attributable to DPM for acute (short-term) health effects.

I1.5 Cumulative Impacts

Table I1-6 and Table I1-7 summarize the maximum annual cumulative construction emissions anticipated to result from the identified cumulative projects within the SFBAAB and SJVAB respectively. These emissions were obtained from publicly available environmental documents and represent the maximum annual construction emissions for each pollutant from each cumulative project after the application of applicable mitigations outlined in the respective environmental documents.

Table I1-6. San Francisco Bay Area Air Basin Cumulative Construction Emissions

Cumulative Development Projects	ROG / VOC	CO	NO_X	SO_X	PM_{10}	$PM_{2.5}$
Delta Conveyance Project (tpy)	3	122	27	<1	93	14
Los Vaqueros Reservoir Expansion Project (tpy)	10	74	86	--[1]	39	--[1]
Total Cumulative Development Projects (tpy)	**>13**	>196	**>113**	>1	**>132**	**>14**
BAAQMD's project-level quantitative criteria	54 lb./day (10 tpy)	n/a	54 lb./day (10 tpy)	n/a	82 lb./day (15 tpy)	54 lb./day (10 tpy)
Total greater than BAAQMD project-level quantitative criteria?	**yes**	n/a	**yes**	n/a	**yes**	**yes**

Source: Reclamation 2009, 2015

Note: Values in **bold** indicate that the BAAQMD significance threshold was exceeded.

Key: BAAQMD = Bay Area Air Quality Management District; CO = carbon monoxide; lb./day = pounds per day; n/a = not applicable; NOx = nitrogen oxides; PM_{10} = inhalable particulate matter; $PM_{2.5}$ = fine particulate matter; ROG = reactive organic gases; SJVAPCD = San Joaquin Valley Air Pollution Control District; SO_2 = sulfur dioxide; tpy = tons per year; VOCs = volatile organic compounds

Table I1-7. San Joaquin Valley Air Basin Cumulative Construction Emissions

Cumulative Development Projects	ROG / VOC	CO	NO_X	SO_X	PM_{10}	$PM_{2.5}$
Delta Conveyance Project (tpy)	2	34	34	<1	18	3
Mendota Pool Bypass and Reach 2B Improvements Project (tpy)	0[1]	>100	0[1]	1	0[1]	0[1]
San Luis Low Point Improvement Project (tpy)	6	49	9	<1	41	6
Del Puerto Canyon Reservoir Project (tpy)	3	93	17	<1	10	4
Total Cumulative Development Projects (tpy)	**>21**	**>276**	**>70**	>1	**>84**	**>28**
SJVAPCD's project-level quantitative criteria (tpy)	10	100	10	27	15	15
Total greater than SJVAPCD project-level quantitative criteria?	**yes**	**yes**	**yes**	no	**yes**	**yes**

Source: Del Puerto Water District (DPWD) 2019; Reclamation 2015, 2019

Notes:

[1] Zero values are based on the execution of the Voluntary Emissions Reduction Agreement on January 17, 2019, between Reclamation and SJVAPCD.

Values in **bold** indicate that the SJVAPCD significance threshold was exceeded.

Key: CO = carbon monoxide; NOx = nitrogen oxides; PM_{10} = inhalable particulate matter; $PM_{2.5}$ = fine particulate matter; ROG = reactive organic gases; SJVAPD = San Joaquin Valley Air Pollution Control District; SO_2 = sulfur dioxide; tpy = tons per year; VOCs = volatile organic compounds

I1.6 References

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Appendix I2
Air Quality and Greenhouse Gas Emissions Calculations

Key assumptions:
> Model year 2015+ construction equipment.
> Model year 2015+ haul trucks.
> Assumed 50% reuse of excavated material / topsoil on site for project elements where backfill is necessary.
> **Modification of the Earthen Lined Segment** under ADJUST CANAL INVERT AND RAISE DEFICIENT STRUCTURES ALTERNATIVE would occur at half the intensity described in Appendix G of the Delta-Mendota Canal Feasibility Study (i.e., only 18 sites of the canal would be worked concurrently instead of 36 sites and construction would take place over six years instead of three).

> Haul trucks would be assumed to be at least 10 cubic yards for all construction elements other than the **Modification of the Earthen-Lined Segment**, which would use 20 cubic yard hauling trucks.

> A single, 10-hour shift would be assumed daily for all construction elements other than the **Modification of the Earthen-Lined Segment,** which would have two, 10-hour shifts daily.

RAISE DEFICIENT STRUCTURES ALTERNATIVE (SJVAB)

Construction Phase	Start	End	POLLUTANT [TONS PER YEAR; METRIC TONS FOR CO2e] ROG	TOG	CO	NOx	SOx	PM10	PM2.5	CO2e
Bridge Replacement	04/07/2025	07/30/2032	0.1	0.1	2.2	0.8	<0.1	0.6	0.1	584
Concrete Lining w Associated Embankment Raise (low flow work)	10/01/2025	10/10/2029	0.1	0.1	1.4	1.0	<0.1	0.7	0.2	621
Concrete Lining Repairs (low season work)	10/01/2025	04/10/2026	0.1	0.1	1.0	0.7	<0.1	0.7	0.1	384
Stabilize Canal Banks Along Earthlined Segment (low flow work)	10/01/2025	10/06/2026	0.3	0.4	5.8	3.8	<0.1	2.6	0.6	2,321
Impacted Pipline Crossing Replacements (all season work)	04/07/2025	04/14/2027	<0.1	<0.1	0.6	0.3	<0.1	0.1	<0.1	170
Check Structures and Wasteways Modifications (low flow work)	10/01/2025	04/30/2030	<0.1	<0.1	0.2	0.1	<0.1	<0.1	<0.1	60
Turnout Modifications (all season work)	04/07/2025	04/14/2027	<0.1	<0.1	0.2	0.1	<0.1	<0.1	<0.1	74
Drainage Stucture Modifications (all season work)	04/07/2025	03/13/2028	<0.1	<0.1	0.1	0.1	<0.1	<0.1	<0.1	29
MAXIMUM ANNUAL TOTAL PROJECT EMISSIONS [TONS PER YEAR; METRIC TONS FOR CO2e]			**0.5**	**0.6**	**9.3**	**5.3**	**<0.1**	**3.6**	**0.8**	**3,408**
SJVAPCD CEQA Threshold:			10	n/a	100	10	27	15	15	n/a
Exceeds Threshold?			no	no	no	no	no	no	no	no
General Conformity De Minimis Emission Level:			10	n/a	n/a	10	n/a	100	70	n/a
Exceeds De Minimis Emission Level?			no	no	no	no	no	no	no	no

Key assumptions:
> Model year 2015+ construction equipment.
> Model year 2015+ haul trucks.
> Assumed 50% reuse of excavated material / topsoil on site for project elements where backfill is necessary.
> **Modification of the Earthen Lined Segment** under ADJUST CANAL INVERT AND RAISE DEFICIENT STRUCTURES ALTERNATIVE would occur at half the intensity described in Appendix G of the Delta-Mendota Canal Feasibility Study (i.e., only 18 sites of the canal would be worked concurrently instead of 36 sites and construction would take place over six years instead of three).

> Haul trucks would be assumed to be at least 10 cubic yards for all construction elements other than the **Modification of the Earthen-Lined Segment**, which would use 20 cubic yard hauling trucks.

> A single, 10-hour shift would be assumed daily for all construction elements other than the **Modification of the Earthen-Lined Segment,** which would have two, 10-hour shifts daily.

RAISE DEFICIENT STRUCTURES ALTERNATIVE (SJVAB)

Construction Phase	Start	End	ROG [TONS PER YEAR] 2025	2026	2027	2028	2029	2030	2031	2032
Bridge Replacement	04/07/2025	07/30/2032	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0
Concrete Lining w Associated Embankment Raise (low flow work)	10/01/2025	10/10/2029	<0.1	0.1	0.1	0.1	0.1	0.0	0.0	0
Concrete Lining Repairs (low season work)	10/01/2025	04/10/2026	<0.1	<0.1	0.0	0.0	0.0	0.0	0.0	0
Stabilize Canal Banks Along Earthlined Segment (low flow work)	10/01/2025	10/06/2026	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0
Impacted Pipline Crossing Replacements (all season work)	04/07/2025	04/14/2027	<0.1	<0.1	<0.1	0.0	0.0	0.0	0.0	0
Check Structures and Wasteways Modifications (low flow work)	10/01/2025	04/30/2030	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.0	0
Turnout Modifications (all season work)	04/07/2025	04/14/2027	<0.1	<0.1	<0.1	0.0	0.0	0.0	0.0	0
Drainage Stucture Modifications (all season work)	04/07/2025	03/13/2028	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0	0
MAXIMUM ANNUAL TOTAL PROJECT EMISSIONS [TONS PER YEAR; METRIC TONS FOR CO2e]			**0.2**	**0.5**	**0.2**	**0.2**	**0.2**	**0.1**	**0.1**	**0**
SJVAPCD CEQA Threshold:			10	10	10	10	10	10	10	10
Exceeds Threshold?			no	no	no	no	no	no	no	no
General Conformity De Minimis Emission Level:			10	10	10	10	10	10	10	10
Exceeds De Minimis Emission Level?			no	no	no	no	no	no	no	no

Key assumptions:
> Model year 2015+ construction equipment.
> Model year 2015+ haul trucks.
> Assumed 50% reuse of excavated material / topsoil on site for project elements where backfill is necessary.
> **Modification of the Earthen Lined Segment** under ADJUST CANAL INVERT AND RAISE DEFICIENT STRUCTURES ALTERNATIVE would occur at half the intensity described in Appendix G of the Delta-Mendota Canal Feasibility Study (i.e., only 18 sites of the canal would be worked concurrently instead of 36 sites and construction would take place over six years instead of three).

> Haul trucks would be assumed to be at least 10 cubic yards for all construction elements other than the **Modification of the Earthen-Lined Segment**, which would use 20 cubic yard hauling trucks.

> A single, 10-hour shift would be assumed daily for all construction elements other than the **Modification of the Earthen-Lined Segment,** which would have two, 10-hour shifts daily.

RAISE DEFICIENT STRUCTURES ALTERNATIVE (SJVAB)

Construction Phase	Start	End	TOG [TONS PER YEAR] 2025	2026	2027	2028	2029	2030	2031	2032
Bridge Replacement	04/07/2025	07/30/2032	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0
Concrete Lining w Associated Embankment Raise (low flow work)	10/01/2025	10/10/2029	<0.1	0.1	0.1	0.1	0.1	0.0	0.0	0
Concrete Lining Repairs (low season work)	10/01/2025	04/10/2026	<0.1	<0.1	0.0	0.0	0.0	0.0	0.0	0
Stabilize Canal Banks Along Earthlined Segment (low flow work)	10/01/2025	10/06/2026	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0
Impacted Pipline Crossing Replacements (all season work)	04/07/2025	04/14/2027	<0.1	<0.1	<0.1	0.0	0.0	0.0	0.0	0
Check Structures and Wasteways Modifications (low flow work)	10/01/2025	04/30/2030	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.0	0
Turnout Modifications (all season work)	04/07/2025	04/14/2027	<0.1	<0.1	<0.1	0.0	0.0	0.0	0.0	0
Drainage Stucture Modifications (all season work)	04/07/2025	03/13/2028	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0	0
MAXIMUM ANNUAL TOTAL PROJECT EMISSIONS [TONS PER YEAR; METRIC TONS FOR CO2e]			**0.3**	**0.6**	**0.3**	**0.2**	**0.2**	**0.1**	**0.1**	**0**
SJVAPCD CEQA Threshold:			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exceeds Threshold?			no	no	no	no	no	no	no	no
General Conformity De Minimis Emission Level:			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exceeds De Minimis Emission Level?			no	no	no	no	no	no	no	no

Key assumptions:
> Model year 2015+ construction equipment.
> Model year 2015+ haul trucks.
> Assumed 50% reuse of excavated material / topsoil on site for project elements where backfill is necessary.
> **Modification of the Earthen Lined Segment** under ADJUST CANAL INVERT AND RAISE DEFICIENT STRUCTURES ALTERNATIVE would occur at half the intensity described in Appendix G of the Delta-Mendota Canal Feasibility Study (i.e., only 18 sites of the canal would be worked concurrently instead of 36 sites and construction would take place over six years instead of three).

> Haul trucks would be assumed to be at least 10 cubic yards for all construction elements other than the **Modification of the Earthen-Lined Segment**, which would use 20 cubic yard hauling trucks.

> A single, 10-hour shift would be assumed daily for all construction elements other than the **Modification of the Earthen-Lined Segment,** which would have two, 10-hour shifts daily.

RAISE DEFICIENT STRUCTURES ALTERNATIVE (SJVAB)

CO [TONS PER YEAR]

Construction Phase	Start	End	2025	2026	2027	2028	2029	2030	2031	2032
Bridge Replacement	04/07/2025	07/30/2032	1.6	2.2	2.2	2.2	2.2	2.2	2.2	1
Concrete Lining w Associated Embankment Raise (low flow work)	10/01/2025	10/10/2029	0.4	1.4	1.4	1.4	1.1	0.0	0.0	0
Concrete Lining Repairs (low season work)	10/01/2025	04/10/2026	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0
Stabilize Canal Banks Along Earthlined Segment (low flow work)	10/01/2025	10/06/2026	1.5	4.4	0.0	0.0	0.0	0.0	0.0	0
Impacted Pipline Crossing Replacements (all season work)	04/07/2025	04/14/2027	0.4	0.6	0.2	0.0	0.0	0.0	0.0	0
Check Structures and Wasteways Modifications (low flow work)	10/01/2025	04/30/2030	<0.1	0.2	0.2	0.2	0.2	0.1	0.0	0
Turnout Modifications (all season work)	04/07/2025	04/14/2027	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0
Drainage Stucture Modifications (all season work)	04/07/2025	03/13/2028	0.1	0.1	0.1	<0.1	0.0	0.0	0.0	0
MAXIMUM ANNUAL TOTAL PROJECT EMISSIONS [TONS PER YEAR; METRIC TONS FOR CO2e]			**4.5**	**9.3**	**4.1**	**3.8**	**3.5**	**2.3**	**2.2**	**1**
SJVAPCD CEQA Threshold:			100	100	100	100	100	100	100	100
Exceeds Threshold?			no	no	no	no	no	no	no	no
General Conformity De Minimis Emission Level:			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exceeds De Minimis Emission Level?			no	no	no	no	no	no	no	no

Key assumptions:
> Model year 2015+ construction equipment.
> Model year 2015+ haul trucks.
> Assumed 50% reuse of excavated material / topsoil on site for project elements where backfill is necessary.
> **Modification of the Earthen Lined Segment** under ADJUST CANAL INVERT AND RAISE DEFICIENT STRUCTURES ALTERNATIVE would occur at half the intensity described in Appendix G of the Delta-Mendota Canal Feasibility Study (i.e., only 18 sites of the canal would be worked concurrently instead of 36 sites and construction would take place over six years instead of three).

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> A single, 10-hour shift would be assumed daily for all construction elements other than the **Modification of the Earthen-Lined Segment,** which would have two, 10-hour shifts daily.

RAISE DEFICIENT STRUCTURES ALTERNATIVE (SJVAB)

Construction Phase	Start	End	NOx [TONS PER YEAR] 2025	2026	2027	2028	2029	2030	2031	2032
Bridge Replacement	04/07/2025	07/30/2032	0.6	0.8	0.8	0.8	0.8	0.8	0.8	0
Concrete Lining w Associated Embankment Raise (low flow work)	10/01/2025	10/10/2029	0.2	1.0	1.0	1.0	0.7	0.0	0.0	0
Concrete Lining Repairs (low season work)	10/01/2025	04/10/2026	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0
Stabilize Canal Banks Along Earthlined Segment (low flow work)	10/01/2025	10/06/2026	1.0	2.9	0.0	0.0	0.0	0.0	0.0	0
Impacted Pipline Crossing Replacements (all season work)	04/07/2025	04/14/2027	0.2	0.3	0.1	0.0	0.0	0.0	0.0	0
Check Structures and Wasteways Modifications (low flow work)	10/01/2025	04/30/2030	<0.1	0.1	0.1	0.1	0.1	<0.1	0.0	0
Turnout Modifications (all season work)	04/07/2025	04/14/2027	0.1	0.1	<0.1	0.0	0.0	0.0	0.0	0
Drainage Stucture Modifications (all season work)	04/07/2025	03/13/2028	<0.1	0.1	0.1	<0.1	0.0	0.0	0.0	0
MAXIMUM ANNUAL TOTAL PROJECT EMISSIONS [TONS PER YEAR; METRIC TONS FOR CO2e]			**2.3**	**5.3**	**2.0**	**1.9**	**1.6**	**0.9**	**0.8**	**0**
SJVAPCD CEQA Threshold:			10	10	10	10	10	10	10	10
Exceeds Threshold?			no	no	no	no	no	no	no	no
General Conformity De Minimis Emission Level:			10	10	10	10	10	10	10	10
Exceeds De Minimis Emission Level?			no	no	no	no	no	no	no	no

Key assumptions:
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> Model year 2015+ haul trucks.
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RAISE DEFICIENT STRUCTURES ALTERNATIVE (SJVAB)

SOx [TONS PER YEAR]

Construction Phase	Start	End	2025	2026	2027	2028	2029	2030	2031	2032
Bridge Replacement	04/07/2025	07/30/2032	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Concrete Lining w Associated Embankment Raise (low flow work)	10/01/2025	10/10/2029	<0.1	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0
Concrete Lining Repairs (low season work)	10/01/2025	04/10/2026	<0.1	<0.1	0.0	0.0	0.0	0.0	0.0	0
Stabilize Canal Banks Along Earthlined Segment (low flow work)	10/01/2025	10/06/2026	<0.1	<0.1	0.0	0.0	0.0	0.0	0.0	0
Impacted Pipline Crossing Replacements (all season work)	04/07/2025	04/14/2027	<0.1	<0.1	<0.1	0.0	0.0	0.0	0.0	0
Check Structures and Wasteways Modifications (low flow work)	10/01/2025	04/30/2030	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.0	0
Turnout Modifications (all season work)	04/07/2025	04/14/2027	<0.1	<0.1	<0.1	0.0	0.0	0.0	0.0	0
Drainage Stucture Modifications (all season work)	04/07/2025	03/13/2028	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0	0
MAXIMUM ANNUAL TOTAL PROJECT EMISSIONS [TONS PER YEAR; METRIC TONS FOR CO2e]			**<0.1**	**<0.1**	**<0.1**	**<0.1**	**<0.1**	**<0.1**	**<0.1**	**<0.1**
		SJVAPCD CEQA Threshold:	27	27	27	27	27	27	27	27
		Exceeds Threshold?	no	no	no	no	no	no	no	no
		General Conformity De Minimis Emission Level:	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Exceeds De Minimis Emission Level?	no	no	no	no	no	no	no	no

Key assumptions:
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> Model year 2015+ haul trucks.
> Assumed 50% reuse of excavated material / topsoil on site for project elements where backfill is necessary.
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RAISE DEFICIENT STRUCTURES ALTERNATIVE (SJVAB)

Construction Phase	Start	End	PM10 [TONS PER YEAR] 2025	2026	2027	2028	2029	2030	2031	2032
Bridge Replacement	04/07/2025	07/30/2032	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0
Concrete Lining w Associated Embankment Raise (low flow work)	10/01/2025	10/10/2029	0.2	0.7	0.7	0.7	0.6	0.0	0.0	0
Concrete Lining Repairs (low season work)	10/01/2025	04/10/2026	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0
Stabilize Canal Banks Along Earthlined Segment (low flow work)	10/01/2025	10/06/2026	0.7	2.0	0.0	0.0	0.0	0.0	0.0	0
Impacted Pipline Crossing Replacements (all season work)	04/07/2025	04/14/2027	0.1	0.1	<0.1	0.0	0.0	0.0	0.0	0
Check Structures and Wasteways Modifications (low flow work)	10/01/2025	04/30/2030	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.0	0
Turnout Modifications (all season work)	04/07/2025	04/14/2027	<0.1	<0.1	<0.1	0.0	0.0	0.0	0.0	0
Drainage Stucture Modifications (all season work)	04/07/2025	03/13/2028	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0	0
MAXIMUM ANNUAL TOTAL PROJECT EMISSIONS [TONS PER YEAR; METRIC TONS FOR CO2e]			**1.6**	**3.6**	**1.3**	**1.3**	**1.1**	**0.6**	**0.6**	**0**
SJVAPCD CEQA Threshold:			15	15	15	15	15	15	15	15
Exceeds Threshold?			no	no	no	no	no	no	no	no
General Conformity De Minimis Emission Level:			100	100	100	100	100	100	100	100
Exceeds De Minimis Emission Level?			no	no	no	no	no	no	no	no

Key assumptions:
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> Model year 2015+ haul trucks.
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> A single, 10-hour shift would be assumed daily for all construction elements other than the **Modification of the Earthen-Lined Segment,** which would have two, 10-hour shifts daily.

RAISE DEFICIENT STRUCTURES ALTERNATIVE (SJVAB)

PM2.5 [TONS PER YEAR]

Construction Phase	Start	End	2025	2026	2027	2028	2029	2030	2031	2032
Bridge Replacement	04/07/2025	07/30/2032	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0
Concrete Lining w Associated Embankment Raise (low flow work)	10/01/2025	10/10/2029	<0.1	0.2	0.2	0.2	0.2	0.0	0.0	0
Concrete Lining Repairs (low season work)	10/01/2025	04/10/2026	<0.1	<0.1	0.0	0.0	0.0	0.0	0.0	0
Stabilize Canal Banks Along Earthlined Segment (low flow work)	10/01/2025	10/06/2026	0.2	0.5	0.0	0.0	0.0	0.0	0.0	0
Impacted Pipline Crossing Replacements (all season work)	04/07/2025	04/14/2027	<0.1	<0.1	<0.1	0.0	0.0	0.0	0.0	0
Check Structures and Wasteways Modifications (low flow work)	10/01/2025	04/30/2030	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.0	0
Turnout Modifications (all season work)	04/07/2025	04/14/2027	<0.1	<0.1	<0.1	0.0	0.0	0.0	0.0	0
Drainage Stucture Modifications (all season work)	04/07/2025	03/13/2028	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0	0
MAXIMUM ANNUAL TOTAL PROJECT EMISSIONS [TONS PER YEAR; METRIC TONS FOR CO2e]			**0.3**	**0.8**	**0.3**	**0.3**	**0.3**	**0.1**	**0.1**	**0**
		SJVAPCD CEQA Threshold:	15	15	15	15	15	15	15	15
		Exceeds Threshold?	no	no	no	no	no	no	no	no
		General Conformity De Minimis Emission Level:	70	70	70	70	70	70	70	70
		Exceeds De Minimis Emission Level?	no	no	no	no	no	no	no	no

Key assumptions:
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> Model year 2015+ haul trucks.
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RAISE DEFICIENT STRUCTURES ALTERNATIVE (SJVAB)

Construction Phase	Start	End	CO2e [TONS PER YEAR] 2025	2026	2027	2028	2029	2030	2031	2032
Bridge Replacement	04/07/2025	07/30/2032	433	584	582	582	584	584	584	339
Concrete Lining w Associated Embankment Raise (low flow work)	10/01/2025	10/10/2029	159	621	619	619	481	0	0	0
Concrete Lining Repairs (low season work)	10/01/2025	04/10/2026	98	105	0	0	0	0	0	0
Stabilize Canal Banks Along Earthlined Segment (low flow work)	10/01/2025	10/06/2026	594	1,763	0	0	0	0	0	0
Impacted Pipline Crossing Replacements (all season work)	04/07/2025	04/14/2027	126	170	48	0	0	0	0	0
Check Structures and Wasteways Modifications (low flow work)	10/01/2025	04/30/2030	15	60	60	60	60	20	0	0
Turnout Modifications (all season work)	04/07/2025	04/14/2027	55	74	21	0	0	0	0	0
Drainage Stucture Modifications (all season work)	04/07/2025	03/13/2028	22	29	29	6	0	0	0	0
MAXIMUM ANNUAL TOTAL PROJECT EMISSIONS [TONS PER YEAR; METRIC TONS FOR CO2e]			**1,501**	**3,408**	**1,359**	**1,267**	**1,126**	**604**	**584**	**339**
SJVAPCD CEQA Threshold:			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exceeds Threshold?			no	no	no	no	no	no	no	no
General Conformity De Minimis Emission Level:			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exceeds De Minimis Emission Level?			no	no	no	no	no	no	no	no

Key assumptions:
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RAISE DEFICIENT STRUCTURES ALTERNATIVE (SFBAAB)			POLLUTANT [AVERAGE POUNDS PER DAY]							
Construction Phase	**Start**	**End**	**ROG**	**TOG**	**CO**	**NOx**	**SOx**	**PM10**	**PM2.5**	**CO2e**
Bridge Replacement	04/07/2025	07/30/2032	0.8	1.0	17.0	6.4	<0.1	4.3	0.9	4,461
Concrete Lining w Associated Embankment Raise (low flow work)	10/01/2025	10/10/2029	0.7	0.8	10.5	7.3	<0.1	5.5	1.5	4,742
Concrete Lining Repairs (low season work)	10/01/2025	04/10/2026	0.5	0.6	7.8	5.0	<0.1	5.6	0.7	2,930
Stabilize Canal Banks Along Earthlined Segment (low flow work)	10/01/2025	10/06/2026	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]
Impacted Pipline Crossing Replacements (all season work)	04/07/2025	04/14/2027	0.2	0.3	4.4	1.9	<0.1	1.1	0.1	1,297
Check Structures and Wasteways Modifications (low flow work)	10/01/2025	04/30/2030	0.1	0.1	1.3	0.5	<0.1	<0.1	<0.1	462
Turnout Modifications (all season work)	04/07/2025	04/14/2027	0.1	0.1	1.7	0.6	<0.1	<0.1	<0.1	566
Drainage Stucture Modifications (all season work)	04/07/2025	03/13/2028	<0.1	<0.1	0.9	0.4	<0.1	0.1	<0.1	222
AVERAGE DAILY TOTAL PROJECT EMISSIONS [POUNDS PER DAY]			**2.1**	**2.5**	**37.9**	**18.6**	**0.1**	**12.5**	**2.7**	**12,555**
BAAQMD CEQA Threshold:			54	n/a	n/a	54	n/a	82	54	n/a
Exceeds Threshold?			no	no	no	no	no	no	no	no
MAXIMUM ANNUAL TOTAL PROJECT EMISSIONS [TONS PER YEAR; METRIC TONS FOR CO2e]			**0.3**	**0.3**	**5.0**	**2.4**	**<0.1**	**1.6**	**0.4**	**1,645**
General Conformity De Minimis Emission Level:			100	n/a	n/a	100	n/a	n/a	100	n/a
Exceeds De Minimis Emission Level?			no	no	no	no	no	no	no	no

[1] construction element would not occur in SFBAAB

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RAISE DEFICIENT STRUCTURES ALTERNATIVE (SFBAAB)

Construction Phase	Start	End	ROG [AVERAGE POUNDS PER DAY] 2025	2026	2027	2028	2029	2030	2031	2032
Bridge Replacement	04/07/2025	07/30/2032	0.6	0.8	0.8	0.8	0.8	0.8	0.8	0
Concrete Lining w Associated Embankment Raise (low flow work)	10/01/2025	10/10/2029	0.2	0.7	0.7	0.7	0.5	0.0	0.0	0
Concrete Lining Repairs (low season work)	10/01/2025	04/10/2026	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0
Stabilize Canal Banks Along Earthlined Segment (low flow work)	10/01/2025	10/06/2026	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]
Impacted Pipline Crossing Replacements (all season work)	04/07/2025	04/14/2027	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0
Check Structures and Wasteways Modifications (low flow work)	10/01/2025	04/30/2030	<0.1	0.1	0.1	0.1	0.1	<0.1	0.0	0
Turnout Modifications (all season work)	04/07/2025	04/14/2027	0.1	0.1	<0.1	0.0	0.0	0.0	0.0	0
Drainage Stucture Modifications (all season work)	04/07/2025	03/13/2028	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0	0
AVERAGE DAILY TOTAL PROJECT EMISSIONS [POUNDS PER DAY]			**1.2**	**2.1**	**1.7**	**1.6**	**1.4**	**0.9**	**0.8**	**0**
BAAQMD CEQA Threshold:			54	54	54	54	54	54	54	54
Exceeds Threshold?			no	no	no	no	no	no	no	no
MAXIMUM ANNUAL TOTAL PROJECT EMISSIONS [TONS PER YEAR; METRIC TONS FOR CO2e]			**0.2**	**0.3**	**0.2**	**0.2**	**0.2**	**0.1**	**0.1**	**0**
General Conformity De Minimis Emission Level:			100	100	100	100	100	100	100	100
Exceeds De Minimis Emission Level?			no	no	no	no	no	no	no	no

[1] construction element would not occur in SFBAAB

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> Model year 2015+ haul trucks.
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RAISE DEFICIENT STRUCTURES ALTERNATIVE (SFBAAB) | TOG [AVERAGE POUNDS PER DAY]

Construction Phase	Start	End	2025	2026	2027	2028	2029	2030	2031	2032
Bridge Replacement	04/07/2025	07/30/2032	0.7	1.0	1.0	1.0	1.0	1.0	1.0	1
Concrete Lining w Associated Embankment Raise (low flow work)	10/01/2025	10/10/2029	0.2	0.8	0.8	0.8	0.6	0.0	0.0	0
Concrete Lining Repairs (low season work)	10/01/2025	04/10/2026	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0
Stabilize Canal Banks Along Earthlined Segment (low flow work)	10/01/2025	10/06/2026	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]
Impacted Pipline Crossing Replacements (all season work)	04/07/2025	04/14/2027	0.2	0.3	0.1	0.0	0.0	0.0	0.0	0
Check Structures and Wasteways Modifications (low flow work)	10/01/2025	04/30/2030	<0.1	0.1	0.1	0.1	0.1	<0.1	0.0	0
Turnout Modifications (all season work)	04/07/2025	04/14/2027	0.1	0.1	<0.1	0.0	0.0	0.0	0.0	0
Drainage Stucture Modifications (all season work)	04/07/2025	03/13/2028	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0	0
AVERAGE DAILY TOTAL PROJECT EMISSIONS [POUNDS PER DAY]			**1.4**	**2.5**	**2.0**	**1.9**	**1.7**	**1.0**	**1.0**	**1**
BAAQMD CEQA Threshold:			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exceeds Threshold?			no	no	no	no	no	no	no	no
MAXIMUM ANNUAL TOTAL PROJECT EMISSIONS [TONS PER YEAR; METRIC TONS FOR CO2e]			**0.2**	**0.3**	**0.3**	**0.2**	**0.2**	**0.1**	**0.1**	**0**
General Conformity De Minimis Emission Level:			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exceeds De Minimis Emission Level?			no	no	no	no	no	no	no	no

[1] construction element would not occur in SFBAAB

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> Model year 2015+ haul trucks.
> Assumed 50% reuse of excavated material / topsoil on site for project elements where backfill is necessary.
> **Modification of the Earthen Lined Segment** under ADJUST CANAL INVERT AND RAISE DEFICIENT STRUCTURES ALTERNATIVE would occur at half the intensity described in Appendix G of the Delta-Mendota Canal Feasibility Study (i.e., only 18 sites of the canal would be worked concurrently instead of 36 sites and construction would take place over six years instead of three).

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RAISE DEFICIENT STRUCTURES ALTERNATIVE (SFBAAB)

Construction Phase	Start	End	CO [AVERAGE POUNDS PER DAY] 2025	2026	2027	2028	2029	2030	2031	2032
Bridge Replacement	04/07/2025	07/30/2032	12.6	17.0	16.9	16.9	17.0	17.0	17.0	10
Concrete Lining w Associated Embankment Raise (low flow work)	10/01/2025	10/10/2029	2.7	10.5	10.4	10.4	8.1	0.0	0.0	0
Concrete Lining Repairs (low season work)	10/01/2025	04/10/2026	2.0	2.1	0.0	0.0	0.0	0.0	0.0	0
Stabilize Canal Banks Along Earthlined Segment (low flow work)	10/01/2025	10/06/2026	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]
Impacted Pipline Crossing Replacements (all season work)	04/07/2025	04/14/2027	3.3	4.4	1.2	0.0	0.0	0.0	0.0	0
Check Structures and Wasteways Modifications (low flow work)	10/01/2025	04/30/2030	0.3	1.3	1.3	1.3	1.3	0.4	0.0	0
Turnout Modifications (all season work)	04/07/2025	04/14/2027	1.3	1.7	0.5	0.0	0.0	0.0	0.0	0
Drainage Stucture Modifications (all season work)	04/07/2025	03/13/2028	0.7	0.9	0.9	0.2	0.0	0.0	0.0	0
AVERAGE DAILY TOTAL PROJECT EMISSIONS [POUNDS PER DAY]			**22.8**	**37.9**	**31.3**	**28.8**	**26.4**	**17.4**	**17.0**	**10**
BAAQMD CEQA Threshold:			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exceeds Threshold?			no	no	no	no	no	no	no	no
MAXIMUM ANNUAL TOTAL PROJECT EMISSIONS [TONS PER YEAR; METRIC TONS FOR CO2e]			**3.0**	**5.0**	**4.1**	**3.8**	**3.5**	**2.3**	**2.2**	**1**
General Conformity De Minimis Emission Level:			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exceeds De Minimis Emission Level?			no	no	no	no	no	no	no	no

[1] construction element would not occur in SFBAAB

Key assumptions:
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> Model year 2015+ haul trucks.
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RAISE DEFICIENT STRUCTURES ALTERNATIVE (SFBAAB) — NOx [AVERAGE POUNDS PER DAY]

Construction Phase	Start	End	2025	2026	2027	2028	2029	2030	2031	2032
Bridge Replacement	04/07/2025	07/30/2032	4.8	6.4	6.4	6.4	6.4	6.4	6.4	4
Concrete Lining w Associated Embankment Raise (low flow work)	10/01/2025	10/10/2029	1.9	7.3	7.3	7.3	5.7	0.0	0.0	0
Concrete Lining Repairs (low season work)	10/01/2025	04/10/2026	1.3	1.4	0.0	0.0	0.0	0.0	0.0	0
Stabilize Canal Banks Along Earthlined Segment (low flow work)	10/01/2025	10/06/2026	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]
Impacted Pipline Crossing Replacements (all season work)	04/07/2025	04/14/2027	1.4	1.9	0.5	0.0	0.0	0.0	0.0	0
Check Structures and Wasteways Modifications (low flow work)	10/01/2025	04/30/2030	0.1	0.5	0.5	0.5	0.5	0.1	0.0	0
Turnout Modifications (all season work)	04/07/2025	04/14/2027	0.5	0.6	0.2	0.0	0.0	0.0	0.0	0
Drainage Stucture Modifications (all season work)	04/07/2025	03/13/2028	0.3	0.4	0.4	0.1	0.0	0.0	0.0	0
AVERAGE DAILY TOTAL PROJECT EMISSIONS [POUNDS PER DAY]			**10.2**	**18.6**	**15.3**	**14.2**	**12.6**	**6.6**	**6.4**	**4**
BAAQMD CEQA Threshold:			54	54	54	54	54	54	54	54
Exceeds Threshold?			no	no	no	no	no	no	no	no
MAXIMUM ANNUAL TOTAL PROJECT EMISSIONS [TONS PER YEAR; METRIC TONS FOR CO2e]			**1.3**	**2.4**	**2.0**	**1.9**	**1.6**	**0.9**	**0.8**	**0**
General Conformity De Minimis Emission Level:			100	100	100	100	100	100	100	100
Exceeds De Minimis Emission Level?			no	no	no	no	no	no	no	no

[1] construction element would not occur in SFBAAB

Key assumptions:
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> Model year 2015+ haul trucks.
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RAISE DEFICIENT STRUCTURES ALTERNATIVE (SFBAAB)

Construction Phase	Start	End	SOx [AVERAGE POUNDS PER DAY] 2025	2026	2027	2028	2029	2030	2031	2032
Bridge Replacement	04/07/2025	07/30/2032	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Concrete Lining w Associated Embankment Raise (low flow work)	10/01/2025	10/10/2029	<0.1	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0
Concrete Lining Repairs (low season work)	10/01/2025	04/10/2026	<0.1	<0.1	0.0	0.0	0.0	0.0	0.0	0
Stabilize Canal Banks Along Earthlined Segment (low flow work)	10/01/2025	10/06/2026	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]
Impacted Pipline Crossing Replacements (all season work)	04/07/2025	04/14/2027	<0.1	<0.1	<0.1	0.0	0.0	0.0	0.0	0
Check Structures and Wasteways Modifications (low flow work)	10/01/2025	04/30/2030	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.0	0
Turnout Modifications (all season work)	04/07/2025	04/14/2027	<0.1	<0.1	<0.1	0.0	0.0	0.0	0.0	0
Drainage Stucture Modifications (all season work)	04/07/2025	03/13/2028	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0	0
AVERAGE DAILY TOTAL PROJECT EMISSIONS [POUNDS PER DAY]			**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**<0.1**	**<0.1**	**<0.1**
BAAQMD CEQA Threshold:			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exceeds Threshold?			no	no	no	no	no	no	no	no
MAXIMUM ANNUAL TOTAL PROJECT EMISSIONS [TONS PER YEAR; METRIC TONS FOR CO2e]			**<0.1**	**<0.1**	**<0.1**	**<0.1**	**<0.1**	**<0.1**	**<0.1**	**<0.1**
General Conformity De Minimis Emission Level:			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exceeds De Minimis Emission Level?			no	no	no	no	no	no	no	no

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> Model year 2015+ haul trucks.
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RAISE DEFICIENT STRUCTURES ALTERNATIVE (SFBAAB) — PM10 [AVERAGE POUNDS PER DAY]

Construction Phase	Start	End	2025	2026	2027	2028	2029	2030	2031	2032
Bridge Replacement	04/07/2025	07/30/2032	3.2	4.3	4.3	4.3	4.3	4.3	4.3	2
Concrete Lining w Associated Embankment Raise (low flow work)	10/01/2025	10/10/2029	1.4	5.5	5.4	5.4	4.2	0.0	0.0	0
Concrete Lining Repairs (low season work)	10/01/2025	04/10/2026	1.4	1.5	0.0	0.0	0.0	0.0	0.0	0
Stabilize Canal Banks Along Earthlined Segment (low flow work)	10/01/2025	10/06/2026	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]
Impacted Pipline Crossing Replacements (all season work)	04/07/2025	04/14/2027	0.8	1.1	0.3	0.0	0.0	0.0	0.0	0
Check Structures and Wasteways Modifications (low flow work)	10/01/2025	04/30/2030	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.0	0
Turnout Modifications (all season work)	04/07/2025	04/14/2027	<0.1	<0.1	<0.1	0.0	0.0	0.0	0.0	0
Drainage Stucture Modifications (all season work)	04/07/2025	03/13/2028	0.1	0.1	0.1	<0.1	0.0	0.0	0.0	0
AVERAGE DAILY TOTAL PROJECT EMISSIONS [POUNDS PER DAY]			**6.9**	**12.5**	**10.1**	**9.8**	**8.5**	**4.3**	**4.3**	**2**
BAAQMD CEQA Threshold:			82	82	82	82	82	82	82	82
Exceeds Threshold?			no	no	no	no	no	no	no	no
MAXIMUM ANNUAL TOTAL PROJECT EMISSIONS [TONS PER YEAR; METRIC TONS FOR CO2e]			**0.9**	**1.6**	**1.3**	**1.3**	**1.1**	**0.6**	**0.6**	**0**
General Conformity De Minimis Emission Level:			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exceeds De Minimis Emission Level?			no	no	no	no	no	no	no	no

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RAISE DEFICIENT STRUCTURES ALTERNATIVE (SFBAAB) — PM2.5 [AVERAGE POUNDS PER DAY]

Construction Phase	Start	End	2025	2026	2027	2028	2029	2030	2031	2032
Bridge Replacement	04/07/2025	07/30/2032	0.6	0.9	0.8	0.8	0.9	0.9	0.9	0
Concrete Lining w Associated Embankment Raise (low flow work)	10/01/2025	10/10/2029	0.4	1.5	1.5	1.5	1.2	0.0	0.0	0
Concrete Lining Repairs (low season work)	10/01/2025	04/10/2026	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0
Stabilize Canal Banks Along Earthlined Segment (low flow work)	10/01/2025	10/06/2026	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]
Impacted Pipline Crossing Replacements (all season work)	04/07/2025	04/14/2027	0.1	0.1	<0.1	0.0	0.0	0.0	0.0	0
Check Structures and Wasteways Modifications (low flow work)	10/01/2025	04/30/2030	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.0	0
Turnout Modifications (all season work)	04/07/2025	04/14/2027	<0.1	<0.1	<0.1	0.0	0.0	0.0	0.0	0
Drainage Stucture Modifications (all season work)	04/07/2025	03/13/2028	<0.1	<0.1	<0.1	<0.1	0.0	0.0	0.0	0
AVERAGE DAILY TOTAL PROJECT EMISSIONS [POUNDS PER DAY]			**1.3**	**2.7**	**2.4**	**2.3**	**2.0**	**0.9**	**0.9**	**0**
BAAQMD CEQA Threshold:			54	54	54	54	54	54	54	54
Exceeds Threshold?			no	no	no	no	no	no	no	no
MAXIMUM ANNUAL TOTAL PROJECT EMISSIONS [TONS PER YEAR; METRIC TONS FOR CO2e]			**0.2**	**0.4**	**0.3**	**0.3**	**0.3**	**0.1**	**0.1**	**0**
General Conformity De Minimis Emission Level:			100	100	100	100	100	100	100	100
Exceeds De Minimis Emission Level?			no	no	no	no	no	no	no	no

[1] construction element would not occur in SFBAAB

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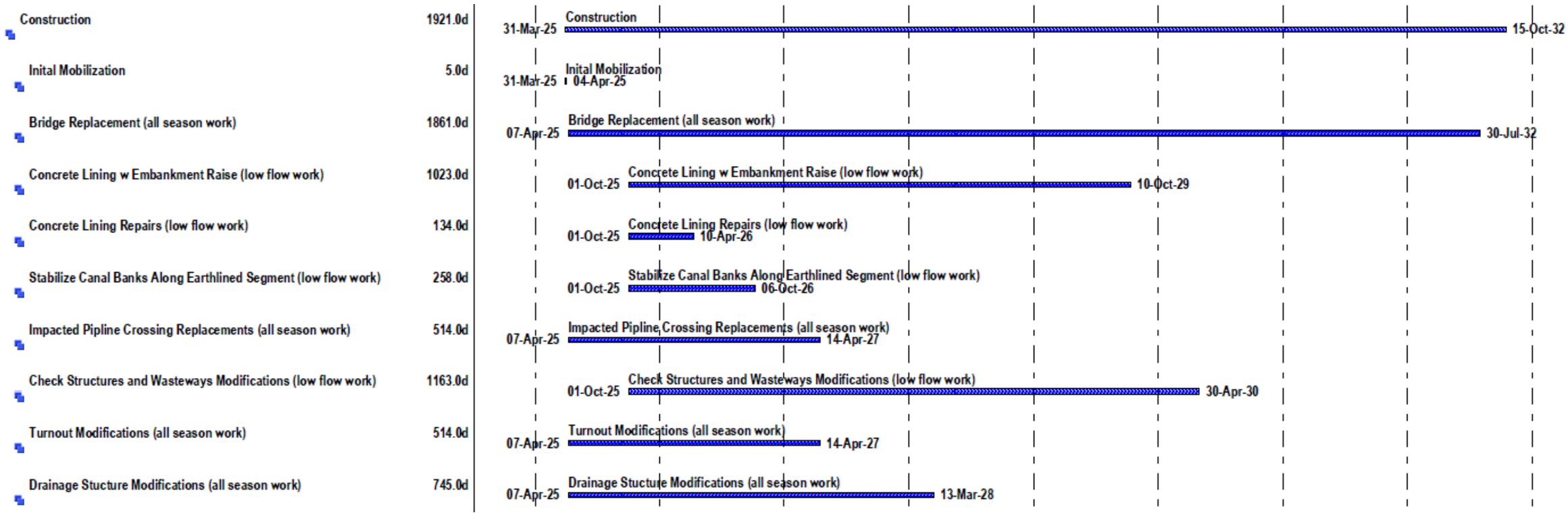
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RAISE DEFICIENT STRUCTURES ALTERNATIVE (SFBAAB)

Construction Phase	Start	End	CO2e [AVERAGE POUNDS PER DAY] 2025	2026	2027	2028	2029	2030	2031	2032
Bridge Replacement	04/07/2025	07/30/2032	3,303	4,461	4,444	4,444	4,461	4,461	4,461	2,588
Concrete Lining w Associated Embankment Raise (low flow work)	10/01/2025	10/10/2029	1,213	4,742	4,723	4,723	3,674	0	0	0
Concrete Lining Repairs (low season work)	10/01/2025	04/10/2026	749	805	0	0	0	0	0	0
Stabilize Canal Banks Along Earthlined Segment (low flow work)	10/01/2025	10/06/2026	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]
Impacted Pipline Crossing Replacements (all season work)	04/07/2025	04/14/2027	961	1,297	366	0	0	0	0	0
Check Structures and Wasteways Modifications (low flow work)	10/01/2025	04/30/2030	118	462	460	460	462	152	0	0
Turnout Modifications (all season work)	04/07/2025	04/14/2027	419	566	160	0	0	0	0	0
Drainage Stucture Modifications (all season work)	04/07/2025	03/13/2028	164	222	221	43	0	0	0	0
AVERAGE DAILY TOTAL PROJECT EMISSIONS [POUNDS PER DAY]			**6,927**	**12,555**	**10,374**	**9,670**	**8,596**	**4,613**	**4,461**	**2,588**
BAAQMD CEQA Threshold:			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exceeds Threshold?			no	no	no	no	no	no	no	no
MAXIMUM ANNUAL TOTAL PROJECT EMISSIONS [TONS PER YEAR; METRIC TONS FOR CO2e]			**907**	**1,645**	**1,359**	**1,267**	**1,126**	**604**	**584**	**339**
General Conformity De Minimis Emission Level:			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Exceeds De Minimis Emission Level?			no	no	no	no	no	no	no	no

[1] construction element would not occur in SFBAAB

Raise Deficient Structures Alternative - Proposed Action (presented schedule not final - assumes the maximum possible construction overlap)



	BRIDGE REPLACEMENT	(workdays per area)					
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**Count**	**Assumptions**	**Factor Type**
1	temporary utility relocation	10	1	service truck with crane	1	a,	offroad
1	temporary utility relocation	10	1	personnel	3	a,f,	onroad
2	demolishion of existing bridge	20	1	crane	2	a,	offroad
2	demolishion of existing bridge	20	1	sawcut	1	a,	offroad
2	demolishion of existing bridge	20	1	personnel	7	a,f,	onroad
2	demolishion of existing bridge	20	1	hauling trips (demolished material)	2	a,b,c,d,f,	onroad
3	earthwork to rasie abutments (1-3 foot raise)	10	1	dozer	1	a,	offroad
3	earthwork to rasie abutments (1-3 foot raise)	10	1	end dump truck	6	a,h	offroad
3	earthwork to rasie abutments (1-3 foot raise)	10	1	compactor	1	a,	offroad
3	earthwork to rasie abutments (1-3 foot raise)	10	1	excavator	1	a,	offroad
3	earthwork to rasie abutments (1-3 foot raise)	10	1	tractor	1	a,	offroad
3	earthwork to rasie abutments (1-3 foot raise)	10	1	personnel	12	a,f,	onroad
3	earthwork to rasie abutments (1-3 foot raise)	10	1	hauling trips (material import)	12	a,b,c,f,	onroad
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	drill rig	1	a,	offroad
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	crane	1	a,	offroad
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	skid steer	1	a,	offroad
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	excavator	1	a,	offroad
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	personnel	11	a,f,	onroad
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	hauling trips (vendor delivery)	1	a,b,c,e,f,	onroad
5	form and place wing walls	10	1	excavator	1	a,	offroad
5	form and place wing walls	10	1	personnel	5	a,f,	onroad
5	form and place wing walls	10	1	hauling trips (vendor delivery)	1	a,b,c,e,f,	onroad
6	set bridge girders	15	1	crane	1	a,	offroad
6	set bridge girders	15	1	skid steer	1	a,	offroad
6	set bridge girders	15	1	personnel	5	a,f,	onroad
6	set bridge girders	15	1	hauling trips (vendor delivery)	3	a,b,c,e,f,	onroad
7	form and place deck	30	1	truck	2	a,g,	onroad
7	form and place deck	30	1	skid steer	1	a,	offroad
7	form and place deck	30	1	personnel	6	a,f,	onroad
7	form and place deck	30	1	hauling trips (vendor delivery)	3	a,b,c,e,f,	onroad
8	utility replacement	10	1	snooper truck	1	a,	offroad
8	utility replacement	10	1	personnel	3	a,f,	onroad
9	final grading and paving	10	1	skid steer	1	a,	offroad
9	final grading and paving	10	1	paver	1	a,	offroad
9	final grading and paving	10	1	truck	4	a,g,	onroad
9	final grading and paving	10	1	personnel	10	a,f,	onroad
9	final grading and paving	10	1	hauling trips (vendor delivery)	1	a,b,c,e,f,	onroad

	BRIDGE REPLACEMENT	(workdays per area)					
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**Vehicle Category**	**Usage Factor**	**Trip Distance**
1	temporary utility relocation	10	1	service truck with crane	Construction and Mining - Cranes	0.85	--
1	temporary utility relocation	10	1	personnel	Workers	1.00	22
2	demolishion of existing bridge	20	1	crane	Construction and Mining - Cranes	0.85	--
2	demolishion of existing bridge	20	1	sawcut	Construction and Mining - Misc - Concrete/Industrial Sav	0.85	--
2	demolishion of existing bridge	20	1	personnel	Workers	1.00	22
2	demolishion of existing bridge	20	1	hauling trips (demolished material)	Hauling/Delivery	1.00	40
3	earthwork to rasie abutments (1-3 foot raise)	10	1	dozer	Construction and Mining - Rubber Tired Dozers	0.85	--
3	earthwork to rasie abutments (1-3 foot raise)	10	1	end dump truck	Construction and Mining - Off-Highway Trucks	0.25	--
3	earthwork to rasie abutments (1-3 foot raise)	10	1	compactor	Construction and Mining - Misc - Plate Compactors	0.85	--
3	earthwork to rasie abutments (1-3 foot raise)	10	1	excavator	Construction and Mining - Excavators	0.85	--
3	earthwork to rasie abutments (1-3 foot raise)	10	1	tractor	Construction and Mining - Tractors/Loaders/Backhoes	0.85	--
3	earthwork to rasie abutments (1-3 foot raise)	10	1	personnel	Workers	1.00	22
3	earthwork to rasie abutments (1-3 foot raise)	10	1	hauling trips (material import)	Hauling/Delivery	1.00	40
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	drill rig	Construction and Mining - Bore/Drill Rigs	0.85	--
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	crane	Construction and Mining - Cranes	0.85	--
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	skid steer	Construction and Mining - Skid Steer Loaders	0.85	--
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	excavator	Construction and Mining - Excavators	0.85	--
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	personnel	Workers	1.00	22
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	hauling trips (vendor delivery)	Hauling/Delivery	1.00	17
5	form and place wing walls	10	1	excavator	Construction and Mining - Excavators	0.85	--
5	form and place wing walls	10	1	personnel	Workers	1.00	22
5	form and place wing walls	10	1	hauling trips (vendor delivery)	Hauling/Delivery	1.00	17
6	set bridge girders	15	1	crane	Construction and Mining - Cranes	0.85	--
6	set bridge girders	15	1	skid steer	Construction and Mining - Skid Steer Loaders	0.85	--
6	set bridge girders	15	1	personnel	Workers	1.00	22
6	set bridge girders	15	1	hauling trips (vendor delivery)	Hauling/Delivery	1.00	17
7	form and place deck	30	1	truck	LDT1	0.25	300
7	form and place deck	30	1	skid steer	Construction and Mining - Skid Steer Loaders	0.85	--
7	form and place deck	30	1	personnel	Workers	1.00	22
7	form and place deck	30	1	hauling trips (vendor delivery)	Hauling/Delivery	1.00	17
8	utility replacement	10	1	snooper truck	Construction and Mining - Cranes	0.85	--
8	utility replacement	10	1	personnel	Workers	1.00	22
9	final grading and paving	10	1	skid steer	Construction and Mining - Skid Steer Loaders	0.85	--
9	final grading and paving	10	1	paver	Construction and Mining - Pavers	0.85	--
9	final grading and paving	10	1	truck	LDT1	0.25	300
9	final grading and paving	10	1	personnel	Workers	1.00	22
9	final grading and paving	10	1	hauling trips (vendor delivery)	Hauling/Delivery	1.00	17

	BRIDGE REPLACEMENT	(workdays per area)			Emission Factors (g/hr for offroad; g/mi for onroad)							
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**ROG**	**TOG**	**CO**	**NOx**	**CO2e**	**PM10**	**PM2.5**	**SOx**
1	temporary utility relocation	10	1	service truck with crane	5.03E+00	5.98E+00	9.58E+01	2.54E+01	3.72E+04	6.69E-01	6.15E-01	3.35E-01
1	temporary utility relocation	10	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
2	demolishion of existing bridge	20	1	crane	5.03E+00	5.98E+00	9.58E+01	2.54E+01	3.72E+04	6.69E-01	6.15E-01	3.35E-01
2	demolishion of existing bridge	20	1	sawcut	5.30E+00	6.41E+00	8.56E+01	7.02E+01	1.40E+04	2.80E-01	2.57E-01	1.77E-01
2	demolishion of existing bridge	20	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
2	demolishion of existing bridge	20	1	hauling trips (demolished material)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
3	earthwork to rasie abutments (1-3 foot raise)	10	1	dozer	1.07E+01	1.27E+01	1.31E+02	4.02E+01	4.73E+04	1.34E+02	7.41E+01	4.25E-01
3	earthwork to rasie abutments (1-3 foot raise)	10	1	end dump truck	1.92E+01	2.28E+01	1.85E+02	1.42E+02	8.46E+04	4.21E+02	4.40E+01	7.60E-01
3	earthwork to rasie abutments (1-3 foot raise)	10	1	compactor	2.15E+01	2.57E+01	7.49E+02	1.62E+01	1.54E+03	7.89E+00	5.96E+00	4.41E-02
3	earthwork to rasie abutments (1-3 foot raise)	10	1	excavator	5.50E+00	6.55E+00	1.03E+02	3.39E+01	3.29E+04	6.15E-01	5.66E-01	2.95E-01
3	earthwork to rasie abutments (1-3 foot raise)	10	1	tractor	3.99E+00	4.74E+00	1.04E+02	4.20E+01	1.96E+04	4.17E-01	3.83E-01	1.76E-01
3	earthwork to rasie abutments (1-3 foot raise)	10	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
3	earthwork to rasie abutments (1-3 foot raise)	10	1	hauling trips (material import)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	drill rig	7.69E+00	9.15E+00	1.63E+02	5.15E+01	5.83E+04	1.04E+00	9.60E-01	5.24E-01
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	crane	5.03E+00	5.98E+00	9.58E+01	2.54E+01	3.72E+04	6.69E-01	6.15E-01	3.35E-01
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	skid steer	2.29E+00	2.72E+00	7.73E+01	3.75E+01	1.34E+04	2.44E-01	2.25E-01	1.21E-01
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	excavator	5.50E+00	6.55E+00	1.03E+02	3.39E+01	3.29E+04	6.15E-01	5.66E-01	2.95E-01
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	hauling trips (vendor delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
5	form and place wing walls	10	1	excavator	5.50E+00	6.55E+00	1.03E+02	3.39E+01	3.29E+04	6.15E-01	5.66E-01	2.95E-01
5	form and place wing walls	10	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
5	form and place wing walls	10	1	hauling trips (vendor delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
6	set bridge girders	15	1	crane	5.03E+00	5.98E+00	9.58E+01	2.54E+01	3.72E+04	6.69E-01	6.15E-01	3.35E-01
6	set bridge girders	15	1	skid steer	2.29E+00	2.72E+00	7.73E+01	3.75E+01	1.34E+04	2.44E-01	2.25E-01	1.21E-01
6	set bridge girders	15	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
6	set bridge girders	15	1	hauling trips (vendor delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
7	form and place deck	30	1	truck	4.28E-02	4.56E-02	6.35E-01	3.16E-02	2.70E+02	1.35E-01	4.15E-02	2.65E-03
7	form and place deck	30	1	skid steer	2.29E+00	2.72E+00	7.73E+01	3.75E+01	1.34E+04	2.44E-01	2.25E-01	1.21E-01
7	form and place deck	30	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
7	form and place deck	30	1	hauling trips (vendor delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
8	utility replacement	10	1	snooper truck	5.03E+00	5.98E+00	9.58E+01	2.54E+01	3.72E+04	6.69E-01	6.15E-01	3.35E-01
8	utility replacement	10	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
9	final grading and paving	10	1	skid steer	2.29E+00	2.72E+00	7.73E+01	3.75E+01	1.34E+04	2.44E-01	2.25E-01	1.21E-01
9	final grading and paving	10	1	paver	4.23E+00	5.03E+00	1.26E+02	3.27E+01	3.08E+04	5.46E-01	5.02E-01	2.77E-01
9	final grading and paving	10	1	truck	4.28E-02	4.56E-02	6.35E-01	3.16E-02	2.70E+02	1.35E-01	4.15E-02	2.65E-03
9	final grading and paving	10	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
9	final grading and paving	10	1	hauling trips (vendor delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02

	BRIDGE REPLACEMENT	(workdays per area)			Emissions (tons per bridge)							
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**ROG**	**TOG**	**CO**	**NOx**	**CO2e**	**PM10**	**PM2.5**	**SOx**
1	temporary utility relocation	10	1	service truck with crane	4.71E-04	5.60E-04	8.98E-03	2.38E-03	3.49E+00	6.26E-05	5.76E-05	3.14E-05
1	temporary utility relocation	10	1	personnel	2.81E-05	3.02E-05	4.55E-04	2.20E-05	1.74E-01	9.71E-05	2.97E-05	1.71E-06
2	demolishion of existing bridge	20	1	crane	1.88E-03	2.24E-03	3.59E-02	9.54E-03	1.40E+01	2.51E-04	2.31E-04	1.26E-04
2	demolishion of existing bridge	20	1	sawcut	9.93E-04	1.20E-03	1.60E-02	1.32E-02	2.63E+00	5.24E-05	4.82E-05	3.31E-05
2	demolishion of existing bridge	20	1	personnel	1.31E-04	1.41E-04	2.12E-03	1.03E-04	8.11E-01	4.53E-04	1.39E-04	7.96E-06
2	demolishion of existing bridge	20	1	hauling trips (demolished material)	2.65E-05	3.01E-05	3.74E-04	3.84E-03	2.07E+00	4.22E-04	1.56E-04	1.87E-05
3	earthwork to rasie abutments (1-3 foot raise)	10	1	dozer	9.99E-04	1.19E-03	1.23E-02	3.76E-03	4.43E+00	1.26E-02	6.94E-03	3.98E-05
3	earthwork to rasie abutments (1-3 foot raise)	10	1	end dump truck	3.17E-03	3.78E-03	3.06E-02	2.34E-02	1.40E+01	6.97E-02	7.28E-03	1.26E-04
3	earthwork to rasie abutments (1-3 foot raise)	10	1	compactor	2.01E-03	2.41E-03	7.02E-02	1.52E-03	1.44E-01	7.40E-04	5.59E-04	4.13E-06
3	earthwork to rasie abutments (1-3 foot raise)	10	1	excavator	5.16E-04	6.14E-04	9.67E-03	3.18E-03	3.08E+00	5.76E-05	5.30E-05	2.77E-05
3	earthwork to rasie abutments (1-3 foot raise)	10	1	tractor	3.73E-04	4.44E-04	9.75E-03	3.94E-03	1.84E+00	3.90E-05	3.59E-05	1.65E-05
3	earthwork to rasie abutments (1-3 foot raise)	10	1	personnel	1.13E-04	1.21E-04	1.82E-03	8.80E-05	6.95E-01	3.89E-04	1.19E-04	6.83E-06
3	earthwork to rasie abutments (1-3 foot raise)	10	1	hauling trips (material import)	7.94E-05	9.04E-05	1.12E-03	1.15E-02	6.20E+00	1.27E-03	4.69E-04	5.60E-05
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	drill rig	1.08E-03	1.29E-03	2.29E-02	7.24E-03	8.19E+00	1.47E-04	1.35E-04	7.36E-05
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	crane	7.06E-04	8.41E-04	1.35E-02	3.58E-03	5.23E+00	9.40E-05	8.65E-05	4.71E-05
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	skid steer	3.21E-04	3.82E-04	1.09E-02	5.27E-03	1.89E+00	3.44E-05	3.16E-05	1.70E-05
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	excavator	7.74E-04	9.21E-04	1.45E-02	4.77E-03	4.62E+00	8.64E-05	7.95E-05	4.15E-05
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	personnel	1.55E-04	1.66E-04	2.50E-03	1.21E-04	9.56E-01	5.34E-04	1.64E-04	9.39E-06
4	shaft foundation, rebar cage, and concrete placement at abutments	15	1	hauling trips (vendor delivery)	4.10E-06	4.67E-06	5.80E-05	5.96E-04	3.21E-01	6.54E-05	2.42E-05	2.89E-06
5	form and place wing walls	10	1	excavator	5.16E-04	6.14E-04	9.67E-03	3.18E-03	3.08E+00	5.76E-05	5.30E-05	2.77E-05
5	form and place wing walls	10	1	personnel	4.69E-05	5.03E-05	7.58E-04	3.67E-05	2.90E-01	1.62E-04	4.95E-05	2.84E-06
5	form and place wing walls	10	1	hauling trips (vendor delivery)	2.74E-06	3.12E-06	3.86E-05	3.97E-04	2.14E-01	4.36E-05	1.62E-05	1.93E-06
6	set bridge girders	15	1	crane	7.06E-04	8.41E-04	1.35E-02	3.58E-03	5.23E+00	9.40E-05	8.65E-05	4.71E-05
6	set bridge girders	15	1	skid steer	3.21E-04	3.82E-04	1.09E-02	5.27E-03	1.89E+00	3.44E-05	3.16E-05	1.70E-05
6	set bridge girders	15	1	personnel	7.04E-05	7.54E-05	1.14E-03	5.50E-05	4.34E-01	2.43E-04	7.43E-05	4.27E-06
6	set bridge girders	15	1	hauling trips (vendor delivery)	1.23E-05	1.40E-05	1.74E-04	1.79E-03	9.62E-01	1.96E-04	7.27E-05	8.68E-06
7	form and place deck	30	1	truck	2.12E-04	2.26E-04	3.15E-03	1.57E-04	1.34E+00	6.72E-04	2.06E-04	1.32E-05
7	form and place deck	30	1	skid steer	6.42E-04	7.64E-04	2.17E-02	1.05E-02	3.77E+00	6.87E-05	6.32E-05	3.39E-05
7	form and place deck	30	1	personnel	1.69E-04	1.81E-04	2.73E-03	1.32E-04	1.04E+00	5.83E-04	1.78E-04	1.02E-05
7	form and place deck	30	1	hauling trips (vendor delivery)	2.46E-05	2.80E-05	3.48E-04	3.58E-03	1.92E+00	3.93E-04	1.45E-04	1.74E-05
8	utility replacement	10	1	snooper truck	4.71E-04	5.60E-04	8.98E-03	2.38E-03	3.49E+00	6.26E-05	5.76E-05	3.14E-05
8	utility replacement	10	1	personnel	2.81E-05	3.02E-05	4.55E-04	2.20E-05	1.74E-01	9.71E-05	2.97E-05	1.71E-06
9	final grading and paving	10	1	skid steer	2.14E-04	2.55E-04	7.25E-03	3.51E-03	1.26E+00	2.29E-05	2.11E-05	1.13E-05
9	final grading and paving	10	1	paver	3.96E-04	4.71E-04	1.18E-02	3.07E-03	2.89E+00	5.11E-05	4.71E-05	2.60E-05
9	final grading and paving	10	1	truck	1.42E-04	1.51E-04	2.10E-03	1.04E-04	8.92E-01	4.48E-04	1.37E-04	8.77E-06
9	final grading and paving	10	1	personnel	9.38E-05	1.01E-04	1.52E-03	7.34E-05	5.79E-01	3.24E-04	9.91E-05	5.69E-06
9	final grading and paving	10	1	hauling trips (vendor delivery)	2.74E-06	3.12E-06	3.86E-05	3.97E-04	2.14E-01	4.36E-05	1.62E-05	1.93E-06

NOTE: Bridge replacement phasing assumed to be performed in series (i.e. does not overlap) [Appendix G of the Delta-Mendota Canal Feasibility Study]. Therefore, peak bridge replacement phase assumed to represent bridge construction on all counts (equipment emissions, trips, personnel, etc.)

Emissions (tons per bridge)

ROG	TOG	CO	NOx	CO2e	PM10	PM2.5	SOx
0.02	0.02	0.36	0.14	104.36	0.09	0.02	0.00

Total Bridge Construction Duration

04/07/2025	07/30/2032
1,910	total workdays
262	workdays per year
45	impacted bridges
0.0236	bridges per workday
6.17	average bridges per year

Emissions (tons per year)

ROG	TOG	CO	NOx	CO2e	PM10	PM2.5	SOx
0.11	0.13	2.22	0.84	644.18	0.56	0.11	0.01

CONCRETE LINING AND ASSOCIATED EMBANKMENT RAISE

Phase #	Construction Phase	Duration	Shifts	Equipment	Count	Assumptions	Factor Type
1	stripping	1,063	1	small dozer	1	a,	offroad
1	stripping	1,063	1	personnel	1	a,d,	onroad
2	topsoil moving	1,063	1	small dozer	0	a,c,	offroad
2	topsoil moving	1,063	1	front end loader	1	a,	offroad
2	topsoil moving	1,063	1	personnel	2	a,d,	onroad
2	topsoil moving	1,063	1	hauling trips (topsoil export)	1	a,b,d,	onroad
3	excavation	1,063	1	small excavator	1	a,	offroad
3	excavation	1,063	1	end dump truck	2	a,f	offroad
3	excavation	1,063	1	personnel	3	a,d,	onroad
3	excavation	1,063	1	hauling trips (material export)	10	a,b,d,	onroad
4	compacted backfill	1,063	1	front end loader	1	a,	offroad
4	compacted backfill	1,063	1	roller compactor (4-foot) with blade	1	a,	offroad
4	compacted backfill	1,063	1	personnel	2	a,d,	onroad
4	compacted backfill	1,063	1	hauling trips (material import)	15	a,b,d,	onroad
5	concrete lining	1,063	1	pickup truck	3	a,e,	onroad
5	concrete lining	1,063	1	skid steer	1	a,	offroad
5	concrete lining	1,063	1	personnel	15	a,d,	onroad
5	concrete lining	1,063	1	hauling trips (vendor delivery)	6	a,b,d,	onroad

CONCRETE LINING AND ASSOCIATED EMBANKMENT RAISE

Phase #	Construction Phase	Duration	Shifts	Equipment	Vehicle Category	Usage Factor	Trip Distance
1	stripping	1,063	1	small dozer	Construction and Mining - Rubber Tired Dozers	0.85	--
1	stripping	1,063	1	personnel	Workers	1.00	22
2	topsoil moving	1,063	1	small dozer	Construction and Mining - Rubber Tired Dozers	0.85	--
2	topsoil moving	1,063	1	front end loader	Construction and Mining - Rubber Tired Loaders	0.85	--
2	topsoil moving	1,063	1	personnel	Workers	1.00	22
2	topsoil moving	1,063	1	hauling trips (topsoil export)	Hauling/Delivery	1.00	40
3	excavation	1,063	1	small excavator	Construction and Mining - Excavators	0.85	--
3	excavation	1,063	1	end dump truck	Construction and Mining - Off-Highway Trucks	0.25	--
3	excavation	1,063	1	personnel	Workers	1.00	22
3	excavation	1,063	1	hauling trips (material export)	Hauling/Delivery	1.00	40
4	compacted backfill	1,063	1	front end loader	Construction and Mining - Rubber Tired Loaders	0.85	--
4	compacted backfill	1,063	1	roller compactor (4-foot) with blade	Construction and Mining - Rollers	0.85	--
4	compacted backfill	1,063	1	personnel	Workers	1.00	22
4	compacted backfill	1,063	1	hauling trips (material import)	Hauling/Delivery	1.00	40
5	concrete lining	1,063	1	pickup truck	LDT1	0.25	300
5	concrete lining	1,063	1	skid steer	Construction and Mining - Skid Steer Loaders	0.85	--
5	concrete lining	1,063	1	personnel	Workers	1.00	22
5	concrete lining	1,063	1	hauling trips (vendor delivery)	Hauling/Delivery	1.00	17

	CONCRETE LINING AND ASSOCIATED EMBANKMENT RAISE				Emission Factors (g/hr for offroad; g/mi for onroad)							
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**ROG**	**TOG**	**CO**	**NOx**	**CO2e**	**PM10**	**PM2.5**	**SOx**
1	stripping	1,063	1	small dozer	1.07E+01	1.27E+01	1.31E+02	4.02E+01	4.73E+04	1.34E+02	7.41E+01	4.25E-01
1	stripping	1,063	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
2	topsoil moving	1,063	1	small dozer	1.07E+01	1.27E+01	1.31E+02	4.02E+01	4.73E+04	1.34E+02	7.41E+01	4.25E-01
2	topsoil moving	1,063	1	front end loader	8.11E+00	9.66E+00	1.22E+02	3.15E+01	3.99E+04	8.24E-01	7.58E-01	3.59E-01
2	topsoil moving	1,063	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
2	topsoil moving	1,063	1	hauling trips (topsoil export)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
3	excavation	1,063	1	small excavator	5.50E+00	6.55E+00	1.03E+02	3.39E+01	3.29E+04	6.15E-01	5.66E-01	2.95E-01
3	excavation	1,063	1	end dump truck	1.92E+01	2.28E+01	1.85E+02	1.42E+02	8.46E+04	4.21E+02	4.40E+01	7.60E-01
3	excavation	1,063	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
3	excavation	1,063	1	hauling trips (material export)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
4	compacted backfill	1,063	1	front end loader	8.11E+00	9.66E+00	1.22E+02	3.15E+01	3.99E+04	8.24E-01	7.58E-01	3.59E-01
4	compacted backfill	1,063	1	roller compactor (4-foot) with blade	2.71E+00	3.23E+00	8.87E+01	3.48E+01	1.69E+04	2.99E-01	2.75E-01	1.52E-01
4	compacted backfill	1,063	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
4	compacted backfill	1,063	1	hauling trips (material import)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
5	concrete lining	1,063	1	pickup truck	4.28E-02	4.56E-02	6.35E-01	3.16E-02	2.70E+02	1.35E-01	4.15E-02	2.65E-03
5	concrete lining	1,063	1	skid steer	2.29E+00	2.72E+00	7.73E+01	3.75E+01	1.34E+04	2.44E-01	2.25E-01	1.21E-01
5	concrete lining	1,063	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
5	concrete lining	1,063	1	hauling trips (vendor delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02

	CONCRETE LINING AND ASSOCIATED EMBANKMENT RAISE				Emissions (total tons)							
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**ROG**	**TOG**	**CO**	**NOx**	**CO2e**	**PM10**	**PM2.5**	**SOx**
1	stripping	1,063	1	small dozer	1.06E-01	1.26E-01	1.31E+00	4.00E-01	4.71E+02	1.34E+00	7.38E-01	4.23E-03
1	stripping	1,063	1	personnel	9.97E-04	1.07E-03	1.61E-02	7.80E-04	6.16E+00	3.44E-03	1.05E-03	6.05E-05
2	topsoil moving	1,063	1	small dozer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	topsoil moving	1,063	1	front end loader	8.08E-02	9.62E-02	1.22E+00	3.14E-01	3.97E+02	8.21E-03	7.55E-03	3.57E-03
2	topsoil moving	1,063	1	personnel	1.99E-03	2.14E-03	3.22E-02	1.56E-03	1.23E+01	6.88E-03	2.11E-03	1.21E-04
2	topsoil moving	1,063	1	hauling trips (topsoil export)	7.03E-04	8.01E-04	9.93E-03	1.02E-01	5.49E+01	1.12E-02	4.15E-03	4.96E-04
3	excavation	1,063	1	small excavator	5.48E-02	6.52E-02	1.03E+00	3.38E-01	3.27E+02	6.12E-03	5.63E-03	2.94E-03
3	excavation	1,063	1	end dump truck	1.12E-01	1.34E-01	1.08E+00	8.30E-01	4.95E+02	2.47E+00	2.58E-01	4.45E-03
3	excavation	1,063	1	personnel	2.99E-03	3.21E-03	4.84E-02	2.34E-03	1.85E+01	1.03E-02	3.16E-03	1.81E-04
3	excavation	1,063	1	hauling trips (material export)	7.03E-03	8.01E-03	9.93E-02	1.02E+00	5.49E+02	1.12E-01	4.15E-02	4.96E-03
4	compacted backfill	1,063	1	front end loader	8.08E-02	9.62E-02	1.22E+00	3.14E-01	3.97E+02	8.21E-03	7.55E-03	3.57E-03
4	compacted backfill	1,063	1	roller compactor (4-foot) with blade	2.70E-02	3.22E-02	8.84E-01	3.47E-01	1.68E+02	2.98E-03	2.74E-03	1.51E-03
4	compacted backfill	1,063	1	personnel	1.99E-03	2.14E-03	3.22E-02	1.56E-03	1.23E+01	6.88E-03	2.11E-03	1.21E-04
4	compacted backfill	1,063	1	hauling trips (material import)	1.06E-02	1.20E-02	1.49E-01	1.53E+00	8.24E+02	1.68E-01	6.23E-02	7.44E-03
5	concrete lining	1,063	1	pickup truck	1.13E-02	1.20E-02	1.67E-01	8.32E-03	7.11E+01	3.57E-02	1.09E-02	6.99E-04
5	concrete lining	1,063	1	skid steer	2.28E-02	2.71E-02	7.70E-01	3.73E-01	1.34E+02	2.44E-03	2.24E-03	1.20E-03
5	concrete lining	1,063	1	personnel	1.50E-02	1.60E-02	2.42E-01	1.17E-02	9.24E+01	5.16E-02	1.58E-02	9.07E-04
5	concrete lining	1,063	1	hauling trips (vendor delivery)	1.75E-03	1.99E-03	2.46E-02	2.53E-01	1.36E+02	2.78E-02	1.03E-02	1.23E-03

NOTE: Concrete lining and associated embankment raise phasing assumed to be performed concurrently (i.e. overlapping) [Appendix G of the Delta-Mendota Canal Feasibility Study]

Emissions (total tons)

ROG	TOG	CO	NOx	CO2e	PM10	PM2.5	SOx
0.54	0.64	8.33	5.85	4,166.95	4.27	1.17	0.04

Concrete Lining w Associated Embankment Raise (low flow work)

10/01/2025	10/10/2029
1,063	total workdays
175	workdays per year

Emissions (tons per year)

ROG	TOG	CO	NOx	CO2e	PM10	PM2.5	SOx
0.09	0.10	1.37	0.96	684.69	0.70	0.19	0.01

	CONCRETE LINING REPAIRS	(workdays per area)					
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**Count**	**Assumptions**	**Factor Type**
1	remove damaged concrete	10	1	excavator	1	a,	offroad
1	remove damaged concrete	10	1	dump truck	2	a,d	offroad
1	remove damaged concrete	10	1	skid steer	1	a,	offroad
1	remove damaged concrete	10	1	personnel	6	a,c,	onroad
1	remove damaged concrete	10	1	hauling trips (damaged concrete)	6	a,b,c,	onroad
2	place gravel bedding	10	1	excavator	1	a,	offroad
2	place gravel bedding	10	1	dump truck	2	a,d	offroad
2	place gravel bedding	10	1	skid steer	1	a,	offroad
2	place gravel bedding	10	1	personnel	6	a,c,	onroad
2	place gravel bedding	10	1	hauling trips (vendor delivery)	8	a,b,c,	onroad
3	install concrete	10	1	excavator	1	a,	offroad
3	install concrete	10	1	personnel	6	a,	onroad
3	install concrete	10	1	hauling trips (vendor delivery)	6	a,b,c,	onroad

	CONCRETE LINING REPAIRS	(workdays per area)					
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**Vehicle Category**	**Usage Factor**	**Trip Distance**
1	remove damaged concrete	10	1	excavator	Construction and Mining - Excavators	0.85	--
1	remove damaged concrete	10	1	dump truck	Construction and Mining - Off-Highway Trucks	0.25	--
1	remove damaged concrete	10	1	skid steer	Construction and Mining - Skid Steer Loaders	0.85	--
1	remove damaged concrete	10	1	personnel	Workers	1.00	22
1	remove damaged concrete	10	1	hauling trips (damaged concrete)	Hauling/Delivery	1.00	40
2	place gravel bedding	10	1	excavator	Construction and Mining - Excavators	0.85	--
2	place gravel bedding	10	1	dump truck	Construction and Mining - Off-Highway Trucks	0.25	--
2	place gravel bedding	10	1	skid steer	Construction and Mining - Skid Steer Loaders	0.85	--
2	place gravel bedding	10	1	personnel	Workers	1.00	22
2	place gravel bedding	10	1	hauling trips (vendor delivery)	Hauling/Delivery	1.00	17
3	install concrete	10	1	excavator	Construction and Mining - Excavators	0.85	--
3	install concrete	10	1	personnel	Workers	1.00	22
3	install concrete	10	1	hauling trips (vendor delivery)	Hauling/Delivery	1.00	17

	CONCRETE LINING REPAIRS	(workdays per area)			**Emission Factors (g/hr for offroad; g/mi for onroad)**							
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**ROG**	**TOG**	**CO**	**NOx**	**CO2e**	**PM10**	**PM2.5**	**SOx**
1	remove damaged concrete	10	1	excavator	5.50E+00	6.55E+00	1.03E+02	3.39E+01	3.29E+04	6.15E-01	5.66E-01	2.95E-01
1	remove damaged concrete	10	1	dump truck	1.92E+01	2.28E+01	1.85E+02	1.42E+02	8.46E+04	4.21E+02	4.40E+01	7.60E-01
1	remove damaged concrete	10	1	skid steer	2.29E+00	2.72E+00	7.73E+01	3.75E+01	1.34E+04	2.44E-01	2.25E-01	1.21E-01
1	remove damaged concrete	10	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
1	remove damaged concrete	10	1	hauling trips (damaged concrete)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
2	place gravel bedding	10	1	excavator	5.50E+00	6.55E+00	1.03E+02	3.39E+01	3.29E+04	6.15E-01	5.66E-01	2.95E-01
2	place gravel bedding	10	1	dump truck	1.92E+01	2.28E+01	1.85E+02	1.42E+02	8.46E+04	4.21E+02	4.40E+01	7.60E-01
2	place gravel bedding	10	1	skid steer	2.29E+00	2.72E+00	7.73E+01	3.75E+01	1.34E+04	2.44E-01	2.25E-01	1.21E-01
2	place gravel bedding	10	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
2	place gravel bedding	10	1	hauling trips (vendor delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
3	install concrete	10	1	excavator	5.50E+00	6.55E+00	1.03E+02	3.39E+01	3.29E+04	6.15E-01	5.66E-01	2.95E-01
3	install concrete	10	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
3	install concrete	10	1	hauling trips (vendor delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02

	CONCRETE LINING REPAIRS	(workdays per area)			**Emissions (tons per area)**							
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**ROG**	**TOG**	**CO**	**NOx**	**CO2e**	**PM10**	**PM2.5**	**SOx**
1	remove damaged concrete	10	1	excavator	5.16E-04	6.14E-04	9.67E-03	3.18E-03	3.08E+00	5.76E-05	5.30E-05	2.77E-05
1	remove damaged concrete	10	1	dump truck	1.06E-03	1.26E-03	1.02E-02	7.81E-03	4.66E+00	2.32E-02	2.43E-03	4.19E-05
1	remove damaged concrete	10	1	skid steer	2.14E-04	2.55E-04	7.25E-03	3.51E-03	1.26E+00	2.29E-05	2.11E-05	1.13E-05
1	remove damaged concrete	10	1	personnel	5.63E-05	6.03E-05	9.10E-04	4.40E-05	3.48E-01	1.94E-04	5.95E-05	3.41E-06
1	remove damaged concrete	10	1	hauling trips (damaged concrete)	3.97E-05	4.52E-05	5.61E-04	5.76E-03	3.10E+00	6.33E-04	2.34E-04	2.80E-05
2	place gravel bedding	10	1	excavator	5.16E-04	6.14E-04	9.67E-03	3.18E-03	3.08E+00	5.76E-05	5.30E-05	2.77E-05
2	place gravel bedding	10	1	dump truck	1.06E-03	1.26E-03	1.02E-02	7.81E-03	4.66E+00	2.32E-02	2.43E-03	4.19E-05
2	place gravel bedding	10	1	skid steer	2.14E-04	2.55E-04	7.25E-03	3.51E-03	1.26E+00	2.29E-05	2.11E-05	1.13E-05
2	place gravel bedding	10	1	personnel	5.63E-05	6.03E-05	9.10E-04	4.40E-05	3.48E-01	1.94E-04	5.95E-05	3.41E-06
2	place gravel bedding	10	1	hauling trips (vendor delivery)	2.19E-05	2.49E-05	3.09E-04	3.18E-03	1.71E+00	3.49E-04	1.29E-04	1.54E-05
3	install concrete	10	1	excavator	5.16E-04	6.14E-04	9.67E-03	3.18E-03	3.08E+00	5.76E-05	5.30E-05	2.77E-05
3	install concrete	10	1	personnel	5.63E-05	6.03E-05	9.10E-04	4.40E-05	3.48E-01	1.94E-04	5.95E-05	3.41E-06
3	install concrete	10	1	hauling trips (vendor delivery)	1.64E-05	1.87E-05	2.32E-04	2.38E-03	1.28E+00	2.62E-04	9.69E-05	1.16E-05

NOTE: Concrete lining repairs phasing assumed to be performed in series (i.e. does not overlap) [Appendix G of the Delta-Mendota Canal Feasibility Study]. Therefore, peak concrete lining repairs phase assumed to represent concrete lining repairs on all counts (equipment emissions, trips, personnel, etc.)

Emissions (tons per area)

ROG	TOG	CO	NOx	CO2e	PM10	PM2.5	SOx
0.00	0.01	0.07	0.04	28.20	0.05	0.01	0.00

Concrete Lining Repairs

10/01/2025	04/10/2026
150	total workdays
87	workdays per year
15	impacted areas
0.1000	areas per workday
8.73	average areas per year

Emissions (tons per year)

ROG	TOG	CO	NOx	CO2e	PM10	PM2.5	SOx
0.07	0.08	1.02	0.65	423.07	0.73	0.09	0.00

STABILIZE EARTHEN EMBANKMENTS ALONG EARTH-LINED SEGMENTS

Phase #	Construction Phase	Duration	Shifts	Equipment	Count	Assumptions	Factor Type
1	stripping	236	1	dozer	1	a,	offroad
1	stripping	236	1	personnel	1	a,e,	onroad
2	stripping	236	1	dozer	1	a,c,	offroad
2	stripping	236	1	personnel	1	a,c,e,	onroad
3	topsoil moving	236	1	front end loader	1	a,	offroad
3	topsoil moving	236	1	dump truck	2	a,f	offroad
3	topsoil moving	236	1	personnel	3	a,e,	onroad
3	topsoil moving	236	1	hauling trips (material export)	7	a,b,e,	onroad
4	topsoil moving	236	1	front end loader	1	a,c,	offroad
4	topsoil moving	236	1	dump truck	2	a,c,f	offroad
4	topsoil moving	236	1	personnel	3	a,c,e,	onroad
4	topsoil moving	236	1	hauling trips (material export)	20	a,b,c,e,	onroad
5	excavation	236	1	small excavator	1	a,	offroad
5	excavation	236	1	dump truck	2	a,f	offroad
5	excavation	236	1	personnel	3	a,e,	onroad
5	excavation	236	1	hauling trips (material export)	26	a,b,e,	onroad
6	compacted backfill	236	1	front end loader	2	a,	offroad
6	compacted backfill	236	1	roller compactor (4-foot) with blade	2	a,	offroad
6	compacted backfill	236	1	personnel	4	a,e,	onroad
6	compacted backfill	236	1	hauling trips (material import)	35	a,b,e,	onroad
7	bedding material	236	1	medium sized excavator	1	a,	offroad
7	bedding material	236	1	vibratory plate compactor	1	a,	offroad
7	bedding material	236	1	front end loader	1	a,	offroad
7	bedding material	236	1	personnel	8	a,e,	onroad
7	bedding material	236	1	hauling trips (vendor delivery)	16	a,d,e,	onroad
8	riprap	236	1	personnel	1	a,e,	onroad
8	riprap	236	1	hauling trips (vendor delivery)	15	a,d,e,	onroad
9	gravel road surfacing	236	1	road grader	1	a,	offroad
9	gravel road surfacing	236	1	personnel	1	a,e,	onroad
10	chip seal/seal coat	236	1	personnel	1	a,e,	onroad

STABILIZE EARTHEN EMBANKMENTS ALONG EARTH-LINED SEGMENTS

Phase #	Construction Phase	Duration	Shifts	Equipment	Vehicle Category	Usage Factor	Trip Distance
1	stripping	236	1	dozer	Construction and Mining - Rubber Tired Dozers	0.85	--
1	stripping	236	1	personnel	Workers	1.00	22
2	stripping	236	1	dozer	Construction and Mining - Rubber Tired Dozers	0.85	--
2	stripping	236	1	personnel	Workers	1.00	22
3	topsoil moving	236	1	front end loader	Construction and Mining - Rubber Tired Loaders	0.85	--
3	topsoil moving	236	1	dump truck	Construction and Mining - Off-Highway Trucks	0.25	--
3	topsoil moving	236	1	personnel	Workers	1.00	22
3	topsoil moving	236	1	hauling trips (material export)	Hauling/Delivery	1.00	40
4	topsoil moving	236	1	front end loader	Construction and Mining - Rubber Tired Loaders	0.85	--
4	topsoil moving	236	1	dump truck	Construction and Mining - Off-Highway Trucks	0.25	--
4	topsoil moving	236	1	personnel	Workers	1.00	22
4	topsoil moving	236	1	hauling trips (material export)	Hauling/Delivery	1.00	40
5	excavation	236	1	small excavator	Construction and Mining - Excavators	0.85	--
5	excavation	236	1	dump truck	Construction and Mining - Off-Highway Trucks	0.25	--
5	excavation	236	1	personnel	Workers	1.00	22
5	excavation	236	1	hauling trips (material export)	Hauling/Delivery	1.00	40
6	compacted backfill	236	1	front end loader	Construction and Mining - Rubber Tired Loaders	0.85	--
6	compacted backfill	236	1	roller compactor (4-foot) with blade	Construction and Mining - Rollers	0.85	--
6	compacted backfill	236	1	personnel	Workers	1.00	22
6	compacted backfill	236	1	hauling trips (material import)	Hauling/Delivery	1.00	40
7	bedding material	236	1	medium sized excavator	Construction and Mining - Excavators	0.85	--
7	bedding material	236	1	vibratory plate compactor	Construction and Mining - Misc - Plate Compactors	0.85	--
7	bedding material	236	1	front end loader	Construction and Mining - Rubber Tired Loaders	0.85	--
7	bedding material	236	1	personnel	Workers	1.00	22
7	bedding material	236	1	hauling trips (vendor delivery)	Hauling/Delivery	1.00	17
8	riprap	236	1	personnel	Workers	1.00	22
8	riprap	236	1	hauling trips (vendor delivery)	Hauling/Delivery	1.00	17
9	gravel road surfacing	236	1	road grader	Construction and Mining - Graders	0.85	--
9	gravel road surfacing	236	1	personnel	Workers	1.00	22
10	chip seal/seal coat	236	1	personnel	Workers	1.00	22

	STABILIZE EARTHEN EMBANKMENTS ALONG EARTH-LINED SEGMENTS				Emission Factors (g/hr for offroad; g/mi for onroad)							
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**ROG**	**TOG**	**CO**	**NOx**	**CO2e**	**PM10**	**PM2.5**	**SOx**
1	stripping	236	1	dozer	1.07E+01	1.27E+01	1.31E+02	4.02E+01	4.73E+04	1.34E+02	7.41E+01	4.25E-01
1	stripping	236	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
2	stripping	236	1	dozer	1.07E+01	1.27E+01	1.31E+02	4.02E+01	4.73E+04	1.34E+02	7.41E+01	4.25E-01
2	stripping	236	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
3	topsoil moving	236	1	front end loader	8.11E+00	9.66E+00	1.22E+02	3.15E+01	3.99E+04	8.24E-01	7.58E-01	3.59E-01
3	topsoil moving	236	1	dump truck	1.92E+01	2.28E+01	1.85E+02	1.42E+02	8.46E+04	4.21E+02	4.40E+01	7.60E-01
3	topsoil moving	236	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
3	topsoil moving	236	1	hauling trips (material export)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
4	topsoil moving	236	1	front end loader	8.11E+00	9.66E+00	1.22E+02	3.15E+01	3.99E+04	8.24E-01	7.58E-01	3.59E-01
4	topsoil moving	236	1	dump truck	1.92E+01	2.28E+01	1.85E+02	1.42E+02	8.46E+04	4.21E+02	4.40E+01	7.60E-01
4	topsoil moving	236	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
4	topsoil moving	236	1	hauling trips (material export)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
5	excavation	236	1	small excavator	5.50E+00	6.55E+00	1.03E+02	3.39E+01	3.29E+04	6.15E-01	5.66E-01	2.95E-01
5	excavation	236	1	dump truck	1.92E+01	2.28E+01	1.85E+02	1.42E+02	8.46E+04	4.21E+02	4.40E+01	7.60E-01
5	excavation	236	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
5	excavation	236	1	hauling trips (material export)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
6	compacted backfill	236	1	front end loader	8.11E+00	9.66E+00	1.22E+02	3.15E+01	3.99E+04	8.24E-01	7.58E-01	3.59E-01
6	compacted backfill	236	1	roller compactor (4-foot) with blade	2.71E+00	3.23E+00	8.87E+01	3.48E+01	1.69E+04	2.99E-01	2.75E-01	1.52E-01
6	compacted backfill	236	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
6	compacted backfill	236	1	hauling trips (material import)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
7	bedding material	236	1	medium sized excavator	5.50E+00	6.55E+00	1.03E+02	3.39E+01	3.29E+04	6.15E-01	5.66E-01	2.95E-01
7	bedding material	236	1	vibratory plate compactor	2.15E+01	2.57E+01	7.49E+02	1.62E+01	1.54E+03	7.89E+00	5.96E+00	4.41E-02
7	bedding material	236	1	front end loader	8.11E+00	9.66E+00	1.22E+02	3.15E+01	3.99E+04	8.24E-01	7.58E-01	3.59E-01
7	bedding material	236	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
7	bedding material	236	1	hauling trips (vendor delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
8	riprap	236	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
8	riprap	236	1	hauling trips (vendor delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
9	gravel road surfacing	236	1	road grader	6.73E+00	8.00E+00	1.34E+02	2.75E+01	4.08E+04	1.25E+01	1.99E+00	3.67E-01
9	gravel road surfacing	236	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
10	chip seal/seal coat	236	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03

	STABILIZE EARTHEN EMBANKMENTS ALONG EARTH-LINED SEGMENTS				Emissions (total tons)							
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**ROG**	**TOG**	**CO**	**NOx**	**CO2e**	**PM10**	**PM2.5**	**SOx**
1	stripping	236	1	dozer	2.36E-02	2.80E-02	2.90E-01	8.88E-02	1.05E+02	2.97E-01	1.64E-01	9.40E-04
1	stripping	236	1	personnel	2.21E-04	2.37E-04	3.58E-03	1.73E-04	1.37E+00	7.64E-04	2.34E-04	1.34E-05
2	stripping	236	1	dozer	2.36E-02	2.80E-02	2.90E-01	8.88E-02	1.05E+02	2.97E-01	1.64E-01	9.40E-04
2	stripping	236	1	personnel	2.21E-04	2.37E-04	3.58E-03	1.73E-04	1.37E+00	7.64E-04	2.34E-04	1.34E-05
3	topsoil moving	236	1	front end loader	1.79E-02	2.14E-02	2.71E-01	6.97E-02	8.82E+01	1.82E-03	1.68E-03	7.93E-04
3	topsoil moving	236	1	dump truck	2.50E-02	2.97E-02	2.41E-01	1.84E-01	1.10E+02	5.48E-01	5.72E-02	9.89E-04
3	topsoil moving	236	1	personnel	6.64E-04	7.12E-04	1.07E-02	5.19E-04	4.10E+00	2.29E-03	7.02E-04	4.03E-05
3	topsoil moving	236	1	hauling trips (material export)	1.09E-03	1.24E-03	1.54E-02	1.59E-01	8.54E+01	1.74E-02	6.46E-03	7.70E-04
4	topsoil moving	236	1	front end loader	1.79E-02	2.14E-02	2.71E-01	6.97E-02	8.82E+01	1.82E-03	1.68E-03	7.93E-04
4	topsoil moving	236	1	dump truck	2.50E-02	2.97E-02	2.41E-01	1.84E-01	1.10E+02	5.48E-01	5.72E-02	9.89E-04
4	topsoil moving	236	1	personnel	6.64E-04	7.12E-04	1.07E-02	5.19E-04	4.10E+00	2.29E-03	7.02E-04	4.03E-05
4	topsoil moving	236	1	hauling trips (material export)	3.12E-03	3.56E-03	4.41E-02	4.54E-01	2.44E+02	4.98E-02	1.84E-02	2.20E-03
5	excavation	236	1	small excavator	1.22E-02	1.45E-02	2.28E-01	7.50E-02	7.27E+01	1.36E-03	1.25E-03	6.53E-04
5	excavation	236	1	dump truck	2.50E-02	2.97E-02	2.41E-01	1.84E-01	1.10E+02	5.48E-01	5.72E-02	9.89E-04
5	excavation	236	1	personnel	6.64E-04	7.12E-04	1.07E-02	5.19E-04	4.10E+00	2.29E-03	7.02E-04	4.03E-05
5	excavation	236	1	hauling trips (material export)	4.06E-03	4.62E-03	5.73E-02	5.90E-01	3.17E+02	6.47E-02	2.40E-02	2.86E-03
6	compacted backfill	236	1	front end loader	3.59E-02	4.27E-02	5.41E-01	1.39E-01	1.76E+02	3.65E-03	3.35E-03	1.59E-03
6	compacted backfill	236	1	roller compactor (4-foot) with blade	1.20E-02	1.43E-02	3.92E-01	1.54E-01	7.47E+01	1.32E-03	1.22E-03	6.71E-04
6	compacted backfill	236	1	personnel	8.86E-04	9.49E-04	1.43E-02	6.93E-04	5.47E+00	3.06E-03	9.35E-04	5.37E-05
6	compacted backfill	236	1	hauling trips (material import)	5.47E-03	6.22E-03	7.72E-02	7.94E-01	4.27E+02	8.71E-02	3.23E-02	3.85E-03
7	bedding material	236	1	medium sized excavator	1.22E-02	1.45E-02	2.28E-01	7.50E-02	7.27E+01	1.36E-03	1.25E-03	6.53E-04
7	bedding material	236	1	vibratory plate compactor	4.75E-02	5.68E-02	1.66E+00	3.58E-02	3.40E+00	1.75E-02	1.32E-02	9.76E-05
7	bedding material	236	1	front end loader	1.79E-02	2.14E-02	2.71E-01	6.97E-02	8.82E+01	1.82E-03	1.68E-03	7.93E-04
7	bedding material	236	1	personnel	1.77E-03	1.90E-03	2.86E-02	1.39E-03	1.09E+01	6.11E-03	1.87E-03	1.07E-04
7	bedding material	236	1	hauling trips (vendor delivery)	1.03E-03	1.18E-03	1.46E-02	1.50E-01	8.07E+01	1.65E-02	6.10E-03	7.28E-04
8	riprap	236	1	personnel	2.21E-04	2.37E-04	3.58E-03	1.73E-04	1.37E+00	7.64E-04	2.34E-04	1.34E-05
8	riprap	236	1	hauling trips (vendor delivery)	9.69E-04	1.10E-03	1.37E-02	1.41E-01	7.56E+01	1.54E-02	5.72E-03	6.83E-04
9	gravel road surfacing	236	1	road grader	1.49E-02	1.77E-02	2.96E-01	6.08E-02	9.03E+01	2.77E-02	4.40E-03	8.12E-04
9	gravel road surfacing	236	1	personnel	2.21E-04	2.37E-04	3.58E-03	1.73E-04	1.37E+00	7.64E-04	2.34E-04	1.34E-05
10	chip seal/seal coat	236	1	personnel	2.21E-04	2.37E-04	3.58E-03	1.73E-04	1.37E+00	7.64E-04	2.34E-04	1.34E-05

NOTE: Stabilization of earthen embankments along earth-lined segments phasing is assumed to be performed concurrently (i.e. overlapping) [Appendix G of the Delta-Mendota Canal Feasibility Study]

Emissions (total tons)

ROG	TOG	CO	NOx	CO2e	PM10	PM2.5	SOx
0.33	0.39	5.77	3.77	2,558.73	2.57	0.63	0.02

Stabilize Canal Banks Along Earthlined Segment (low flow work)

10/01/2025	10/06/2026
236	total workdays
175	workdays per year

Emissions (tons per year)

ROG	TOG	CO	NOx	CO2e	PM10	PM2.5	SOx
0.33	0.39	5.77	3.77	2,558.73	2.57	0.63	0.02

MODIFICATION OF EARTH-LINED SEGMENT

Phase #	Construction Phase	Duration	Shifts	Equipment	Count	Assumptions	Factor Type
1	canal prism excavation	60	2	track loader	1	a,c,	offroad
1	canal prism excavation	60	2	long reach excavator	1	a,c,	offroad
1	canal prism excavation	60	2	hauling trips (excavation)	36	a,b,c,e,f	onroad
1	canal prism excavation	60	2	personnel	5	a,c,e,	onroad
2	surface prep and compaction	60	1	small dozer	2	a,	offroad
2	surface prep and compaction	60	1	roller compactor	2	a,	offroad
2	surface prep and compaction	60	1	excavator w plate compactor	4	a,	offroad
2	surface prep and compaction	60	1	excavator	4	a,	offroad
2	surface prep and compaction	60	1	personnel	12	a,e,	onroad
3	geocomposite liner	60	1	excavator	1	a,	offroad
3	geocomposite liner	60	1	personnel	24	a,e,	onroad
4	backfill	60	2	conveyor	1	a,d,	offroad
4	backfill	60	2	dozer	1	a,d,	offroad
4	backfill	60	2	compactor	1	a,d,	offroad
4	backfill	60	2	excavator w plate compactor	4	a,d,	offroad
4	backfill	60	2	excavator	4	a,d,	offroad
4	backfill	60	2	personnel	15	a,d,e,	onroad
4	backfill	60	2	hauling trips (material import)	49	a,d,b,c,e,f	onroad

MODIFICATION OF EARTH-LINED SEGMENT

Phase #	Construction Phase	Duration	Shifts	Equipment	Vehicle Category	Usage Factor	Trip Distance
1	canal prism excavation	60	2	track loader	Construction and Mining - Skid Steer Loaders	0.85	--
1	canal prism excavation	60	2	long reach excavator	Construction and Mining - Excavators	0.85	--
1	canal prism excavation	60	2	hauling trips (excavation)	Hauling/Delivery	1.00	40
1	canal prism excavation	60	2	personnel	Workers	1.00	22
2	surface prep and compaction	60	1	small dozer	Construction and Mining - Rubber Tired Dozers	0.85	--
2	surface prep and compaction	60	1	roller compactor	Construction and Mining - Rollers	0.85	--
2	surface prep and compaction	60	1	excavator w plate compactor	Construction and Mining - Excavators	0.85	--
2	surface prep and compaction	60	1	excavator	Construction and Mining - Excavators	0.85	--
2	surface prep and compaction	60	1	personnel	Workers	1.00	22
3	geocomposite liner	60	1	excavator	Construction and Mining - Excavators	0.85	--
3	geocomposite liner	60	1	personnel	Workers	1.00	22
4	backfill	60	2	conveyor	Construction and Mining - Other	0.85	--
4	backfill	60	2	dozer	Construction and Mining - Rubber Tired Dozers	0.85	--
4	backfill	60	2	compactor	Construction and Mining - Misc - Plate Compactors	0.85	--
4	backfill	60	2	excavator w plate compactor	Construction and Mining - Excavators	0.85	--
4	backfill	60	2	excavator	Construction and Mining - Excavators	0.85	--
4	backfill	60	2	personnel	Workers	1.00	22
4	backfill	60	2	hauling trips (material import)	Hauling/Delivery	1.00	40

	MODIFICATION OF EARTH-LINED SEGMENT				Emission Factors (g/hr for offroad; g/mi for onroad)							
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**ROG**	**TOG**	**CO**	**NOx**	**CO2e**	**PM10**	**PM2.5**	**SOx**
1	canal prism excavation	60	2	track loader	2.29E+00	2.72E+00	7.73E+01	3.75E+01	1.34E+04	2.44E-01	2.25E-01	1.21E-01
1	canal prism excavation	60	2	long reach excavator	5.50E+00	6.55E+00	1.03E+02	3.39E+01	3.29E+04	6.15E-01	5.66E-01	2.95E-01
1	canal prism excavation	60	2	hauling trips (excavation)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
1	canal prism excavation	60	2	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
2	surface prep and compaction	60	1	small dozer	1.07E+01	1.27E+01	1.31E+02	4.02E+01	4.73E+04	1.34E+02	7.41E+01	4.25E-01
2	surface prep and compaction	60	1	roller compactor	2.71E+00	3.23E+00	8.87E+01	3.48E+01	1.69E+04	2.99E-01	2.75E-01	1.52E-01
2	surface prep and compaction	60	1	excavator w plate compactor	5.50E+00	6.55E+00	1.03E+02	3.39E+01	3.29E+04	6.15E-01	5.66E-01	2.95E-01
2	surface prep and compaction	60	1	excavator	5.50E+00	6.55E+00	1.03E+02	3.39E+01	3.29E+04	6.15E-01	5.66E-01	2.95E-01
2	surface prep and compaction	60	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
3	geocomposite liner	60	1	excavator	5.50E+00	6.55E+00	1.03E+02	3.39E+01	3.29E+04	6.15E-01	5.66E-01	2.95E-01
3	geocomposite liner	60	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
4	backfill	60	2	conveyor	6.08E+00	7.24E+00	1.22E+02	4.66E+01	4.10E+04	7.57E-01	6.97E-01	3.69E-01
4	backfill	60	2	dozer	1.07E+01	1.27E+01	1.31E+02	4.02E+01	4.73E+04	1.34E+02	7.41E+01	4.25E-01
4	backfill	60	2	compactor	2.15E+01	2.57E+01	7.49E+02	1.62E+01	1.54E+03	7.89E+00	5.96E+00	4.41E-02
4	backfill	60	2	excavator w plate compactor	5.50E+00	6.55E+00	1.03E+02	3.39E+01	3.29E+04	6.15E-01	5.66E-01	2.95E-01
4	backfill	60	2	excavator	5.50E+00	6.55E+00	1.03E+02	3.39E+01	3.29E+04	6.15E-01	5.66E-01	2.95E-01
4	backfill	60	2	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
4	backfill	60	2	hauling trips (material import)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02

	MODIFICATION OF EARTH-LINED SEGMENT				Emissions (tons per operation area)							
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**ROG**	**TOG**	**CO**	**NOx**	**CO2e**	**PM10**	**PM2.5**	**SOx**
1	canal prism excavation	60	2	track loader	2.57E-03	3.06E-03	8.69E-02	4.21E-02	1.51E+01	2.75E-04	2.53E-04	1.36E-04
1	canal prism excavation	60	2	long reach excavator	6.19E-03	7.36E-03	1.16E-01	3.82E-02	3.69E+01	6.91E-04	6.36E-04	3.32E-04
1	canal prism excavation	60	2	hauling trips (excavation)	1.43E-03	1.63E-03	2.02E-02	2.08E-01	1.12E+02	2.28E-02	8.44E-03	1.01E-03
1	canal prism excavation	60	2	personnel	2.81E-04	3.02E-04	4.55E-03	2.20E-04	1.74E+00	9.71E-04	2.97E-04	1.71E-05
2	surface prep and compaction	60	1	small dozer	1.20E-02	1.43E-02	1.48E-01	4.52E-02	5.31E+01	1.51E-01	8.33E-02	4.78E-04
2	surface prep and compaction	60	1	roller compactor	3.05E-03	3.63E-03	9.98E-02	3.91E-02	1.90E+01	3.36E-04	3.09E-04	1.71E-04
2	surface prep and compaction	60	1	excavator w plate compactor	1.24E-02	1.47E-02	2.32E-01	7.63E-02	7.39E+01	1.38E-03	1.27E-03	6.64E-04
2	surface prep and compaction	60	1	excavator	1.24E-02	1.47E-02	2.32E-01	7.63E-02	7.39E+01	1.38E-03	1.27E-03	6.64E-04
2	surface prep and compaction	60	1	personnel	6.76E-04	7.24E-04	1.09E-02	5.28E-04	4.17E+00	2.33E-03	7.13E-04	4.10E-05
3	geocomposite liner	60	1	excavator	3.09E-03	3.68E-03	5.80E-02	1.91E-02	1.85E+01	3.46E-04	3.18E-04	1.66E-04
3	geocomposite liner	60	1	personnel	1.35E-03	1.45E-03	2.18E-02	1.06E-03	8.34E+00	4.66E-03	1.43E-03	8.19E-05
4	backfill	60	2	conveyor	6.84E-03	8.14E-03	1.37E-01	5.24E-02	4.61E+01	8.52E-04	7.83E-04	4.14E-04
4	backfill	60	2	dozer	1.20E-02	1.43E-02	1.48E-01	4.52E-02	5.31E+01	1.51E-01	8.33E-02	4.78E-04
4	backfill	60	2	compactor	2.41E-02	2.89E-02	8.42E-01	1.82E-02	1.73E+00	8.88E-03	6.71E-03	4.96E-05
4	backfill	60	2	excavator w plate compactor	2.48E-02	2.95E-02	4.64E-01	1.53E-01	1.48E+02	2.77E-03	2.54E-03	1.33E-03
4	backfill	60	2	excavator	2.48E-02	2.95E-02	4.64E-01	1.53E-01	1.48E+02	2.77E-03	2.54E-03	1.33E-03
4	backfill	60	2	personnel	8.44E-04	9.05E-04	1.37E-02	6.60E-04	5.21E+00	2.91E-03	8.92E-04	5.12E-05
4	backfill	60	2	hauling trips (material import)	1.95E-03	2.22E-03	2.75E-02	2.82E-01	1.52E+02	3.10E-02	1.15E-02	1.37E-03

NOTE: Modification of earth-lined segments phasing is assumed to be performed concurrently (i.e. overlapping), with 36 instances of canal prism excavation and 4 instances of backfill occuring simultaneously [Appendix G of the Delta-Mendota Canal Feasibility Study]

Emissions (tons per year - Appendix G Schedule)

ROG	TOG	CO	NOx	CO2e	PM10	PM2.5	SOx
0.80	0.95	17.38	13.44	8,419.45	1.85	0.87	0.08

Stabilize Canal Banks Along Earthlined Segment (low flow work)

10/01/2025	10/06/2026
60	total workdays
60	workdays per year [6 days per week for this portion of construction]

Emissions (tons per year - half intensity)

ROG	TOG	CO	NOx	CO2e	PM10	PM2.5	SOx
0.40	0.48	8.69	6.72	4,209.73	0.93	0.43	0.04

CHECK STRUCTURES AND WASTEWAYS

Phase #	Construction Phase	Duration	Shifts	Equipment	Count	Assumptions	Factor Type
1	Coffer dam	40	1	crane	1	a,	offroad
1	Coffer dam	40	1	personnel	8	a,	onroad
1	Coffer dam	40	1	hauling trips (supersack delivery)	2	a,e,f,	onroad
2	Install beams	10	1	crane	1	a,	offroad
2	Install beams	10	1	personnel	5	a,	onroad
2	Install beams	10	1	hauling trips (vendor delivery)	1	a,b,c,	onroad
3	Sikawrap	19	1	aerial lift	2	a,	offroad
3	Sikawrap	19	1	personnel	4	a,	onroad
4	Gate modifications	20	1	crane	1	a,	offroad
4	Gate modifications	20	1	aerial lift	1	a,	offroad
4	Gate modifications	20	1	personnel	5	a,	onroad
4	Gate modifications	20	1	hauling trips (vendor delivery)	1	a,f,	onroad

CHECK STRUCTURES AND WASTEWAYS

Phase #	Construction Phase	Duration	Shifts	Equipment	Vehicle Category	Usage Factor	Trip Distance
1	Coffer dam	40	1	crane	Construction and Mining - Cranes	0.85	--
1	Coffer dam	40	1	personnel	Workers	1.00	22
1	Coffer dam	40	1	hauling trips (supersack delivery)	Hauling/Delivery	1.00	17
2	Install beams	10	1	crane	Construction and Mining - Cranes	0.85	--
2	Install beams	10	1	personnel	Workers	1.00	22
2	Install beams	10	1	hauling trips (vendor delivery)	Hauling/Delivery	1.00	17
3	Sikawrap	19	1	aerial lift	Construction and Mining - Other	0.85	--
3	Sikawrap	19	1	personnel	Workers	1.00	22
4	Gate modifications	20	1	crane	Construction and Mining - Cranes	0.85	--
4	Gate modifications	20	1	aerial lift	Construction and Mining - Other	0.85	--
4	Gate modifications	20	1	personnel	Workers	1.00	22
4	Gate modifications	20	1	hauling trips (vendor delivery)	Hauling/Delivery	1.00	17

	CHECK STRUCTURES AND WASTEWAYS				Emission Factors (g/hr for offroad; g/mi for onroad)							
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**ROG**	**TOG**	**CO**	**NOx**	**CO2e**	**PM10**	**PM2.5**	**SOx**
1	Coffer dam	40	1	crane	5.03E+00	5.98E+00	9.58E+01	2.54E+01	3.72E+04	6.69E-01	6.15E-01	3.35E-01
1	Coffer dam	40	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
1	Coffer dam	40	1	hauling trips (supersack delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
2	Install beams	10	1	crane	5.03E+00	5.98E+00	9.58E+01	2.54E+01	3.72E+04	6.69E-01	6.15E-01	3.35E-01
2	Install beams	10	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
2	Install beams	10	1	hauling trips (vendor delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
3	Sikawrap	19	1	aerial lift	6.08E+00	7.24E+00	1.22E+02	4.66E+01	4.10E+04	7.57E-01	6.97E-01	3.69E-01
3	Sikawrap	19	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
4	Gate modifications	20	1	crane	5.03E+00	5.98E+00	9.58E+01	2.54E+01	3.72E+04	6.69E-01	6.15E-01	3.35E-01
4	Gate modifications	20	1	aerial lift	6.08E+00	7.24E+00	1.22E+02	4.66E+01	4.10E+04	7.57E-01	6.97E-01	3.69E-01
4	Gate modifications	20	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
4	Gate modifications	20	1	hauling trips (vendor delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02

	CHECK STRUCTURES AND WASTEWAYS				Emissions (tons per impacted structure)							
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**ROG**	**TOG**	**CO**	**NOx**	**CO2e**	**PM10**	**PM2.5**	**SOx**
1	Coffer dam	40	1	crane	1.88E-03	2.24E-03	3.59E-02	9.54E-03	1.40E+01	2.51E-04	2.31E-04	1.26E-04
1	Coffer dam	40	1	personnel	3.00E-04	3.22E-04	4.85E-03	2.35E-04	1.85E+00	1.04E-03	3.17E-04	1.82E-05
1	Coffer dam	40	1	hauling trips (supersack delivery)	2.19E-05	2.49E-05	3.09E-04	3.18E-03	1.71E+00	3.49E-04	1.29E-04	1.54E-05
2	Install beams	10	1	crane	4.71E-04	5.60E-04	8.98E-03	2.38E-03	3.49E+00	6.26E-05	5.76E-05	3.14E-05
2	Install beams	10	1	personnel	4.69E-05	5.03E-05	7.58E-04	3.67E-05	2.90E-01	1.62E-04	4.95E-05	2.84E-06
2	Install beams	10	1	hauling trips (vendor delivery)	2.74E-06	3.12E-06	3.86E-05	3.97E-04	2.14E-01	4.36E-05	1.62E-05	1.93E-06
3	Sikawrap	19	1	aerial lift	2.16E-03	2.58E-03	4.34E-02	1.66E-02	1.46E+01	2.70E-04	2.48E-04	1.31E-04
3	Sikawrap	19	1	personnel	7.13E-05	7.64E-05	1.15E-03	5.58E-05	4.40E-01	2.46E-04	7.53E-05	4.32E-06
4	Gate modifications	20	1	crane	9.42E-04	1.12E-03	1.80E-02	4.77E-03	6.98E+00	1.25E-04	1.15E-04	6.28E-05
4	Gate modifications	20	1	aerial lift	1.14E-03	1.36E-03	2.28E-02	8.73E-03	7.68E+00	1.42E-04	1.31E-04	6.91E-05
4	Gate modifications	20	1	personnel	9.38E-05	1.01E-04	1.52E-03	7.34E-05	5.79E-01	3.24E-04	9.91E-05	5.69E-06
4	Gate modifications	20	1	hauling trips (vendor delivery)	5.47E-06	6.23E-06	7.73E-05	7.95E-04	4.27E-01	8.72E-05	3.23E-05	3.86E-06

NOTE: Check structure and wasteway phasing is assumed to be performed concurrently (i.e. overlapping) for all phases but coffer dam construction [Appendix G of the Delta-Mendota Canal Feasibility Study]

Emissions (tons per impacted structure)

ROG	TOG	CO	NOx	CO2e	PM10	PM2.5	SOx
0.01	0.01	0.14	0.05	52.21	0.00	0.00	0.00

Check Structures and Wasteways Modifications (low flow work)

10/01/2025	10/06/2026
1,163	total workdays
87	workdays per year
17	impacted structures
0.0146	areas per workday
1.28	average structures per year

Emissions (tons per year)

ROG	TOG	CO	NOx	CO2e	PM10	PM2.5	SOx
0.01	0.01	0.18	0.06	66.65	0.00	0.00	0.00

UTILITY CROSSINGS

Phase #	Construction Phase	Duration	Shifts	Equipment	Count	Assumptions	Factor Type
1	Construction of foundations	10	1	small excavator	1	a,	offroad
1	Construction of foundations	10	1	skid steer	1	a,	offroad
1	Construction of foundations	10	1	personnel	5	a,g	onroad
1	Construction of foundations	10	1	hauling trips (vendor delivery)	2	a,b,c,g	onroad
2	Demolition of old utility	3	1	crane	1	a,	offroad
2	Demolition of old utility	3	1	front end loader	1	a,	offroad
2	Demolition of old utility	3	1	skid steer	1	a,	offroad
2	Demolition of old utility	3	1	dump truck	2	a,h	offroad
2	Demolition of old utility	3	1	personnel	6	a,g	onroad
2	Demolition of old utility	3	1	hauling trips (demolition)	2	a,d,e,f,g	onroad
3	Install new span	2	1	crane	1	a,	offroad
3	Install new span	2	1	personnel	5	a,g	onroad
3	Install new span	2	1	hauling trips (vendor delivery)	1	a,b,c,f,g	onroad

UTILITY CROSSINGS

Phase #	Construction Phase	Duration	Shifts	Equipment	Vehicle Category	Usage Factor	Trip Distance
1	Construction of foundations	10	1	small excavator	Construction and Mining - Excavators	0.85	--
1	Construction of foundations	10	1	skid steer	Construction and Mining - Skid Steer Loaders	0.85	--
1	Construction of foundations	10	1	personnel	Workers	1.00	22
1	Construction of foundations	10	1	hauling trips (vendor delivery)	Hauling/Delivery	1.00	17
2	Demolition of old utility	3	1	crane	Construction and Mining - Cranes	0.85	--
2	Demolition of old utility	3	1	front end loader	Construction and Mining - Rubber Tired Loaders	0.85	--
2	Demolition of old utility	3	1	skid steer	Construction and Mining - Skid Steer Loaders	0.85	--
2	Demolition of old utility	3	1	dump truck	Construction and Mining - Off-Highway Trucks	0.25	--
2	Demolition of old utility	3	1	personnel	Workers	1.00	22
2	Demolition of old utility	3	1	hauling trips (demolition)	Hauling/Delivery	1.00	40
3	Install new span	2	1	crane	Construction and Mining - Cranes	0.85	--
3	Install new span	2	1	personnel	Workers	1.00	22
3	Install new span	2	1	hauling trips (vendor delivery)	Hauling/Delivery	1.00	17

	UTILITY CROSSINGS				Emission Factors (g/hr for offroad; g/mi for onroad)							
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**ROG**	**TOG**	**CO**	**NOx**	**CO2e**	**PM10**	**PM2.5**	**SOx**
1	Construction of foundations	10	1	small excavator	5.50E+00	6.55E+00	1.03E+02	3.39E+01	3.29E+04	6.15E-01	5.66E-01	2.95E-01
1	Construction of foundations	10	1	skid steer	2.29E+00	2.72E+00	7.73E+01	3.75E+01	1.34E+04	2.44E-01	2.25E-01	1.21E-01
1	Construction of foundations	10	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
1	Construction of foundations	10	1	hauling trips (vendor delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
2	Demolition of old utility	3	1	crane	5.03E+00	5.98E+00	9.58E+01	2.54E+01	3.72E+04	6.69E-01	6.15E-01	3.35E-01
2	Demolition of old utility	3	1	front end loader	8.11E+00	9.66E+00	1.22E+02	3.15E+01	3.99E+04	8.24E-01	7.58E-01	3.59E-01
2	Demolition of old utility	3	1	skid steer	2.29E+00	2.72E+00	7.73E+01	3.75E+01	1.34E+04	2.44E-01	2.25E-01	1.21E-01
2	Demolition of old utility	3	1	dump truck	1.92E+01	2.28E+01	1.85E+02	1.42E+02	8.46E+04	4.21E+02	4.40E+01	7.60E-01
2	Demolition of old utility	3	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
2	Demolition of old utility	3	1	hauling trips (demolition)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
3	Install new span	2	1	crane	5.03E+00	5.98E+00	9.58E+01	2.54E+01	3.72E+04	6.69E-01	6.15E-01	3.35E-01
3	Install new span	2	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
3	Install new span	2	1	hauling trips (vendor delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02

	UTILITY CROSSINGS				Emissions (tons per impacted structure)							
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**ROG**	**TOG**	**CO**	**NOx**	**CO2e**	**PM10**	**PM2.5**	**SOx**
1	Construction of foundations	10	1	small excavator	5.16E-04	6.14E-04	9.67E-03	3.18E-03	3.08E+00	5.76E-05	5.30E-05	2.77E-05
1	Construction of foundations	10	1	skid steer	2.14E-04	2.55E-04	7.25E-03	3.51E-03	1.26E+00	2.29E-05	2.11E-05	1.13E-05
1	Construction of foundations	10	1	personnel	4.69E-05	5.03E-05	7.58E-04	3.67E-05	2.90E-01	1.62E-04	4.95E-05	2.84E-06
1	Construction of foundations	10	1	hauling trips (vendor delivery)	5.47E-06	6.23E-06	7.73E-05	7.95E-04	4.27E-01	8.72E-05	3.23E-05	3.86E-06
2	Demolition of old utility	3	1	crane	1.41E-04	1.68E-04	2.69E-03	7.15E-04	1.05E+00	1.88E-05	1.73E-05	9.41E-06
2	Demolition of old utility	3	1	front end loader	2.28E-04	2.71E-04	3.44E-03	8.86E-04	1.12E+00	2.32E-05	2.13E-05	1.01E-05
2	Demolition of old utility	3	1	skid steer	6.42E-05	7.64E-05	2.17E-03	1.05E-03	3.77E-01	6.87E-06	6.32E-06	3.39E-06
2	Demolition of old utility	3	1	dump truck	3.17E-04	3.78E-04	3.06E-03	2.34E-03	1.40E+00	6.97E-03	7.28E-04	1.26E-05
2	Demolition of old utility	3	1	personnel	1.69E-05	1.81E-05	2.73E-04	1.32E-05	1.04E-01	5.83E-05	1.78E-05	1.02E-06
2	Demolition of old utility	3	1	hauling trips (demolition)	3.97E-06	4.52E-06	5.61E-05	5.76E-04	3.10E-01	6.33E-05	2.34E-05	2.80E-06
3	Install new span	2	1	crane	9.42E-05	1.12E-04	1.80E-03	4.77E-04	6.98E-01	1.25E-05	1.15E-05	6.28E-06
3	Install new span	2	1	personnel	9.38E-06	1.01E-05	1.52E-04	7.34E-06	5.79E-02	3.24E-05	9.91E-06	5.69E-07
3	Install new span	2	1	hauling trips (vendor delivery)	5.47E-07	6.23E-07	7.73E-06	7.95E-05	4.27E-02	8.72E-06	3.23E-06	3.86E-07

NOTE: Utility crossing phasing is assumed to be performed concurrently (i.e. overlapping) [Appendix G of the Delta-Mendota Canal Feasibility Study]

Emissions (tons per impacted structure)

ROG	TOG	CO	NOx	CO2e	PM10	PM2.5	SOx
0.00	0.00	0.03	0.01	10.21	0.01	0.00	0.00

Impacted Pipline Crossing Replacements (all season work)

514	total workdays
262	workdays per year
36	impacted structures
0.0700	areas per workday
18.35	average structures per year

Emissions (tons per year)

ROG	TOG	CO	NOx	CO2e	PM10	PM2.5	SOx
0.03	0.04	0.58	0.25	187.33	0.14	0.02	0.00

DRAINAGE STRUCTURES

Phase #	Construction Phase	Duration	Shifts	Equipment	Count	Assumptions	Factor Type
1	Install trash racks at the entrances of all drain inlets	3	1	excavator	1	a,	offroad
1	Install trash racks at the entrances of all drain inlets	3	1	personnel	4	a,	onroad
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	excavator	1	a,	offroad
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	skid steer	1	a,	offroad
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	dump truck	1	a,e	offroad
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	personnel	4	a,	onroad
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	hauling trips (vendor delivery)	2	a,b,c,d,	onroad
3	Raise the headwalls at the entrances of drain inlets	5	1	skid steer	1	a,	offroad
3	Guard rails and ladder steps for each turnout stilling pit	5	1	personnel	4	a,	onroad
3	Guard rails and ladder steps for each turnout stilling pit	5	1	hauling trips (vendor delivery)	2	a,b,c,d,	onroad
4	Replace headwalls at culverts and overchutes at locations where raising the embankment will require higher walls	5	1	skid steer	1	a,	offroad
4	Replace headwalls at culverts and overchutes at locations where raising the embankment will require higher walls	5	1	personnel	4	a,	onroad
4	Replace headwalls at culverts and overchutes at locations where raising the embankment will require higher walls	5	1	hauling trips (vendor delivery)	2	a,b,c,d,	onroad

DRAINAGE STRUCTURES

Phase #	Construction Phase	Duration	Shifts	Equipment	Vehicle Category	Usage Factor	Trip Distance
1	Install trash racks at the entrances of all drain inlets	3	1	excavator	Construction and Mining - Excavators	0.85	--
1	Install trash racks at the entrances of all drain inlets	3	1	personnel	Workers	1.00	22
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	excavator	Construction and Mining - Excavators	0.85	--
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	skid steer	Construction and Mining - Skid Steer Loaders	0.85	--
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	dump truck	Construction and Mining - Off-Highway Trucks	0.25	--
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	personnel	Workers	1.00	22
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	hauling trips (vendor delivery)	Hauling/Delivery	1.00	17
3	Raise the headwalls at the entrances of drain inlets	5	1	skid steer	Construction and Mining - Skid Steer Loaders	0.85	--
3	Guard rails and ladder steps for each turnout stilling pit	5	1	personnel	Workers	1.00	22
3	Guard rails and ladder steps for each turnout stilling pit	5	1	hauling trips (vendor delivery)	Hauling/Delivery	1.00	17
4	Replace headwalls at culverts and overchutes at locations where raising the embankment will require higher walls	5	1	skid steer	Construction and Mining - Skid Steer Loaders	0.85	--
4	Replace headwalls at culverts and overchutes at locations where raising the embankment will require higher walls	5	1	personnel	Workers	1.00	22
4	Replace headwalls at culverts and overchutes at locations where raising the embankment will require higher walls	5	1	hauling trips (vendor delivery)	Hauling/Delivery	1.00	17

	DRAINAGE STRUCTURES				Emission Factors (g/hr for offroad; g/mi for onroad)							
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**ROG**	**TOG**	**CO**	**NOx**	**CO2e**	**PM10**	**PM2.5**	**SOx**
1	Install trash racks at the entrances of all drain inlets	3	1	excavator	5.50E+00	6.55E+00	1.03E+02	3.39E+01	3.29E+04	6.15E-01	5.66E-01	2.95E-01
1	Install trash racks at the entrances of all drain inlets	3	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	excavator	5.50E+00	6.55E+00	1.03E+02	3.39E+01	3.29E+04	6.15E-01	5.66E-01	2.95E-01
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	skid steer	2.29E+00	2.72E+00	7.73E+01	3.75E+01	1.34E+04	2.44E-01	2.25E-01	1.21E-01
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	dump truck	1.92E+01	2.28E+01	1.85E+02	1.42E+02	8.46E+04	4.21E+02	4.40E+01	7.60E-01
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	hauling trips (vendor delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
3	Raise the headwalls at the entrances of drain inlets	5	1	skid steer	2.29E+00	2.72E+00	7.73E+01	3.75E+01	1.34E+04	2.44E-01	2.25E-01	1.21E-01
3	Guard rails and ladder steps for each turnout stilling pit	5	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
3	Guard rails and ladder steps for each turnout stilling pit	5	1	hauling trips (vendor delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
4	Replace headwalls at culverts and overchutes at locations where raising the embankment will require higher walls	5	1	skid steer	2.29E+00	2.72E+00	7.73E+01	3.75E+01	1.34E+04	2.44E-01	2.25E-01	1.21E-01
4	Replace headwalls at culverts and overchutes at locations where raising the embankment will require higher walls	5	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
4	Replace headwalls at culverts and overchutes at locations where raising the embankment will require higher walls	5	1	hauling trips (vendor delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02

	DRAINAGE STRUCTURES				Emissions (tons per impacted structure)							
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**ROG**	**TOG**	**CO**	**NOx**	**CO2e**	**PM10**	**PM2.5**	**SOx**
1	Install trash racks at the entrances of all drain inlets	3	1	excavator	1.55E-04	1.84E-04	2.90E-03	9.54E-04	9.24E-01	1.73E-05	1.59E-05	8.31E-06
1	Install trash racks at the entrances of all drain inlets	3	1	personnel	1.13E-05	1.21E-05	1.82E-04	8.80E-06	6.95E-02	3.89E-05	1.19E-05	6.83E-07
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	excavator	5.16E-05	6.14E-05	9.67E-04	3.18E-04	3.08E-01	5.76E-06	5.30E-06	2.77E-06
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	skid steer	2.14E-05	2.55E-05	7.25E-04	3.51E-04	1.26E-01	2.29E-06	2.11E-06	1.13E-06
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	dump truck	5.29E-05	6.29E-05	5.10E-04	3.91E-04	2.33E-01	1.16E-03	1.21E-04	2.09E-06
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	personnel	3.75E-06	4.02E-06	6.07E-05	2.93E-06	2.32E-02	1.30E-05	3.96E-06	2.28E-07
2	Stabilize the areas downstream of each culvert and overchute through earth work and installation of riprap for erosion protection	1	1	hauling trips (vendor delivery)	5.47E-07	6.23E-07	7.73E-06	7.95E-05	4.27E-02	8.72E-06	3.23E-06	3.86E-07
3	Raise the headwalls at the entrances of drain inlets	5	1	skid steer	1.07E-04	1.27E-04	3.62E-03	1.76E-03	6.28E-01	1.15E-05	1.05E-05	5.65E-06
3	Guard rails and ladder steps for each turnout stilling pit	5	1	personnel	1.88E-05	2.01E-05	3.03E-04	1.47E-05	1.16E-01	6.48E-05	1.98E-05	1.14E-06
3	Guard rails and ladder steps for each turnout stilling pit	5	1	hauling trips (vendor delivery)	2.74E-06	3.12E-06	3.86E-05	3.97E-04	2.14E-01	4.36E-05	1.62E-05	1.93E-06
4	Replace headwalls at culverts and overchutes at locations where raising the embankment will require higher walls	5	1	skid steer	1.07E-04	1.27E-04	3.62E-03	1.76E-03	6.28E-01	1.15E-05	1.05E-05	5.65E-06
4	Replace headwalls at culverts and overchutes at locations where raising the embankment will require higher walls	5	1	personnel	1.88E-05	2.01E-05	3.03E-04	1.47E-05	1.16E-01	6.48E-05	1.98E-05	1.14E-06
4	Replace headwalls at culverts and overchutes at locations where raising the embankment will require higher walls	5	1	hauling trips (vendor delivery)	2.74E-06	3.12E-06	3.86E-05	3.97E-04	2.14E-01	4.36E-05	1.62E-05	1.93E-06

NOTE: Drainage structures phasing is assumed to be performed concurrently (i.e. overlapping) [Appendix G of the Delta-Mendota Canal Feasibility Study]

Emissions (tons per impacted structure)

ROG	TOG	CO	NOx	CO2e	PM10	PM2.5	SOx
0.00	0.00	0.01	0.01	3.64	0.00	0.00	0.00

Impacted Pipline Crossing Replacements (all season work)

745	total workdays
262	workdays per year
25	impacted structures
0.0336	areas per workday
8.79	average structures per year

Emissions (tons per year)

ROG	TOG	CO	NOx	CO2e	PM10	PM2.5	SOx
0.00	0.01	0.12	0.06	32.02	0.01	0.00	0.00

	TURNOUTS						
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**Count**	**Assumptions**	**Factor Type**
1	Corregated metal pipe to raise the manholes/pits for the water meter	2	1	service truck with crane	1	a,	offroad
1	Corregated metal pipe to raise the manholes/pits for the water meter	2	1	personnel	3	a,	onroad
2	Concrete work to raise the stilling pits	2	1	skid steer	1	a,	offroad
2	Concrete work to raise the stilling pits	2	1	personnel	3	a,	onroad
2	Concrete work to raise the stilling pits	2	1	hauling trips (vendor delivery)	2	a,b,c,d,	onroad
3	Guard rails and ladder steps for each turnout stilling pit	2	1	service truck with crane	1	a,	offroad
3	Guard rails and ladder steps for each turnout stilling pit	2	1	personnel	3	a,	onroad
3	Guard rails and ladder steps for each turnout stilling pit	2	1	hauling trips (vendor delivery)	2	a,b,c,d,	onroad
4	Monitoring wells standpipe raise	2	1	personnel	3	a,	onroad

TURNOUTS

Phase #	Construction Phase	Duration	Shifts	Equipment	Vehicle Category	Usage Factor	Trip Distance
1	Corregated metal pipe to raise the manholes/pits for the water meter	2	1	service truck with crane	Construction and Mining - Cranes	0.85	--
1	Corregated metal pipe to raise the manholes/pits for the water meter	2	1	personnel	Workers	1.00	22
2	Concrete work to raise the stilling pits	2	1	skid steer	Construction and Mining - Skid Steer Loaders	0.85	--
2	Concrete work to raise the stilling pits	2	1	personnel	Workers	1.00	22
2	Concrete work to raise the stilling pits	2	1	hauling trips (vendor delivery)	Hauling/Delivery	1.00	17
3	Guard rails and ladder steps for each turnout stilling pit	2	1	service truck with crane	Construction and Mining - Cranes	0.85	--
3	Guard rails and ladder steps for each turnout stilling pit	2	1	personnel	Workers	1.00	22
3	Guard rails and ladder steps for each turnout stilling pit	2	1	hauling trips (vendor delivery)	Hauling/Delivery	1.00	17
4	Monitoring wells standpipe raise	2	1	personnel	Workers	1.00	22

	TURNOUTS				Emission Factors (g/hr for offroad; g/mi for onroad)							
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**ROG**	**TOG**	**CO**	**NOx**	**CO2e**	**PM10**	**PM2.5**	**SOx**
1	Corregated metal pipe to raise the manholes/pits for the water meter	2	1	service truck with crane	5.03E+00	5.98E+00	9.58E+01	2.54E+01	3.72E+04	6.69E-01	6.15E-01	3.35E-01
1	Corregated metal pipe to raise the manholes/pits for the water meter	2	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
2	Concrete work to raise the stilling pits	2	1	skid steer	2.29E+00	2.72E+00	7.73E+01	3.75E+01	1.34E+04	2.44E-01	2.25E-01	1.21E-01
2	Concrete work to raise the stilling pits	2	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
2	Concrete work to raise the stilling pits	2	1	hauling trips (vendor delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
3	Guard rails and ladder steps for each turnout stilling pit	2	1	service truck with crane	5.03E+00	5.98E+00	9.58E+01	2.54E+01	3.72E+04	6.69E-01	6.15E-01	3.35E-01
3	Guard rails and ladder steps for each turnout stilling pit	2	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03
3	Guard rails and ladder steps for each turnout stilling pit	2	1	hauling trips (vendor delivery)	1.50E-02	1.71E-02	2.12E-01	2.18E+00	1.17E+03	2.39E-01	8.86E-02	1.06E-02
4	Monitoring wells standpipe raise	2	1	personnel	3.92E-02	4.20E-02	6.34E-01	3.07E-02	2.42E+02	1.35E-01	4.14E-02	2.38E-03

	TURNOUTS				Emissions (tons per impacted structure)							
Phase #	**Construction Phase**	**Duration**	**Shifts**	**Equipment**	**ROG**	**TOG**	**CO**	**NOx**	**CO2e**	**PM10**	**PM2.5**	**SOx**
1	Corregated metal pipe to raise the manholes/pits for the water meter	2	1	service truck with crane	9.42E-05	1.12E-04	1.80E-03	4.77E-04	6.98E-01	1.25E-05	1.15E-05	6.28E-06
1	Corregated metal pipe to raise the manholes/pits for the water meter	2	1	personnel	5.63E-06	6.03E-06	9.10E-05	4.40E-06	3.48E-02	1.94E-05	5.95E-06	3.41E-07
2	Concrete work to raise the stilling pits	2	1	skid steer	4.28E-05	5.10E-05	1.45E-03	7.02E-04	2.51E-01	4.58E-06	4.21E-06	2.26E-06
2	Concrete work to raise the stilling pits	2	1	personnel	5.63E-06	6.03E-06	9.10E-05	4.40E-06	3.48E-02	1.94E-05	5.95E-06	3.41E-07
2	Concrete work to raise the stilling pits	2	1	hauling trips (vendor delivery)	1.09E-06	1.25E-06	1.55E-05	1.59E-04	8.55E-02	1.74E-05	6.46E-06	7.71E-07
3	Guard rails and ladder steps for each turnout stilling pit	2	1	service truck with crane	9.42E-05	1.12E-04	1.80E-03	4.77E-04	6.98E-01	1.25E-05	1.15E-05	6.28E-06
3	Guard rails and ladder steps for each turnout stilling pit	2	1	personnel	5.63E-06	6.03E-06	9.10E-05	4.40E-06	3.48E-02	1.94E-05	5.95E-06	3.41E-07
3	Guard rails and ladder steps for each turnout stilling pit	2	1	hauling trips (vendor delivery)	1.09E-06	1.25E-06	1.55E-05	1.59E-04	8.55E-02	1.74E-05	6.46E-06	7.71E-07
4	Monitoring wells standpipe raise	2	1	personnel	5.63E-06	6.03E-06	9.10E-05	4.40E-06	3.48E-02	1.94E-05	5.95E-06	3.41E-07

NOTE: Turnouts phasing is assumed to be performed partially concurrently (i.e. any two phases overlapping) [Appendix G of the Delta-Mendota Canal Feasibility Study]

Emissions (tons per impacted structure)

ROG	TOG	CO	NOx	CO2e	PM10	PM2.5	SOx
0.00	0.00	0.01	0.00	1.96	0.00	0.00	0.00

Impacted Pipline Crossing Replacements (all season work)

514	total workdays
262	workdays per year
82	impacted structures
0.1595	areas per workday
41.80	average structures per year

Emissions (tons per year)

ROG	TOG	CO	NOx	CO2e	PM10	PM2.5	SOx
0.01	0.01	0.23	0.08	81.80	0.01	0.00	0.00

Fugitive Dust Emissions
Bulldozing

Equations (AP-42, Chapter 11.9):

$$TSP = \frac{5.7(s)^{1.2}}{M^{1.3}} \quad \text{and} \quad PM15 = \frac{1.0(s)^{1.5}}{M^{1.4}}$$

where:

s = silt content	6.9	%	(AP-42, Table 11.9-3, Overburden)
M = material moisture content	7.9	%	(AP-42, Table 11.9-3, Overburden)

Scaling Factors

PM10	0.75	(multiply the 15-micron equation by this fraction to determine emissions)
PM2.5	0.105	(multiply the TSP equation by this fraction to determine emissions)

Bulldozing Emissions

Size	EF lb/hr	EF (incl. watering) lb/hr	EF (incl. watering) g/hr
PM10	0.75	0.29	133.16
PM2.5	0.41	0.16	73.20

Dust Control

61% reduction from watering at least 3 times per day
Source: CalEEMod

Applicable to…
Construction and Mining - Rubber Tired Dozers

Fugitive Dust Emissions
Grading

Operating Schedule
7.1 miles per hour (AP-42, Table 11.9-3)

Equations (AP-42, Chapter 11.9):

$TSP = 0.040(S)^{2.5}$ and $PM15 = 0.051(S)^{2.0}$

where:
S = mean vehicle speed, miles per hour

Scaling Factors
PM10 0.60 (multiply the 15-micron equation by this fraction to determine emissions)
PM2.5 0.031 (multiply the TSP equation by this fraction to determine emissions)

Grading Emission Factors

Size	EF lb/VMT	EF (incl. watering) lb/VMT	EF (incl. watering) g/hr
PM10	1.54	0.60	11.73
PM2.5	0.17	0.06	1.27

Dust Control
61% reduction from watering at least 3 times per day
Source: CalEEMod

Applicable to…
Construction and Mining - Graders

Total Grading Performed
https://caleemod.com/documents/user-guide/CalEEMod_User_Guide_v2022.1.pdf

$E_p = EF_p \times VMT$ and $VMT = AS \div Wb \times UC_1 \div UC_2$

where:
E = emissions (lb/day).
EF = emission factor (lb/VMT).
VMT = vehicle miles traveled (mile).
As = the acreage of the grading site (acre/day).
Wb = Blade width of the grading equipment. CalEEMod assumes a default blade width of 12 feet based on Caterpillar's 140 Motor Grader (Caterpillar 2021).
UC1 = unit conversion from acre to square feet (43,560 sqft/acre).
UC2 = unit conversion from feet to miles (5,280 feet/mile).
p = pollutant (PM10 or PM2.5).

Table G-14. Daily Acres Graded by Equipment Type

Equipment	Acres Graded per 8 Hour Day
Crawler Tractors	0.5
Graders	0.5
Rubber Tired Dozers	0.5
Scrapers	1

Source: South Coast Air Quality Management District Construction Survey
https://www.caleemod.com/documents/user-guide/08_Appendix%20G.xlsx

Fugitive Dust Emissions
Material Handling

Equation (AP-42, Chapter 13.2.4):

$$E = k(0.0032)\frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

where:
E = emission factor, pound per ton
k = particle size multiplier
U = mean wind speed, miles per hour
M = material moisture content, %

Average Wind Speed 6.08 mph
Source: WeatherWX, San Joaquin County Avg. Wind Speed based on the past 10 years of data. Accessed on: June 1, 2022. Available at: https://www.weatherwx.com/hazardoutlook/ca/san+joaquin+county.html.

Material Moisture Content: 7.9 %
Source: EPA. 1998. AP-42, Chapter 11-9, Overburden moisture content, bulldozing.

Material Handling Emissions

Size	k	EF lb/ton	EF (incl. watering) g/cubic yard
PM10	0.35	2.1E-04	0.093
PM2.5	0.053	3.2E-05	0.014

Density

1.25 tons per cubic yard

Note: CalEEMod assumes haul trucks can handle 20 tons or 16 cy.

Number of Drops

2 drops per truck

Dust Control

61% reduction from watering at least 3 times per day

Source: CalEEMod

Workdays per Year

262 days

Annual Emissions	Total Cubic Yards	Total Handling Emissions (g) PM10	PM2.5	Workdays	Emissions per Year (ton/yr) PM10	PM2.5
BridgeReplacement	72,000	6,725	1,018	1,910	0.0010	0.0002
ConcreteLining EmbankmentRaise	570,276	53,267	8,066	1,063	0.0145	0.0022
ConcreteLiningRepairs	45,000	4,203	636	150	0.0046	0.0007
StabilizeEarthenEmbankments	467,988	43,713	6,619	236	0.0482	0.0073
ModificationOfEarthLinedSegment	6,779,918	633,286	95,898	60	0.2327	0.0352
UtilityCrossings	60	6	1	514	0.0000	0.0000
CheckStructuresAndWasteways	0	0	0	1,163	0.0000	0.0000
Turnouts	0	0	0	514	0.0000	0.0000
DrainageStructures	0	0	0	745	0.0000	0.0000

Fugitive Dust Emissions
Paved Road Dust

Equation 1:

$$E = k(sL)^{0.91} \times (W)^{1.02}$$

where: E = particulate emission factor (having units matching the units of k),
k = particle size multiplier for particle size range and units of interest (see below),
sL = road surface silt loading (grams per square meter) (g/m2), and
W = average weight (tons) of the vehicles traveling the road.

Equation 2:

$$E_{ext} = [k(sL)^{0.91} \times (W)^{1.02}](1 - P/4N)$$

where: k, sL, and W are as defined in Equation 1 and
E_{ext} = annual or other long-term average emission factor in the same units as k,
P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period, and
N = number of days in the averaging period (e.g., 365 for annual, 91 for seasonal, 30 for monthly).

Particle Size Multipliers for Paved Road Equation

Size Range [a]	Ref.	Particle Size Multiplier, k [b]		
		g/VKT	g/VMT	lb/VMT
$PM_{2.5}$	[c]	0.15	0.25	0.00054
PM_{10}		0.62	1.00	0.0022
PM_{15}		0.77	1.23	0.0027
PM_{30}	[d]	3.23	5.24	0.011

Source: AP-42, Table 13.2.1-1
Notes:
[a] Refers to airborne particulate matter (PM-x) with an aerodynamic diameter equal to or less than x micrometers.

[b] Units shown are grams per vehicle kilometer traveled (g/VKT), grams per vehicle mile traveled (g/VMT), and pounds per vehicle mile traveled (lb/VMT). The multiplier k includes unit conversions to produce emission factors in the units shown for the indicated size range from the mixed units required in Equation 1.
[c] The k-factors for $PM_{2.5}$ were based on the average $PM_{2.5}$:PM_{10} ratio of test runs in Reference 30.
[d] PM-30 is sometimes termed "suspendable particulate" (SP) and is often used as a surrogate for TSP.

Default Assumptions

Number precipitation days >0.1 inches
San Joaquin Valley Air Basin 45

Road silt loading 0.03 g/m^2 (AP-42, ADT > 10,000, ubiquitous baseline)
Average vehicle weight 2.2 tons

Source: CalEEMod

Paved Road Dust Emission Factors

Air Basin	Emission Factor (g/VMT)			
	Uncontrolled		Controlled	
	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
San Joaquin Valley	0.092	0.023	0.089	0.022

Note:
Controlled emission factor only applicable to long-term (annual) emissions; uncontrolled emission factor used for daily emissions.

Fugitive Dust Emissions
Unpaved Road Dust

Equations (AP-42, Chapter 13.2.2):

$$E = k(s/12)^a(W/3)^b$$

$$E_{ext} = E[(365 - P)/365]$$

where:
k, a, and b are empirical constants
E = size-specific emission factor (lb/VMT)
s = surface material silt content (%)
W = mean vehicle weight (tons)
Eext = annual size-specific emission factor extrapolated for natural mitigation
P = number of days in a year with at least 0.254 mm (0.01 in) of precipitation

silt content (construction)	8.5	%	(AP-42, Table 13.2.2-1)
days of precipitation	49		(CalEEMod default)
Unloaded truck weight	17	tons	
Loaded truck weight	29	tons	
Average vehicle weight	23	tons	(estimated from eqiupment specifications)

Unmitigated Unpaved Road Dust Emissions

				EF, lb/VMT		EF (incl. watering)
Size	**k**	**a**	**b**	**Uncontrolled**	**Controlled**	**g/VMT**
PM10	1.5	0.9	0.45	2.7	2.4	419.15
PM2.5	0.15	0.9	0.45	0.3	0.2	41.91

Source: AP-42, Table 13.2.2-2

Dust Control

61% reduction from watering at least 3 times per day
Source: CalEEMod

Applicable to…
Construction and Mining - Off-Highway Trucks

EMISSION FACTORS ASSUMING 100% TIER 4 FINAL (2015 OR NEWER) EQUIPMENT FLEET

https://arb.ca.gov/emfac/emissions-inventory/062ea65a6d880915702749cabdedeae6aa349a1e

Model Output: OFFROAD2021 (v1.0.2) Emissions Inventory
Region Type: Air Basin
Region: San Joaquin Valley
Calendar Year: 2025
Scenario: All Adopted Rules - Exhaust
Vehicle Classification: OFFROAD2021 Equipment Types
Units: tons/day for Emissions, gallons/year for Fuel, hours/year for Activity, Horsepower-hours/year for Horsepower-hours

Note on CO2e Factors: CO2e factors are calculated from the CO2 emission factors present in the OFFROAD model. CH4 and N2O components of CO2e are based on OFFROAD fuel estimates and Table 5 of the USEIA Emission Factors for Greenhouse Gas Inventories document dated April 1, 2022 (https://www.epa.gov/system/files/documents/2022-04/ghg_emission_factors_hub.pdf). Global warming potentials are consistent with IPCC AR4.

vmt-weighted aggregate

Region	Calendar Ye	Vehicle Category	Fuel	Avg_HP	g/hr ROG	g/hr TOG	g/hr CO	g/hr NOx	g/hr CO2e	g/hr PM10	g/hr PM2.5	g/hr SOx
San Joaquin Valley	2025	Construction and Mining - Bore/Drill Rigs	Diesel	2.14E+02	7.69E+00	9.15E+00	1.63E+02	5.15E+01	5.83E+04	1.04E+00	9.60E-01	5.24E-01
San Joaquin Valley	2025	Construction and Mining - Cranes	Diesel	2.38E+02	5.03E+00	5.98E+00	9.58E+01	2.54E+01	3.72E+04	6.69E-01	6.15E-01	3.35E-01
San Joaquin Valley	2025	Construction and Mining - Crawler Tractors	Diesel	2.18E+02	7.49E+00	8.91E+00	1.46E+02	4.46E+01	5.08E+04	9.47E-01	8.72E-01	4.56E-01
San Joaquin Valley	2025	Construction and Mining - Excavators	Diesel	1.57E+02	5.50E+00	6.55E+00	1.03E+02	3.39E+01	3.29E+04	6.15E-01	5.66E-01	2.95E-01
San Joaquin Valley	2025	Construction and Mining - Graders	Diesel	1.83E+02	6.73E+00	8.00E+00	1.34E+02	2.75E+01	4.08E+04	1.25E+01	1.99E+00	3.67E-01
San Joaquin Valley	2025	Construction and Mining - Misc - Asphalt Pavers	Gasoline	4.22E+01	1.84E+01	2.20E+01	1.54E+03	3.59E+01	2.25E+04	1.50E+00	1.14E+00	2.36E-01
San Joaquin Valley	2025	Construction and Mining - Misc - Bore/Drill Rigs	Gasoline	8.56E+01	1.90E+01	2.27E+01	1.24E+03	5.43E+01	5.36E+04	3.64E+00	2.75E+00	5.12E-01
San Joaquin Valley	2025	Construction and Mining - Misc - Concrete/Industrial Saws	Diesel	3.30E+01	5.30E+00	6.41E+00	8.56E+01	7.02E+01	1.40E+04	2.80E-01	2.57E-01	1.77E-01
San Joaquin Valley	2025	Construction and Mining - Misc - Concrete/Industrial Saws	Gasoline	4.63E+01	1.95E+01	2.33E+01	1.41E+03	4.00E+01	2.92E+04	1.96E+00	1.48E+00	3.07E-01
San Joaquin Valley	2025	Construction and Mining - Misc - Cranes	Gasoline	6.23E+01	1.55E+01	1.85E+01	1.17E+03	3.64E+01	2.50E+04	1.68E+00	1.27E+00	2.45E-01
San Joaquin Valley	2025	Construction and Mining - Misc - Dumpers/Tenders	Gasoline	8.62E+00	2.05E+01	2.46E+01	8.02E+02	1.61E+01	1.65E+03	9.20E+00	6.95E+00	4.28E-02
San Joaquin Valley	2025	Construction and Mining - Misc - Other	Gasoline	1.26E+02	1.60E+01	1.91E+01	1.48E+03	5.79E+01	4.73E+04	3.28E+00	2.48E+00	4.55E-01
San Joaquin Valley	2025	Construction and Mining - Misc - Other	Diesel	1.36E+01	4.63E+00	5.61E+00	2.75E+01	3.52E+01	4.92E+03	1.36E+00	1.25E+00	7.20E-02
San Joaquin Valley	2025	Construction and Mining - Misc - Paving Equipment	Gasoline	4.28E+01	1.60E+01	1.91E+01	1.20E+03	3.08E+01	2.06E+04	1.38E+00	1.04E+00	2.27E-01
San Joaquin Valley	2025	Construction and Mining - Misc - Plate Compactors	Gasoline	6.13E+00	2.15E+01	2.57E+01	7.49E+02	1.62E+01	1.54E+03	7.89E+00	5.96E+00	4.41E-02
San Joaquin Valley	2025	Construction and Mining - Misc - Plate Compactors	Diesel	8.00E+00	1.88E+00	2.28E+00	1.19E+01	1.43E+01	2.01E+03	5.57E-01	5.13E-01	3.05E-02
San Joaquin Valley	2025	Construction and Mining - Misc - Rollers	Gasoline	6.18E+01	2.31E+01	2.76E+01	1.91E+03	5.25E+01	3.07E+04	2.06E+00	1.56E+00	3.02E-01
San Joaquin Valley	2025	Construction and Mining - Misc - Rough Terrain Forklifts	Gasoline	8.43E+01	2.20E+01	2.63E+01	1.47E+03	5.94E+01	4.35E+04	2.94E+00	2.22E+00	4.11E-01
San Joaquin Valley	2025	Construction and Mining - Misc - Rubber Tired Loaders	Gasoline	6.78E+01	1.73E+01	2.07E+01	1.25E+03	4.43E+01	2.93E+04	1.98E+00	1.49E+00	2.79E-01
San Joaquin Valley	2025	Construction and Mining - Misc - Signal Boards	Diesel	6.07E+00	2.70E+00	3.27E+00	1.73E+01	2.05E+01	2.91E+03	7.96E-01	7.32E-01	4.39E-02
San Joaquin Valley	2025	Construction and Mining - Misc - Signal Boards	Gasoline	7.83E+00	3.30E+01	3.95E+01	1.47E+03	2.87E+01	2.73E+03	1.86E+01	1.41E+01	7.37E-02
San Joaquin Valley	2025	Construction and Mining - Misc - Skid Steer Loaders	Gasoline	5.00E+01	1.53E+01	1.83E+01	1.13E+03	3.21E+01	2.34E+04	1.57E+00	1.18E+00	2.41E-01
San Joaquin Valley	2025	Construction and Mining - Misc - Tampers/Rammers	Gasoline	4.21E+00	1.04E+01	1.24E+01	5.26E+02	9.55E+00	1.06E+03	7.51E+00	5.68E+00	3.99E-02
San Joaquin Valley	2025	Construction and Mining - Misc - Tractors/Loaders/Backhoes	Gasoline	6.30E+01	1.59E+01	1.90E+01	1.17E+03	4.44E+01	2.42E+04	1.63E+00	1.23E+00	2.26E-01
San Joaquin Valley	2025	Construction and Mining - Misc - Trenchers	Gasoline	3.90E+01	1.86E+01	2.23E+01	1.62E+03	3.47E+01	2.08E+04	1.39E+00	1.05E+00	2.23E-01
San Joaquin Valley	2025	Construction and Mining - Off-Highway Tractors	Diesel	1.27E+02	5.72E+00	6.81E+00	1.07E+02	4.37E+01	3.03E+04	5.83E-01	5.36E-01	2.73E-01
San Joaquin Valley	2025	Construction and Mining - Off-Highway Trucks	Diesel	4.08E+02	1.92E+01	2.28E+01	1.85E+02	1.42E+02	8.46E+04	4.21E+02	4.40E+01	7.60E-01
San Joaquin Valley	2025	Construction and Mining - Other	Diesel	1.81E+02	6.08E+00	7.24E+00	1.22E+02	4.66E+01	4.10E+04	7.57E-01	6.97E-01	3.69E-01
San Joaquin Valley	2025	Construction and Mining - Pavers	Diesel	1.36E+02	4.23E+00	5.03E+00	1.26E+02	3.27E+01	3.08E+04	5.46E-01	5.02E-01	2.77E-01
San Joaquin Valley	2025	Construction and Mining - Paving Equipment	Diesel	1.33E+02	3.98E+00	4.74E+00	1.03E+02	3.46E+01	2.58E+04	4.77E-01	4.39E-01	2.32E-01
San Joaquin Valley	2025	Construction and Mining - Rollers	Diesel	8.11E+01	2.71E+00	3.23E+00	8.87E+01	3.48E+01	1.69E+04	2.99E-01	2.75E-01	1.52E-01
San Joaquin Valley	2025	Construction and Mining - Rough Terrain Forklifts	Diesel	1.00E+02	3.18E+00	3.79E+00	1.25E+02	4.81E+01	2.20E+04	3.91E-01	3.60E-01	1.98E-01
San Joaquin Valley	2025	Construction and Mining - Rubber Tired Dozers	Diesel	2.18E+02	1.07E+01	1.27E+01	1.31E+02	4.02E+01	4.73E+04	1.34E+02	7.41E+01	4.25E-01
San Joaquin Valley	2025	Construction and Mining - Rubber Tired Loaders	Diesel	2.03E+02	8.11E+00	9.66E+00	1.22E+02	3.15E+01	3.99E+04	8.24E-01	7.58E-01	3.59E-01
San Joaquin Valley	2025	Construction and Mining - Scrapers	Diesel	3.67E+02	1.36E+01	1.62E+01	1.97E+02	5.34E+01	9.65E+04	1.73E+00	1.59E+00	8.68E-01
San Joaquin Valley	2025	Construction and Mining - Skid Steer Loaders	Diesel	6.60E+01	2.29E+00	2.72E+00	7.73E+01	3.75E+01	1.34E+04	2.44E-01	2.25E-01	1.21E-01
San Joaquin Valley	2025	Construction and Mining - Surfacing Equipment	Diesel	2.79E+02	5.02E+00	5.98E+00	1.06E+02	4.59E+01	4.58E+04	8.16E-01	7.51E-01	4.11E-01
San Joaquin Valley	2025	Construction and Mining - Tractors/Loaders/Backhoes	Diesel	9.76E+01	3.99E+00	4.74E+00	1.04E+02	4.20E+01	1.96E+04	4.17E-01	3.83E-01	1.76E-01
San Joaquin Valley	2025	Construction and Mining - Trenchers	Diesel	7.90E+01	4.04E+00	4.80E+00	9.12E+01	5.57E+01	2.25E+04	3.94E-01	3.62E-01	2.02E-01

EMISSION FACTORS ASSUMING 2015 OR NEWER EQUIPMENT FLEET

https://arb.ca.gov/emfac/emissions-inventory/1d6cf1a0d18800fbedf621f66e2c676b88c2f699

Source: EMFAC2017 (v1.0.3) Emissions Inventory
Region Type: Air Basin
Region: San Joaquin Valley
Calendar Year: 2025
Season: Annual
Vehicle Classification: EMFAC2011 Categories
Units: miles/day for VMT, trips/day for Trips, tons/day for Emissions, 100 vmt-weighted aggregate

Global Warming Potentials
1 *25* *298*
CO2 *CH4* *N2O*
Source: IPCC AR4

Region	Calendar Year	Vehicle Category	g/mi NOx_TOTEX	g/mi PM2.5_TOTA	g/mi PM10_TOTAI	g/mi CO2_TOTEX	g/mi CH4_TOTEX	g/mi N2O_TOTEX	g/mi ROG_TOTAL	g/mi TOG_TOTAL	g/mi CO_TOTEX	g/mi SOx_TOTEX
SAN JOAQUIN VALLEY	2025	LDA	2.95E-02	4.14E-02	1.35E-01	2.29E+02	4.45E-03	5.39E-03	3.56E-02	3.82E-02	6.09E-01	2.26E-03
SAN JOAQUIN VALLEY	2025	LDT1	3.16E-02	4.15E-02	1.35E-01	2.68E+02	4.79E-03	5.41E-03	4.28E-02	4.56E-02	6.35E-01	2.65E-03
SAN JOAQUIN VALLEY	2025	LDT2	3.47E-02	4.15E-02	1.35E-01	2.74E+02	6.17E-03	6.09E-03	5.10E-02	5.47E-02	7.25E-01	2.71E-03
SAN JOAQUIN VALLEY	2025	T6 instate construction heavy	2.05E+00	8.83E-02	2.39E-01	1.10E+03	6.75E-04	1.73E-01	1.45E-02	1.66E-02	2.00E-01	1.04E-02
SAN JOAQUIN VALLEY	2025	T6 instate construction small	2.22E+00	8.87E-02	2.39E-01	1.13E+03	7.04E-04	1.77E-01	1.52E-02	1.73E-02	2.16E-01	1.06E-02
Los Angeles (SC)	2025	Workers	3.07E-02	4.14E-02	1.35E-01	2.40E+02	4.83E-03	5.54E-03	3.92E-02	4.20E-02	6.34E-01	2.38E-03
Los Angeles (SC)	2025	Hauling/Delivery	2.18E+00	8.86E-02	2.39E-01	1.12E+03	6.97E-04	1.76E-01	1.50E-02	1.71E-02	2.12E-01	1.06E-02

"Workers" category includes the vmt-aggregated factors of the LDA, LDT1, and LDT2 vehicle categories.
"Hauling/Delivery" category includes the vmt-aggregated factors of the T6 instate construction * vehicle categories.

Appendix I3
Health Risk Screening Assessment Calculations

Project Component Emissions and Durations

Project Component	On-Site Construction Emissions for HRA Screen (tons per unit)					Annual Workhours per Unit in Vicinity of Receptor	Notes
	TOG	Total PM_{10}	DPM_{10}	$PM_{10.DUST}$	Unit		
BridgeReplacement	1.98E-02	8.42E-02	2.42E-03	8.18E-02	1 bridge	424.4	n/a
ConcreteLining/EmbankmentRaise	1.99E-03	1.32E-02	1.76E-04	1.31E-02	100 meter worksite length	218.8	sum across all prioritization distance brackets to estimate total impact at nearest receptor
StabilizeEarthenEmbankments	8.95E-04	7.76E-03	7.99E-05	7.68E-03	100 meter worksite length	218.8	sum across all prioritization distance brackets to estimate total impact at nearest receptor
ConcreteLiningRepairs	4.87E-03	4.67E-02	4.69E-04	4.62E-02	1 impacted area	100.0	n/a
CheckStructuresAndWasteways	7.86E-03	8.50E-04	8.50E-04	0.00E+00	1 impacted structure	684.1	n/a
UtilityCrossings	1.87E-03	7.11E-03	1.79E-04	6.93E-03	1 impacted structure	142.8	n/a
DrainageStructures	5.89E-04	1.21E-03	5.45E-05	1.16E-03	1 impacted structure	298.0	n/a
Turnouts	2.75E-04	2.96E-05	2.96E-05	0.00E+00	1 impacted structure	62.7	n/a

Proximity to Nearest Sensitive Receptor

Project Component	Nearest Sensitive Receptor Locations	Distance (ft)		Distance (m)		Receptor Proximity and Proximity Factors	
BridgeReplacement	Replacing Impacted Vehicle Bridges	150	--->	46	--->	0< R<100	1.000
ConcreteLining╱EmbankmentRaise	Canal Lining and Embankment Raises	93	--->	28	--->	0< R<100	1.000
StabilizeEarthenEmbankments	Stabilize Canal Banks Along Earth-lined Segment	349	--->	106	--->	100≤R<250	0.250
ConcreteLiningRepairs	Concrete Lining Repairs	515	--->	157	--->	100≤R<250	0.250
CheckStructuresAndWasteways	Modifications to Check Structures and Wasteways	273	--->	83	--->	0< R<100	1.000
UtilityCrossings	Replacing Impacted Pipeline Crossings	227	--->	69	--->	0< R<100	1.000
DrainageStructures	Modifications to Drainage Structures	508	--->	155	--->	100≤R<250	0.250
Turnouts	Modfications to Turnouts	178	--->	54	--->	0< R<100	1.000

BridgeReplacement

Name	Prioritization Calculator			
Applicability	Use to provide a Prioritization score based on the emission potency method. Entries required in yellow areas, output in gray areas.			
Author or updater	Matthew Cegielski	*Last Update*	December 1, 2022	
Facility:	Delta-Mendota Canal			
ID#:	n/a			
Project #:	Delta-Mendota Canal Subsidence Correction Project			
Unit and Process#	BridgeReplacement			
Operating Hours hr/yr	424.44			

Receptor Proximity and Proximity Factors	Cancer Score	Chronic Score	Acute Score	Max Score
0< R<100 1.000	2.6	0.6	0.4	2.6
100£R<250 0.250	0.7	0.1	0.1	0.7
250£R<500 0.040	0.1	0.0	0.0	0.1
500£R<1000 0.011	0.0	0.0	0.0	0.0
1000£R<1500 0.003	0.0	0.0	0.0	0.0
1500£R<2000 0.002	0.0	0.0	0.0	0.0
2000<R 0.001	0.0	0.0	0.0	0.0

Receptor proximity is in meters. Priortization scores are calculated by multiplying the total scores summed below by the proximity factors. Record the Max score for your receptor distance. If the substance list for the unit is longer than the number of rows here or if there are multiple processes use additional worksheets and sum the totals of the Max Scores.

BridgeReplacement

Enter the unit's CAS# of the substances emitted and their amounts.

Prioritzation score for each substance generated below. Totals on last row.

Substance	CAS#	MW Correction	Annual Emissions (lbs/yr)	Maximum Hourly (lbs/hr)	Corrected Annual Emissions (lbs/yr)	CorrectedMaximum Hourly (lbs/hr)	Average Hourly (lbs/hr)	Cancer	Chronic	Acute
Diesel engine exhaust, particulate matter (Diesel PM)	**9901**	**1.0000**	9.83E-01	1.14E-02	9.83E-01	1.14E-02	2.32E-03	2.27E+00	6.95E-02	0.00E+00
Diesel engine exhaust, total organic gas	**9902**	**1.0000**	8.02E+00	9.31E-02	8.02E+00	9.31E-02	1.89E-02	0.00E+00	0.00E+00	0.00E+00
Arsenic	**7440382**	**1.0000**	7.97E-04	9.25E-06	7.97E-04	9.25E-06	1.88E-06	2.03E-02	1.88E-02	6.94E-02
Cadmium	**7440439**	**1.0000**	1.30E-03	1.50E-05	1.30E-03	1.50E-05	3.05E-06	4.19E-02	2.29E-02	0.00E+00
Cobalt	**7440484**	**1.0000**	4.48E-03	5.20E-05	4.48E-03	5.20E-05	1.06E-05	2.66E-01	0.00E+00	0.00E+00
Copper	**7440508**	**1.0000**	4.58E-03	5.32E-05	4.58E-03	5.32E-05	1.08E-05	0.00E+00	0.00E+00	7.98E-04
Chlorine	**7782505**	**1.0000**	1.41E-01	1.64E-03	1.41E-01	1.64E-03	3.33E-04	0.00E+00	2.49E-01	1.17E-02
Lead	**7439921**	**1.0000**	2.33E-02	2.70E-04	2.33E-02	2.70E-04	5.48E-05	2.15E-03	0.00E+00	0.00E+00
Manganese	**7439965**	**1.0000**	3.82E-02	4.43E-04	3.82E-02	4.43E-04	9.00E-05	0.00E+00	1.50E-01	0.00E+00
Nickel	**7440020**	**1.0000**	2.52E-03	2.93E-05	2.52E-03	2.93E-05	5.95E-06	5.05E-03	6.37E-02	2.20E-01
Mercury	**7439976**	**1.0000**	6.64E-04	7.71E-06	6.64E-04	7.71E-06	1.56E-06	0.00E+00	7.82E-03	1.93E-02
Selenium	**7782492**	**1.0000**	9.96E-05	1.16E-06	9.96E-05	1.16E-06	2.35E-07	0.00E+00	1.76E-06	0.00E+00
Vanadium (fume or dust)	**7440622**	**1.0000**	1.10E-02	1.28E-04	1.10E-02	1.28E-04	2.59E-05	0.00E+00	0.00E+00	6.38E-03
Sulfates	**9960**	**1.0000**	1.96E-01	2.27E-03	1.96E-01	2.27E-03	4.61E-04	0.00E+00	0.00E+00	2.84E-02
							Totals	**2.61E+00**	**5.82E-01**	**3.56E-01**

ConcreteLining/EmbankmentRaise

Name	Prioritization Calculator		
Applicability	Use to provide a Prioritization score based on the emission potency method. Entries required in yellow areas, output in gray areas.		
Author or updater	Matthew Cegielski	*Last Update*	December 1, 2022
Facility:	Delta-Mendota Canal		
ID#:	n/a		
Project #:	Delta-Mendota Canal Subsidence Correction Project		
Unit and Process#	ConcreteLining/EmbankmentRaise		
Operating Hours hr/yr	218.75		

Receptor Proximity and Proximity Factors	Cancer Score	Chronic Score	Acute Score	Max Score
0< R<100 1.000	0.4	0.3	0.2	0.4
100£R<250 0.250	0.2	0.1	0.1	0.2
250£R<500 0.040	0.0	0.0	0.0	0.0
500£R<1000 0.011	0.0	0.0	0.0	0.0
1000£R<1500 0.003	0.0	0.0	0.0	0.0
1500£R<2000 0.002	0.0	0.0	0.0	0.0
2000<R 0.001	0.0	0.0	0.0	0.0

Receptor proximity is in meters. Priortization scores are calculated by multiplying the total scores summed below by the proximity factors. Record the Max score for your receptor distance. If the substance list for the unit is longer than the number of rows here or if there are multiple processes use additional worksheets and sum the totals of the Max Scores.

ConcreteLining/EmbankmentRaise

Enter the unit's CAS# of the substances emitted and their amounts.

Prioritzation score for each substance generated below. Totals on last row.

Substance	CAS#	MW Correction	Annual Emissions (lbs/yr)	Maximum Hourly (lbs/hr)	Corrected Annual Emissions (lbs/yr)	CorrectedMaximum Hourly (lbs/hr)	Average Hourly (lbs/hr)	Cancer	Chronic	Acute
Diesel engine exhaust, particulate matter (Diesel PM)	**9901**	**1.0000**	7.14E-02	1.61E-03	7.14E-02	1.61E-03	3.27E-04	0.2	0.0	0.0
Diesel engine exhaust, total organic gas	**9902**	**1.0000**	8.09E-01	1.82E-02	8.09E-01	1.82E-02	3.70E-03	0.0	0.0	0.0
Arsenic	**7440382**	**1.0000**	1.27E-04	2.86E-06	1.27E-04	2.86E-06	5.82E-07	0.0	0.0	0.0
Cadmium	**7440439**	**1.0000**	2.07E-04	4.66E-06	2.07E-04	4.66E-06	9.45E-07	0.0	0.0	0.0
Cobalt	**7440484**	**1.0000**	7.16E-04	1.61E-05	7.16E-04	1.61E-05	3.27E-06	0.0	0.0	0.0
Copper	**7440508**	**1.0000**	7.32E-04	1.65E-05	7.32E-04	1.65E-05	3.34E-06	0.0	0.0	0.0
Chlorine	**7782505**	**1.0000**	2.25E-02	5.07E-04	2.25E-02	5.07E-04	1.03E-04	0.0	0.1	0.0
Lead	**7439921**	**1.0000**	3.72E-03	8.37E-05	3.72E-03	8.37E-05	1.70E-05	0.0	0.0	0.0
Manganese	**7439965**	**1.0000**	6.10E-03	1.37E-04	6.10E-03	1.37E-04	2.79E-05	0.0	0.0	0.0
Nickel	**7440020**	**1.0000**	4.03E-04	9.07E-06	4.03E-04	9.07E-06	1.84E-06	0.0	0.0	0.1
Mercury	**7439976**	**1.0000**	1.06E-04	2.39E-06	1.06E-04	2.39E-06	4.85E-07	0.0	0.0	0.0
Selenium	**7782492**	**1.0000**	1.59E-05	3.58E-07	1.59E-05	3.58E-07	7.27E-08	0.0	0.0	0.0
Vanadium (fume or dust)	**7440622**	**1.0000**	1.75E-03	3.95E-05	1.75E-03	3.95E-05	8.02E-06	0.0	0.0	0.0
Sulfates	**9960**	**1.0000**	3.13E-02	7.04E-04	3.13E-02	7.04E-04	1.43E-04	0.0	0.0	0.0
							Totals	**0.2**	**0.2**	**0.1**

StabilizeEarthenEmbankments

Name	Prioritization Calculator			
Applicability	Use to provide a Prioritization score based on the emission potency method. Entries required in yellow areas, output in gray areas.			
Author or updater	Matthew Cegielski	*Last Update*	December 1, 2022	
Facility:	Delta-Mendota Canal			
ID#:	n/a			
Project #:	Delta-Mendota Canal Subsidence Correction Project			
Unit and Process#	StabilizeEarthenEmbankments			
Operating Hours hr/yr	218.75			

Receptor Proximity and Proximity Factors	Cancer Score	Chronic Score	Acute Score	Max Score
0< R<100 1.000	0.0	0.0	0.0	0.0
100£R<250 0.250	0.1	0.1	0.0	0.1
250£R<500 0.040	0.0	0.0	0.0	0.0
500£R<1000 0.011	0.0	0.0	0.0	0.0
1000£R<1500 0.003	0.0	0.0	0.0	0.0
1500£R<2000 0.002	0.0	0.0	0.0	0.0
2000<R 0.001	0.0	0.0	0.0	0.0

Receptor proximity is in meters. Priortization scores are calculated by multiplying the total scores summed below by the proximity factors. Record the Max score for your receptor distance. If the substance list for the unit is longer than the number of rows here or if there are multiple processes use additional worksheets and sum the totals of the Max Scores.

StabilizeEarthenEmbankments

Enter the unit's CAS# of the substances emitted and their amounts.

Prioritzation score for each substance generated below. Totals on last row.

Substance	CAS#	MW Correction	Annual Emissions (lbs/yr)	Maximum Hourly (lbs/hr)	Corrected Annual Emissions (lbs/yr)	CorrectedMaximum Hourly (lbs/hr)	Average Hourly (lbs/hr)	Cancer	Chronic	Acute
Diesel engine exhaust, particulate matter (Diesel PM)	**9901**	**1.0000**	3.24E-02	7.31E-04	3.24E-02	7.31E-04	1.48E-04	7.50E-02	4.45E-03	0.00E+00
Diesel engine exhaust, total organic gas	**9902**	**1.0000**	3.64E-01	8.19E-03	3.64E-01	8.19E-03	1.66E-03	0.00E+00	0.00E+00	0.00E+00
Arsenic	**7440382**	**1.0000**	7.48E-05	1.69E-06	7.48E-05	1.69E-06	3.42E-07	1.90E-03	3.42E-03	1.26E-02
Cadmium	**7440439**	**1.0000**	1.22E-04	2.74E-06	1.22E-04	2.74E-06	5.56E-07	3.93E-03	4.17E-03	0.00E+00
Cobalt	**7440484**	**1.0000**	4.21E-04	9.48E-06	4.21E-04	9.48E-06	1.92E-06	2.50E-02	0.00E+00	0.00E+00
Copper	**7440508**	**1.0000**	4.30E-04	9.69E-06	4.30E-04	9.69E-06	1.97E-06	0.00E+00	0.00E+00	1.45E-04
Chlorine	**7782505**	**1.0000**	1.33E-02	2.98E-04	1.33E-02	2.98E-04	6.06E-05	0.00E+00	4.54E-02	2.13E-03
Lead	**7439921**	**1.0000**	2.19E-03	4.92E-05	2.19E-03	4.92E-05	9.99E-06	2.02E-04	0.00E+00	0.00E+00
Manganese	**7439965**	**1.0000**	3.59E-03	8.07E-05	3.59E-03	8.07E-05	1.64E-05	0.00E+00	2.73E-02	0.00E+00
Nickel	**7440020**	**1.0000**	2.37E-04	5.34E-06	2.37E-04	5.34E-06	1.08E-06	4.74E-04	1.16E-02	4.00E-02
Mercury	**7439976**	**1.0000**	6.24E-05	1.40E-06	6.24E-05	1.40E-06	2.85E-07	0.00E+00	1.43E-03	3.51E-03
Selenium	**7782492**	**1.0000**	9.35E-06	2.11E-07	9.35E-06	2.11E-07	4.28E-08	0.00E+00	3.21E-07	0.00E+00
Vanadium (fume or dust)	**7440622**	**1.0000**	1.03E-03	2.32E-05	1.03E-03	2.32E-05	4.72E-06	0.00E+00	0.00E+00	1.16E-03
Sulfates	**9960**	**1.0000**	1.84E-02	4.14E-04	1.84E-02	4.14E-04	8.40E-05	0.00E+00	0.00E+00	5.17E-03
							Totals	**1.06E-01**	**9.78E-02**	**6.48E-02**

ConcreteLiningRepairs

Name	Prioritization Calculator			
Applicability	Use to provide a Prioritization score based on the emission potency method. Entries required in yellow areas, output in gray areas.			
Author or updater	Matthew Cegielski	*Last Update*	December 1, 2022	
Facility:	Delta-Mendota Canal			
ID#:	n/a			
Project #:	Delta-Mendota Canal Subsidence Correction Project			
Unit and Process#	ConcreteLiningRepairs			
Operating Hours hr/yr	100.00			

Receptor Proximity and Proximity Factors	Cancer Score	Chronic Score	Acute Score	Max Score
0< R<100 1.000	0.6	1.3	0.9	1.3
100£R<250 0.250	0.2	0.3	0.2	0.3
250£R<500 0.040	0.0	0.1	0.0	0.1
500£R<1000 0.011	0.0	0.0	0.0	0.0
1000£R<1500 0.003	0.0	0.0	0.0	0.0
1500£R<2000 0.002	0.0	0.0	0.0	0.0
2000<R 0.001	0.0	0.0	0.0	0.0

Receptor proximity is in meters. Priortization scores are calculated by multiplying the total scores summed below by the proximity factors. Record the Max score for your receptor distance. If the substance list for the unit is longer than the number of rows here or if there are multiple processes use additional worksheets and sum the totals of the Max Scores.

ConcreteLiningRepairs

Enter the unit's CAS# of the substances emitted and their amounts.

Prioritzation score for each substance generated below. Totals on last row.

Substance	CAS#	MW Correction	Annual Emissions (lbs/yr)	Maximum Hourly (lbs/hr)	Corrected Annual Emissions (lbs/yr)	CorrectedMaximum Hourly (lbs/hr)	Average Hourly (lbs/hr)	Cancer	Chronic	Acute
Diesel engine exhaust, particulate matter (Diesel PM)	**9901**	**1.0000**	1.91E-01	9.39E-03	1.91E-01	9.39E-03	1.91E-03	4.40E-01	5.72E-02	0.00E+00
Diesel engine exhaust, total organic gas	**9902**	**1.0000**	1.98E+00	9.74E-02	1.98E+00	9.74E-02	1.98E-02	0.00E+00	0.00E+00	0.00E+00
Arsenic	**7440382**	**1.0000**	4.50E-04	2.22E-05	4.50E-04	2.22E-05	4.50E-06	1.14E-02	4.50E-02	1.66E-01
Cadmium	**7440439**	**1.0000**	7.32E-04	3.60E-05	7.32E-04	3.60E-05	7.32E-06	2.37E-02	5.49E-02	0.00E+00
Cobalt	**7440484**	**1.0000**	2.53E-03	1.25E-04	2.53E-03	1.25E-04	2.53E-05	1.50E-01	0.00E+00	0.00E+00
Copper	**7440508**	**1.0000**	2.59E-03	1.28E-04	2.59E-03	1.28E-04	2.59E-05	0.00E+00	0.00E+00	1.91E-03
Chlorine	**7782505**	**1.0000**	7.97E-02	3.93E-03	7.97E-02	3.93E-03	7.97E-04	0.00E+00	5.98E-01	2.81E-02
Lead	**7439921**	**1.0000**	1.32E-02	6.48E-04	1.32E-02	6.48E-04	1.32E-04	1.22E-03	0.00E+00	0.00E+00
Manganese	**7439965**	**1.0000**	2.16E-02	1.06E-03	2.16E-02	1.06E-03	2.16E-04	0.00E+00	3.60E-01	0.00E+00
Nickel	**7440020**	**1.0000**	1.43E-03	7.02E-05	1.43E-03	7.02E-05	1.43E-05	2.85E-03	1.53E-01	5.27E-01
Mercury	**7439976**	**1.0000**	3.75E-04	1.85E-05	3.75E-04	1.85E-05	3.75E-06	0.00E+00	1.88E-02	4.62E-02
Selenium	**7782492**	**1.0000**	5.63E-05	2.77E-06	5.63E-05	2.77E-06	5.63E-07	0.00E+00	4.22E-06	0.00E+00
Vanadium (fume or dust)	**7440622**	**1.0000**	6.21E-03	3.06E-04	6.21E-03	3.06E-04	6.21E-05	0.00E+00	0.00E+00	1.53E-02
Sulfates	**9960**	**1.0000**	1.11E-01	5.45E-03	1.11E-01	5.45E-03	1.11E-03	0.00E+00	0.00E+00	6.81E-02
							Totals	**6.30E-01**	**1.29E+00**	**8.53E-01**

CheckStructuresAndWasteways

Name	**Prioritization Calculator**			
Applicability	Use to provide a Prioritization score based on the emission potency method. Entries required in yellow areas, output in gray areas.			
Author or updater	Matthew Cegielski	*Last Update*	December 1, 2022	
Facility:	Delta-Mendota Canal			
ID#:	n/a			
Project #:	Delta-Mendota Canal Subsidence Correction Project			
Unit and Process#	CheckStructuresAndWasteways			
Operating Hours hr/yr	684.12			

Receptor Proximity and Proximity Factors	Cancer Score	Chronic Score	Acute Score	Max Score
0< R<100 1.000	0.8	0.0	0.0	0.8
100£R<250 0.250	0.2	0.0	0.0	0.2
250£R<500 0.040	0.0	0.0	0.0	0.0
500£R<1000 0.011	0.0	0.0	0.0	0.0
1000£R<1500 0.003	0.0	0.0	0.0	0.0
1500£R<2000 0.002	0.0	0.0	0.0	0.0
2000<R 0.001	0.0	0.0	0.0	0.0

Receptor proximity is in meters. Priortization scores are calculated by multiplying the total scores summed below by the proximity factors. Record the Max score for your receptor distance. If the substance list for the unit is longer than the number of rows here or if there are multiple processes use additional worksheets and sum the totals of the Max Scores.

CheckStructuresAndWasteways

Enter the unit's CAS# of the substances emitted and their amounts.

Prioritzation score for each substance generated below. Totals on last row.

Substance	CAS#	MW Correction	Annual Emissions (lbs/yr)	Maximum Hourly (lbs/hr)	Corrected Annual Emissions (lbs/yr)	CorrectedMaximum Hourly (lbs/hr)	Average Hourly (lbs/hr)	Cancer	Chronic	Acute
Diesel engine exhaust, particulate matter (Diesel PM)	**9901**	**1.0000**	3.45E-01	2.49E-03	3.45E-01	2.49E-03	5.05E-04	7.97E-01	1.51E-02	0.00E+00
Diesel engine exhaust, total organic gas	**9902**	**1.0000**	3.19E+00	2.30E-02	3.19E+00	2.30E-02	4.66E-03	0.00E+00	0.00E+00	0.00E+00
Arsenic	**7440382**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cadmium	**7440439**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cobalt	**7440484**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Copper	**7440508**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chlorine	**7782505**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Lead	**7439921**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Manganese	**7439965**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nickel	**7440020**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mercury	**7439976**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Selenium	**7782492**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Vanadium (fume or dust)	**7440622**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sulfates	**9960**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
							Totals	**7.97E-01**	**1.51E-02**	**0.00E+00**

UtilityCrossings

Name	Prioritization Calculator			
Applicability	Use to provide a Prioritization score based on the emission potency method. Entries required in yellow areas, output in gray areas.			
Author or updater	Matthew Cegielski	*Last Update*	December 1, 2022	
Facility:	Delta-Mendota Canal			
ID#:	n/a			
Project #:	Delta-Mendota Canal Subsidence Correction Project			
Unit and Process#	UtilityCrossings			
Operating Hours hr/yr	142.78			

Receptor Proximity and Proximity Factors	Cancer Score	Chronic Score	Acute Score	Max Score
0< R<100 1.000	0.2	0.1	0.1	0.2
100£R<250 0.250	0.0	0.0	0.0	0.0
250£R<500 0.040	0.0	0.0	0.0	0.0
500£R<1000 0.011	0.0	0.0	0.0	0.0
1000£R<1500 0.003	0.0	0.0	0.0	0.0
1500£R<2000 0.002	0.0	0.0	0.0	0.0
2000<R 0.001	0.0	0.0	0.0	0.0

Receptor proximity is in meters. Priortization scores are calculated by multiplying the total scores summed below by the proximity factors. Record the Max score for your receptor distance. If the substance list for the unit is longer than the number of rows here or if there are multiple processes use additional worksheets and sum the totals of the Max Scores.

UtilityCrossings

Enter the unit's CAS# of the substances emitted and their amounts.

Prioritzation score for each substance generated below. Totals on last row.

Substance	CAS#	MW Correction	Annual Emissions (lbs/yr)	Maximum Hourly (lbs/hr)	Corrected Annual Emissions (lbs/yr)	CorrectedMaximum Hourly (lbs/hr)	Average Hourly (lbs/hr)	Cancer	Chronic	Acute
Diesel engine exhaust, particulate matter (Diesel PM)	**9901**	**1.0000**	7.29E-02	2.51E-03	7.29E-02	2.51E-03	5.10E-04	1.68E-01	1.53E-02	0.00E+00
Diesel engine exhaust, total organic gas	**9902**	**1.0000**	7.61E-01	2.63E-02	7.61E-01	2.63E-02	5.33E-03	0.00E+00	0.00E+00	0.00E+00
Arsenic	**7440382**	**1.0000**	6.75E-05	2.33E-06	6.75E-05	2.33E-06	4.73E-07	1.72E-03	4.73E-03	1.75E-02
Cadmium	**7440439**	**1.0000**	1.10E-04	3.79E-06	1.10E-04	3.79E-06	7.69E-07	3.55E-03	5.77E-03	0.00E+00
Cobalt	**7440484**	**1.0000**	3.80E-04	1.31E-05	3.80E-04	1.31E-05	2.66E-06	2.25E-02	0.00E+00	0.00E+00
Copper	**7440508**	**1.0000**	3.88E-04	1.34E-05	3.88E-04	1.34E-05	2.72E-06	0.00E+00	0.00E+00	2.01E-04
Chlorine	**7782505**	**1.0000**	1.20E-02	4.13E-04	1.20E-02	4.13E-04	8.38E-05	0.00E+00	6.28E-02	2.95E-03
Lead	**7439921**	**1.0000**	1.97E-03	6.81E-05	1.97E-03	6.81E-05	1.38E-05	1.82E-04	0.00E+00	0.00E+00
Manganese	**7439965**	**1.0000**	3.24E-03	1.12E-04	3.24E-03	1.12E-04	2.27E-05	0.00E+00	3.78E-02	0.00E+00
Nickel	**7440020**	**1.0000**	2.14E-04	7.38E-06	2.14E-04	7.38E-06	1.50E-06	4.28E-04	1.60E-02	5.53E-02
Mercury	**7439976**	**1.0000**	5.63E-05	1.94E-06	5.63E-05	1.94E-06	3.94E-07	0.00E+00	1.97E-03	4.85E-03
Selenium	**7782492**	**1.0000**	8.44E-06	2.91E-07	8.44E-06	2.91E-07	5.91E-08	0.00E+00	4.43E-07	0.00E+00
Vanadium (fume or dust)	**7440622**	**1.0000**	9.31E-04	3.21E-05	9.31E-04	3.21E-05	6.52E-06	0.00E+00	0.00E+00	1.61E-03
Sulfates	**9960**	**1.0000**	1.66E-02	5.72E-04	1.66E-02	5.72E-04	1.16E-04	0.00E+00	0.00E+00	7.15E-03
							Totals	**1.97E-01**	**1.44E-01**	**8.96E-02**

DrainageStructures

Name	Prioritization Calculator			
Applicability	Use to provide a Prioritization score based on the emission potency method. Entries required in yellow areas, output in gray areas.			
Author or updater	Matthew Cegielski	*Last Update*	December 1, 2022	
Facility:	Delta-Mendota Canal			
ID#:	n/a			
Project #:	Delta-Mendota Canal Subsidence Correction Project			
Unit and Process#	DrainageStructures			
Operating Hours hr/yr	298.00			

Receptor Proximity and Proximity Factors	Cancer Score	Chronic Score	Acute Score	Max Score
0< R<100 1.000	0.1	0.0	0.0	0.1
100£R<250 0.250	0.0	0.0	0.0	0.0
250£R<500 0.040	0.0	0.0	0.0	0.0
500£R<1000 0.011	0.0	0.0	0.0	0.0
1000£R<1500 0.003	0.0	0.0	0.0	0.0
1500£R<2000 0.002	0.0	0.0	0.0	0.0
2000<R 0.001	0.0	0.0	0.0	0.0

Receptor proximity is in meters. Priortization scores are calculated by multiplying the total scores summed below by the proximity factors. Record the Max score for your receptor distance. If the substance list for the unit is longer than the number of rows here or if there are multiple processes use additional worksheets and sum the totals of the Max Scores.

DrainageStructures

Enter the unit's CAS# of the substances emitted and their amounts.

Prioritzation score for each substance generated below. Totals on last row.

Substance	CAS#	MW Correction	Annual Emissions (lbs/yr)	Maximum Hourly (lbs/hr)	Corrected Annual Emissions (lbs/yr)	CorrectedMaximum Hourly (lbs/hr)	Average Hourly (lbs/hr)	Cancer	Chronic	Acute
Diesel engine exhaust, particulate matter (Diesel PM)	**9901**	**1.0000**	2.21E-02	3.66E-04	2.21E-02	3.66E-04	7.43E-05	5.11E-02	2.23E-03	0.00E+00
Diesel engine exhaust, total organic gas	**9902**	**1.0000**	2.39E-01	3.95E-03	2.39E-01	3.95E-03	8.02E-04	0.00E+00	0.00E+00	0.00E+00
Arsenic	**7440382**	**1.0000**	1.13E-05	1.86E-07	1.13E-05	1.86E-07	3.78E-08	2.86E-04	3.78E-04	1.40E-03
Cadmium	**7440439**	**1.0000**	1.83E-05	3.02E-07	1.83E-05	3.02E-07	6.14E-08	5.92E-04	4.60E-04	0.00E+00
Cobalt	**7440484**	**1.0000**	6.33E-05	1.05E-06	6.33E-05	1.05E-06	2.12E-07	3.75E-03	0.00E+00	0.00E+00
Copper	**7440508**	**1.0000**	6.47E-05	1.07E-06	6.47E-05	1.07E-06	2.17E-07	0.00E+00	0.00E+00	1.60E-05
Chlorine	**7782505**	**1.0000**	1.99E-03	3.29E-05	1.99E-03	3.29E-05	6.69E-06	0.00E+00	5.02E-03	2.35E-04
Lead	**7439921**	**1.0000**	3.29E-04	5.43E-06	3.29E-04	5.43E-06	1.10E-06	3.04E-05	0.00E+00	0.00E+00
Manganese	**7439965**	**1.0000**	5.39E-04	8.92E-06	5.39E-04	8.92E-06	1.81E-06	0.00E+00	3.02E-03	0.00E+00
Nickel	**7440020**	**1.0000**	3.56E-05	5.89E-07	3.56E-05	5.89E-07	1.20E-07	7.14E-05	1.28E-03	4.42E-03
Mercury	**7439976**	**1.0000**	9.38E-06	1.55E-07	9.38E-06	1.55E-07	3.15E-08	0.00E+00	1.57E-04	3.88E-04
Selenium	**7782492**	**1.0000**	1.41E-06	2.33E-08	1.41E-06	2.33E-08	4.72E-09	0.00E+00	3.54E-08	0.00E+00
Vanadium (fume or dust)	**7440622**	**1.0000**	1.55E-04	2.57E-06	1.55E-04	2.57E-06	5.21E-07	0.00E+00	0.00E+00	1.28E-04
Sulfates	**9960**	**1.0000**	2.76E-03	4.57E-05	2.76E-03	4.57E-05	9.28E-06	0.00E+00	0.00E+00	5.71E-04
							Totals	**5.59E-02**	**1.25E-02**	**7.15E-03**

Turnouts

Name	Prioritization Calculator			
Applicability	Use to provide a Prioritization score based on the emission potency method. Entries required in yellow areas, output in gray areas.			
Author or updater	Matthew Cegielski	*Last Update*	December 1, 2022	
Facility:	Delta-Mendota Canal			
ID#:	n/a			
Project #:	Delta-Mendota Canal Subsidence Correction Project			
Unit and Process#	Turnouts			
Operating Hours hr/yr	62.68			

Receptor Proximity and Proximity Factors	Cancer Score	Chronic Score	Acute Score	Max Score
0< R<100 1.000	0.0	0.0	0.0	0.0
100£R<250 0.250	0.0	0.0	0.0	0.0
250£R<500 0.040	0.0	0.0	0.0	0.0
500£R<1000 0.011	0.0	0.0	0.0	0.0
1000£R<1500 0.003	0.0	0.0	0.0	0.0
1500£R<2000 0.002	0.0	0.0	0.0	0.0
2000<R 0.001	0.0	0.0	0.0	0.0

Receptor proximity is in meters. Priortization scores are calculated by multiplying the total scores summed below by the proximity factors. Record the Max score for your receptor distance. If the substance list for the unit is longer than the number of rows here or if there are multiple processes use additional worksheets and sum the totals of the Max Scores.

Turnouts

Enter the unit's CAS# of the substances emitted and their amounts.

Prioritzation score for each substance generated below. Totals on last row.

Substance	CAS#	MW Correction	Annual Emissions (lbs/yr)	Maximum Hourly (lbs/hr)	Corrected Annual Emissions (lbs/yr)	CorrectedMaximum Hourly (lbs/hr)	Average Hourly (lbs/hr)	Cancer	Chronic	Acute
Diesel engine exhaust, particulate matter (Diesel PM)	**9901**	**1.0000**	1.20E-02	9.46E-04	1.20E-02	9.46E-04	1.92E-04	2.78E-02	5.76E-03	0.00E+00
Diesel engine exhaust, total organic gas	**9902**	**1.0000**	1.12E-01	8.78E-03	1.12E-01	8.78E-03	1.78E-03	0.00E+00	0.00E+00	0.00E+00
Arsenic	**7440382**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cadmium	**7440439**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cobalt	**7440484**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Copper	**7440508**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chlorine	**7782505**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Lead	**7439921**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Manganese	**7439965**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nickel	**7440020**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mercury	**7439976**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Selenium	**7782492**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Vanadium (fume or dust)	**7440622**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sulfates	**9960**	**1.0000**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
							Totals	**2.78E-02**	**5.76E-03**	**0.00E+00**

Maximum Total Prioritization Summary

	BridgeReplacement	ConcreteLining/EmbankmentRaise	StabilizeEarthenEmbankments	ConcreteLiningRepairs	CheckStructuresAndWasteways	UtilityCrossings	DrainageStructures	Turnouts
Receptor Proximity and Proximity Factors	**Max Score**	**Max Score**	**Max Score**	**Max Score**	**Max Score**	**Max Score**	**Max Score**	**Max Score**
0< R<100 1.000	2.61	0.44			0.80	0.20		0.03
100£R<250 0.250		0.16	0.08	0.32			0.01	
250£R<500 0.040		0.04	0.02					
500£R<1000 0.011		0.02	0.01					
1000£R<1500 0.003		0.01	0.00					
1500£R<2000 0.002		0.00	0.00					
2000<R 0.001		0.00	0.00					
	1	*1,2*	*1,2*	*1*	*1*	*1*	*1*	*1*

1. The green highlight represents the nearest sensitive receptor to each construction activity

2. For these activities, construction would occur over large length of canal (80 miles); Exposure summed based on falling distance from receptor to ensure conservative impact.

Maximum Impacted Receptor Score

4.77

Note: Summation assumes that the maximally impacted receptor would be affected by all construction activities, which is intentionally overly conservative.

Less than 10?

TRUE

Residential Combined Exposure Factor (CEF)

Age	Breathing Rate (L/kg-day)	Age Specific Factor	Exposure Duration (years)	Fraction of Time at Home	Exposure Frequency (350 days/year)	Exposure Duration (years)	CEF for short term & long term project
-0.25 to 0	361	10	0.25	1	0.96	1	155.67
0 to 2	1,090	10	2	1	0.96	2	311.35
2 to 5	631	3	3	1	0.96	5	389.23
2 to 9	631	3	7	1	0.96	9	493.08
2 to 16	572	3	14	1	0.96		
16 to 30	261	1	14	0.73	0.96	30	677.40
16 to 70 *	233	1	54	0.73	0.96	70	766.78

** Not from AQMD Risk Procedure. Numbers from Table 5.7 OEHHA Guideline Manual & Table 1.2-1.4 App.I. Breathing Rate is at 80th percentile.*

1-Year to 70-Year CEF Ratio
0.203022248

Note: The default 7700 normalization factor is based on 70-year exposure per CAPCOA guidance.

CARB Speciation Profile 420 - Construction Dust

PM PROFILE NUMBER	SAROAD	WEIGHT FRACTION OF PM10	COMPOUND	SJVAPCD SUBSTANCE CAS	HAS IMPACT VALUE? Cancer	Chronic	Acute
420	12103	2.40E-05	arsenic	7440382	0.0033	0.015	0.2
420	12110	3.90E-05	cadmium	7440439	0.0042	0.02	0
420	12113	1.35E-04	cobalt	7440484	0.0077	0	0
420	12114	1.38E-04	copper	7440508	0	0	100
420	12115	4.25E-03	chlorine	7782505	0	0.2	210
420	12128	7.01E-04	lead	7439921	0.000012	0	0
420	12132	1.15E-03	manganese	7439965	0	0.09	0
420	12136	7.60E-05	nickel	7440020	0.00026	0.014	0.2
420	12142	2.00E-05	mercury	7439976	0	0.03	0.6
420	12154	3.00E-06	selenium	7782492	0	20	0
420	12164	3.31E-04	vanadium (fume or dust)	7440622	0	0	30
420	12403	5.90E-03	sulfates	9960	0	0	120

Delta-Mendota Canal Subsidence Correction Project Environmental Assessment/Initial Study

Appendix J: Greenhouse Gas Emissions Technical Appendix

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Appendix J Greenhouse Gas Emissions Technical Appendix

This appendix documents the greenhouse gas (GHG) emissions technical analysis to support the impact analysis in the Environmental Assessment/Initial Study (EA/IS) and describes the potential greenhouse gas emissions that could result from the implementation of the No Action/No Project Alternative (subsequently identified as the No Action Alternative) and the Proposed Action/Proposed Project (subsequently identified as the Proposed Action) considered by the EA/IS.

J.1 Existing Conditions

GHGs—carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride, hydrofluorocarbons, and perfluorocarbons—are emitted from human activities and natural systems into the atmosphere and trap heat that would otherwise be released into space. Thermal radiation absorbed by GHGs is reradiated in all directions, including back toward the Earth's surface. This results in an increase of the Earth's surface temperatures above what they would be without the presence of GHGs, which are persistent and remain in the atmosphere for long periods. GHGs differ from criteria pollutants in that GHG emissions do not cause direct adverse human health effects. Rather, the direct environmental effect of GHG emissions is the increase in global temperatures, which in turn has numerous indirect effects on the environment and humans.

Most CO_2 emissions from human activities, known as anthropogenic emissions, are attributed to the burning of fossil fuels for electricity, heat, and transportation and land use changes such as deforestation. Scientific research shows that global GHG emissions from anthropogenic sources have grown since preindustrial times, and continue to grow, with 78 percent of global CO_2 emissions between 1970 and 2010 from fuel combustion and industrial processes (Intergovernmental Panel on Climate Change [IPCC] 2014). In 2020, global average atmospheric concentrations of CO_2 reached 413 parts per million (ppm), atmospheric concentrations of CH_4 reached 1,889 parts per billion (ppb), and atmospheric concentrations of N_2O reached 333 ppb, respectively 149 percent, 262 percent, and 123 percent of preindustrial (1750) levels (World Meteorological Organization [WMO] 2021). These levels are nearly twice the natural range over the last 800,000 years as measured in ice core samples (WMO 2019).

If left unchecked, by the end of the century CO_2 concentrations could reach levels three times higher than preindustrial times, leading to climate change that threatens public health, the economy, and the environment. Efforts are underway globally to both mitigate GHG emissions to reduce further climate change and to adapt to the unavoidable changes in climate that will result from past and future GHG emissions. However, recent studies show that global GHG emissions continue to rise (U.S. Global Change Research Program 2014).

J.2 Assessment Methodology

J.2.1 Construction

Construction emissions are described as temporary or "short-term" in duration. These temporary and short-term emissions have the potential to represent a significant impact to GHG emissions and climate change. The predominant GHG emission source from construction activities is vehicle exhaust from on- and off-road vehicle fuel combustion.

The emissions estimation method (i.e., specific emission calculation equations and sources) incorporates data sourced from project specific equipment lists, equipment activities, phasing, material quantities, and worker counts, in addition to typical construction parameters from the California Air Pollution Control Officers Association (CAPCOA) California Emission Estimator Model (CalEEMod) version 2022.1, and emission factors from the California Air Resources Board (CARB)'s EMFAC2017 and OFFROAD2021 models (CAPCOA 2022; California Air Resources Board [CARB] 2022a, 2022b; Bureau of Reclamation [Reclamation] 2022). Although a more recent version of the EMFAC model, EMFAC2021, has been developed by CARB, that model has not yet been approved by the United States Environmental Protection Agency (USEPA) for use in regulatory purposes and was not used in this assessment. In the estimation of construction equipment GHG emission factors, only equipment of model year 2015 or newer, representative of USEPA Tier 4 final engine standard equipment, were considered. Hauling and delivery vehicles were also assumed to be of model year 2015 or newer.

Task-specific construction equipment, personnel, haul and excavation quantities, and scheduling information was derived from Reclamation's *Delta-Mendota Canal Subsidence Project: Feasibility Study of the Structural Alternatives* (*Feasibility Study of the Structural Alternatives*), completed in 2021. It was assumed that 50 percent of necessary backfill material would be reused from materials excavated on-site. Haul trucks were assumed to be at least 10 cubic yards (CY) in capacity for all construction. Vendor delivery trip counts, if not provided in *Feasibility Study of the Structural Alternatives* for a given element of action construction, were estimated based on the estimated typical square-footage of the construction element and default vendor delivery rates from CalEEMod. Haul route, worker commute, and vendor delivery distances were based on default regional values from the CalEEMod.

The OFFROAD2021 model does not estimate emissions of CH_4 and N_2O; therefore, it was necessary to estimate these emissions separately. Emission factors for Construction/Mining Equipment in Table 5 from the USEPA's 2022 emission factors hub release was used to estimate these emissions (USEPA 2022).

Each GHG contributes to climate change differently, as expressed by its global warming potential (GWP). GHG emissions are discussed in terms of CO_2 equivalent (CO_2e) emissions, which express, for a given mixture of GHG, the amount of CO_2 that would have the same GWP over a specific timescale. CO_2e is determined by multiplying the mass of each GHG by its GWP.

This analysis uses the GWP from the IPCC Fourth Assessment Report (IPCC 2007) for a 100-year time period to estimate CO_2e. This approach is consistent with the federal GHG Reporting Rule (40 Code of Federal Regulations [CFR] 98), as effective on January 1, 2014 (78 FR 71904) and California's 2000-2019 GHG Inventory Trends Report (CARB 2021). The GWPs used in this analysis are 25 for CH_4 and 298 for N_2O.

Detailed construction emission calculations are provided in Appendix I2.

J.2.2 Operation

While the Proposed Action would modify the structure of the existing canal, these modifications would not be expected to result an operational change to GHG emissions relative to the existing, or future no action, conditions. Therefore, emissions of GHG potentially attributable to canal operation were not quantified.

J.3 Significance Criteria

The thresholds of significance for impacts address the environmental checklist items from Appendix G of the State California Environmental Quality Act (CEQA) Guidelines as well as federal GHG requirements. The Proposed Action would result in a significant impact with respect to GHGs if they would either:

1. Generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment.
2. Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the GHG emissions.

The environmental checklist from Appendix G of the State CEQA Guidelines indicates that a project would result in a significant impact on air quality if it would (1) generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment; or (2) conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the GHG emissions.

The San Joaquin Valley Air Pollution Control District (SJVAPCD) and Bay Area Air Quality Management District (BAAQMD) each publish guidance to assist lead agencies with uniform procedures for addressing air quality and GHG impacts in applicable environmental documents within their respective air basins. However, neither agency has promulgated specific quantitative criteria for project-level GHG emissions increases above which a project would result in a significant impact on the environment (BAAQMD 2017; SJVAPCD 2015). SJVAPCD has recommended a tiered approach for assessing the project-level significance of stationary source projects relative to a project's compliance with an applicable GHG mitigation program, implementation of best performance standards (BPS), or GHG emission performance criterion of 29 percent reduction relative to a business-as-usual baseline. However, because the Proposed Action would not involve the installation of new stationary sources or emission sources to which BPS could be applicable, this threshold is not inappropriate for the Delta-Mendota Canal (DMC) Subsidence Correction Project.

No quantitative threshold has been promulgated by an applicable agency that would be perfectly aligned to extraordinary maintenance activities such as those of the Proposed Action. However, the South Coast Air Quality Management District (SCAQMD), which has jurisdiction over the South Coast Air Basin, a region with comparable air quality to that of the San Joaquin Valley Air Basin, has adopted a quantitative significance criterion of 10,000 metric tons CO_2e ($MTCO_2e$) per year for project operations (SCAQMD 2008). Since GHG are an inherently cumulative impact, SCAQMD stipulates that construction GHG emissions be amortized over the presumed project lifetime and added to annual operational emissions for comparison against this criterion. A conservative project lifetime of 30 years is recommended by SCAMQD. The SCAQMD considers this threshold to be adequate to capture GHG emissions increases above which could hinder implementation of the

State's GHG reduction goals, including Assembly Bill (AB) 32. Because of the inclusion of construction-related emissions in this quantitative threshold and the relationship with complying with AB 32, the SCAQMD's method of quantifying emissions and the associated significance threshold was used in this analysis.

The significance criterion of 10,000 $MTCO_2e$ increase is based on the difference between the presumed GHG emissions of the Proposed Action and a presumed baseline. For the purposes of this analysis, as explained earlier, implementation of the Proposed Action would result in no change to GHG emissions from canal operations relative to the existing conditions or future no action (No Action Alternative) conditions. Similarly, no project-related construction GHG emissions would be assumed under the existing conditions or future no action (No Action Alternative) conditions. Therefore, the amortized construction GHG emissions were compared against a baseline of zero GHG emissions for the determination of significance relative to both the National Environmental Policy Act and CEQA requirements.

J.4 Plan Consistency

The Proposed Action was compared to various plans, policies, and regulations that were enacted to reduce GHG emissions. If it is found to be consistent with the applicable plans, then impacts associated with construction and operation would be less than significant for the second criterion related to GHG impacts.

J.4.1 Initial Scoping Plan

The Proposed Action was compared to the AB 32 Initial Scoping Plan (CARB 2008) for consistency. The initial scoping plan contains a variety of strategies that were designed to reduce the state's GHG emissions. Table J-1 summarizes the 18 strategies contained in the initial scoping plan and the Proposed Action were evaluated for consistency.

Table J-1. Initial Scoping Plan Measures Consistency Analysis

Emission Reduction Measure	Project Consistency
1. California Cap-and-Trade Program Linked to Western Climate Initiative Partner Jurisdictions. Implement a broad-based California cap-and-trade program to provide a firm limit on emissions. Link the California cap–and-trade program with other Western Climate Initiative Partner programs to create a regional market system to achieve greater environmental and economic benefits for California. Ensure California's program meets all applicable AB 32 requirements for market-based mechanisms.	**Not Applicable.** The Project is not a part of an industry that is required to comply with the cap-and-trade regulations.
2. California Light-Duty Vehicle GHG Standards. Implement adopted Pavley standards and planned second phase of the program. Align zero-emission vehicle, alternative and renewable fuel and vehicle technology programs with long-term climate change goals.	**Not Applicable.** This is a statewide measure that is not implemented by a Project proponent.

Emission Reduction Measure	Project Consistency
3. Energy Efficiency. Maximize energy efficiency building and appliance standards, and pursue additional efficiency efforts including new technologies, and new policy and implementation mechanisms. Pursue comparable investment in energy efficiency from all retail providers of electricity in California (including both investor-owned and publicly owned utilities).	**Not Applicable.** No new buildings would be built under the Proposed Action.
4. Renewables Portfolio Standard. Achieve 33 percent renewable energy mix statewide.	**Not Applicable.** This is a statewide measure that is not implemented by a project proponent.
5. Low Carbon Fuel Standard. Develop and adopt the Low Carbon Fuel Standard.	**Not Applicable.** This is a statewide measure that is not implemented by a project proponent.
6. Regional Transportation-Related GHG Targets. Develop regional GHG emissions reduction targets for passenger vehicles.	**Not Applicable.** The regional transportation plans developed for the Bay Area contain provisions required under Senate Bill 375 to reduce GHG emissions from vehicle miles traveled. The regional transportation plans do not have any requirements that apply to the Proposed Action.
7. Vehicle Efficiency Measures. Implement light-duty vehicle efficiency measures.	**Not Applicable.** This is a statewide measure that is not implemented by a project proponent.
8. Goods Movement. Implement adopted regulations for the use of shore power for ships at berth. Improve efficiency in goods movement activities.	**Not Applicable.** The Project does not propose any changes to goods movement from trucks, ports, and other related facilities.
9. Million Solar Roofs Program. Install 3,000 megawatts of solar-electric capacity under California's existing solar programs.	**Not Applicable.** The Project does not impede the ability of the state to install additional solar roofs.
10. Medium/Heavy-Duty Vehicles. Adopt medium and heavy-duty vehicle efficiency measures.	**Not Applicable.** This is a statewide measure that is not implemented by a project proponent.
11. Industrial Emissions. Require assessment of large industrial sources to determine whether individual sources within a facility can cost-effectively reduce GHG emissions and provide other pollution reduction benefits. Reduce GHG emissions from fugitive emissions from oil and gas extraction and gas transmission. Adopt and implement regulations to control fugitive methane emissions and reduce flaring at refineries.	**Not Applicable.** This measure only applies to major industrial facilities emitting more than 500,000 $MTCO_2e$ per year.
12. High-Speed Rail. Support implementation of a high-speed rail system.	**Not Applicable.** This is a statewide measure that is not implemented by a project proponent.

Emission Reduction Measure	Project Consistency
13. Green Building Strategy. Expand the use of green building practices to reduce the carbon footprint of California's new and existing inventory of buildings.	**Not Applicable.** No new buildings will be built under the Proposed Action.
14. High Global Warming Potential Gases. Adopt measure to reduce high global warming potential gases.	**Not Applicable.** This Project does not include air conditioning or refrigeration.
15. Recycling and Waste. Reduce methane emissions at landfills. Increase waste diversion, composting and other beneficial uses of organic materials, and mandate commercial recycling. Move toward zero-waste.	**Not Applicable.** Project operations would not result in the generation of waste.
16. Sustainable Forests. Preserve forest sequestration and encourage the use of forest biomass for sustainable energy generation.	**Not Applicable.** The Proposed Action would not be in forested areas or areas zoned as forestland.
17. Water. Continue efficiency programs and use cleaner energy sources to move and treat water.	**Consistent**. Operation of the Proposed Action would be consistent with energy efficiency and clean power requirements established by the state and local municipalities.
18. Agriculture. In the near-term, encourage investment in manure digesters and at the five-year Scoping Plan update determine if the program should be made mandatory by 2020.	**Not Applicable.** The Project site is not designated or in use for agricultural purposes.

Source: CARB 2008
Key: AB = Assembly Bill; GHG = greenhouse gas; $MTCO_2e$ = metric tons carbon dioxide equivalent

J.4.2 Climate Change Scoping Plan Update

California's 2017 Climate Change Scoping Plan (CARB 2017) contains various emission reduction strategies to help the state to meet the goals of Executive Order B-30-15 and Senate Bill (SB) 32 to achieve a 2030 goal of reducing GHG emissions 40 percent below 2020 levels. The updated scoping plan contains various emission reduction measures that are specific to the water sector. Table J-2 summarizes the various measures and evaluates if the Proposed Action would be consistent.

Table J-2. 2017 Updated Scoping Plan Measures Consistency Analysis

Emission Reduction Measure	Project Consistency
1. As directed by Governor Brown's Executive Order B-37-16, California Department of Water Resources (DWR) and State Water Resource Control Board (SWRCB) will develop and implement new water use targets to generate more statewide water conservation than existing targets (the existing state law requires a 20 percent reduction in urban per capita water use by 2020 [SBx7-7, Steinberg, Chapter 4, Statutes of 2009]). The new water use targets will be based on strengthened standards for indoor use, outdoor irrigation, commercial, industrial, and institutional water use.	**Not Applicable.** The Proposed Action would not impede DWR's and SWRCB's ability to implement statewide water conservation targets.

Emission Reduction Measure	Project Consistency
2. SWRCB will develop long-term water conservation regulation, and permanently prohibit practices that waste potable water.	**Not Applicable.** The Proposed Action would not impede SWRCB's ability to implement its recommendations to use water more wisely.
3. DWR and SWRCB will develop and implement actions to minimize water system leaks, and to set performance standards for water loss, as required by SB 555 (Wolk, Chapter 679, Statutes of 2015).	**Not Applicable.** The measure is only applicable to urban retail water suppliers.
4. DWR and California Department of Food and Agriculture (CDFA) will update existing requirements for agricultural water management plans to increase water system efficiency.	**Not Applicable.** The Proposed Action would not impede DWR's and CDFA's ability to increase agricultural water system efficiency.
5. California Energy Commission (CEC) will certify innovative technologies for water conservation and water loss detection and control.	**Not Applicable.** The measure is only applicable at utility, household, and appliance levels.
6. CEC will continue to update the state's Appliance Efficiency Regulations (California Code of Regulations, Title 20, Sections 1601–1608) for appliances offered for sale in California to establish standards that reduce energy consumption for devices that use electricity, gas, and/or water.	**Not Applicable.** The Proposed Action would not involve operation of appliances subject to the emission reduction measure.
7. CalEPA will oversee development of a voluntary registry for GHG emissions resulting from the water-energy nexus, as required by SB 1425 (Pavley, Chapter 596, Statutes of 2016).	**Not Applicable.** The Proposed Action would not impede the state's ability to develop a GHG emission registry.
8. The State Water Project (SWP) has entered long-term contracts to procure renewable electricity from 140 MW solar installations in California.	**Not Applicable.** The Proposed Action would not interfere with the ability of the SWP to procure renewable electricity.
9. As described in its Climate Action Plan, DWR will continue to increase the use of renewable energy to operate the SWP.	**Not Applicable.** The Proposed Action would not interfere with the ability of DWR to increase its renewable energy use.

Source: CARB 2017
Key: CalEPA = California Environmental Protection Agency; CDFA = California Department of Food and Agriculture; CEC = California Energy Commission; DWR = Department of Water Resources; GHG = greenhouse gas; MW = megawatt; SB = Senate Bill; SWP = State Water Project; SWRCB = State Water Resources Control Board

J.5 Project Impacts and Mitigation Measures

J.5.1 No Action Alternative

Impact GHG-1: Would the alternative generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment?

Under the No Action Alternative, no action would be taken to restore, or otherwise offset, conveyance capacity lost in the DMC. As such, no construction-related GHG emissions would occur. Future changes in operation would likely occur to compensate for the effects of any future land subsidence on the capacity of the DMC. However, these changes would not be expected to result in substantial increases to the coverage or frequency of stagnant or atrophic conditions which might result in operational GHG emissions. **Therefore, the No Action Alternative would have no impact to GHG emissions.**

Impact GHG-2: Would the alternative conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing GHG emissions?

Because no actions would be taken under the No Action Alternative and potential future operational changes would not be expected to meaningfully change operational GHG emissions, there would be no Project-related change to GHG emissions relative to existing conditions, and this alternative would not conflict with an applicable plan, policy, or regulation adopted to reduce GHG emissions. **Therefore, this alternative would have no impacts.**

J.5.2 Raise Deficient Structures Alternative (Proposed Action)

J.5.2.1 Impact GHG-1: Would the alternative generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment?

Under the Proposed Action, construction would last for approximately seven and a half years, with the time spent at various locations along the canal. As discussed previously, construction of new facilities that would result in permanent, operational GHG emissions are not proposed under the Proposed Action, therefore GHG emissions from operation of the DMC would be unchanged relative to existing or future no action (No Action Alternative) conditions. As shown in Table J-3, construction activities along the canal would generate GHG emissions throughout the construction period. Detailed GHG emission summaries and calculations are presented in Appendix I2.

Table J-3. Total GHG Emissions from the Construction of the Proposed Action

Construction	Construction GHG Emissions	Significance Criteria	Exceeds Criteria?
Proposed Action	10,188 total $MTCO_2e$[1,2]	n/a	n/a
Amortized Over 30 Years	340 $MTCO_2e$ per year[1]	10,000 $MTCO_2e$ per year	no

Source: CDM Smith 2022

Notes:

[1] CO_2e emissions are estimated from emissions of CO_2, CH_4, and N_2O using IPCC AR4 GWP of 1, 25, and 298 respectively.

[2] The presented value represents the total GHGs emitted over the construction period including exhaust from equipment used during all elements of Project construction, exhaust from hauling and delivery vehicle trips, and exhaust from worker commute vehicles.

Key: GHG = greenhouse gas; $MTCO_2e$ = metric tons CO_2 equivalent; n/a = not applicable

As presented above, GHG emissions from construction activities would total 10,188 $MTCO_2e$ over the entire construction period. Consistent with SCAQMD guidance, when amortized over a presumed Project lifetime of 30 years, this would result in an annual contribution of 340 $MTCO_2e$ per year from construction. Since the change to GHG emissions from DMC operations would be zero, the amortized construction emissions alone were compared against, and do not exceed, the 10,000 $MTCO_2e$ per year significance criteria. **Therefore, environmental impacts from GHG emissions from the Proposed Action would be less than significant.**

Impact GHG-2: Would the alternative conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing GHG emissions?

A consistency analysis, presented in Section J.4, was completed to evaluate whether the Proposed Action would conflict with an applicable plan, policy, or regulation adopted to reduce GHG emissions. The Proposed Action would not conflict with CARB's AB 32 Initial Scoping Plan and Climate Change Scoping Plan Update. **Impacts would therefore be less than significant.**

J.5.3 Mitigation Measures

No mitigation measures would be necessary to reduce the impacts of the Proposed Action to a less than significant level.

J.6 References

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Appendix K
Noise and Vibration Calculations

Construction Noise - Traffic
Proposed Action

Table 1. Construction Vehicles - Equivalent Noise Levels

Type	Roadway	No Action Alternative (2026) AADT	Maximum Daily Truck Hauling Trips	Maximum Daily Worker Trips	Speed (mph)	Equivalency Factor for Heavy-Duty Vehicles	Equivalent Vehicles	Total With Project	Increase Ratio
Fresno County									
State Route	SR-33 (south of DMC)	13,500	112	147	55	10.4	1,312	14,812	1.10
State Route	SR-33 (north of DMC)	2,700	112	147	55	10.4	1,312	4,012	1.49
Merced County									
State Route	SR-165 (south of DMC)	1,400	35	80	55	10.4	444	1,844	1.32
State Route	SR-165 (north of DMC)	1,600	35	80	55	10.4	444	2,044	1.28
State Route	SR-152 (east of DMC)	28,000	35	80	55	10.4	444	28,444	1.02
State Route	SR-152 (west of DMC)	23,800	35	80	55	10.4	444	24,244	1.02
State Route	SR-33 (south of DMC)	11,700	35	80	55	10.4	444	12,144	1.04
State Route	SR-33 (north of DMC)	12,200	35	80	55	10.4	444	12,644	1.04
Interstate	I-5 at SR-152	39,500	70	162	55	10.4	890	40,390	1.02
Stanislaus County									
Interstate	I-5 at SR-130	50,100	105	242	55	10.4	1,334	51,434	1.03
San Joaquin County									
State Route	SR-132 (east of DMC)	14,600	26	80	55	10.4	350.4	14,950	1.02
State Route	SR-132 (west of DMC)	17,600	26	80	55	10.4	350.4	17,950	1.02
Interstate	I-5 (north of DMC)	32,500	26	80	55	10.4	350.4	32,850	1.01
Interstate	I-5 (south of DMC)	31,600	26	80	55	10.4	350.4	31,950	1.01
Interstate	I-205 (west of DMC)	135,700	26	80	55	10.4	350.4	136,050	1.00
Interstate	I-205 (east of DMC)	109,800	26	80	55	10.4	350.4	110,150	1.00
Alameda County									
Interstate	I-580 west of I-205/I-580 split	151,500	26	80	55	10.4	350	151,850	1.00

Note:
Impacts would be significant if equivalent traffic volume increases by nine times (10 dBA increase).

Maximum **1.49**
Significant? **No**

Doubling of the noise source produces only a 3 dB increase, which is a barely perceptible change; therefore, there would be no audible change in traffic noise.
FHWA. 2011. Highway Traffic Noise: Analysis and Abatement Guidance.

Table 2. Number of Equivalent Vehicles as a Function of Vehicle Type and Speed Based on TNM Reference Energy Mean Emission Levels

Speed (km/h [mph])		Equivalent Vehicles		
		1 Heavy Truck	1 Medium Truck	1 Auto
56	(35)	19.1	7.1	1
64	(40)	15.1	5.8	1
72	(45)	12.9	5	1
80	(50)	11.5	4.5	1
88.5	(55)	10.4	4.1	1
97	(60)	9.6	3.7	1
105	(65)	7.9	3.5	1
113	(70)	8.3	3.2	1

Source: Caltrans. 2009. Technical Noise Supplement. Prepared by ICF Jones & Stokes. November.

Construction Vibration - Equipment
Proposed Action

Table 3. Construction Vibration

Phase	Equipment Description	Equivalent Equipment Types	Distance (ft):	At Source 25	Residence off Canyon Road 93
			Number of Equipment	PPV (in/sec)	PPV (in/sec)
Canal Lining and Embankment Raises	Small dozer	Small bulldozer	1	0.003	0.000418
	Front End loader	Large Bulldozer	1	0.089	0.012404
	Small Excavator	Small bulldozer	1	0.003	0.000418
	End Dumps	Loaded Trucks	2	0.152	0.021185
	Front End loader	Large Bulldozer	1	0.089	0.012404
	Compacter with blade	Large Bulldozer	1	0.089	0.012404
	Pickup Trucks	Loaded Trucks	7	0.532	0.074148
	Skid Steer	Small bulldozer	1	0.003	0.000418
Canal Lining and Embankment Raises Total				**N/A**	**0.133800**

Phase	Equipment Description	Equivalent Equipment Types	Distance (ft):	At Source 25	Residence off W Nees Ave 350
			Number of Equipment	PPV (in/sec)	PPV (in/sec)
Stabilize Canal Banks Along Earth-lined Segment	Small Dozer	Small bulldozer	2	0.006	0.000115
	Front End loader	Loaded Trucks	5	0.380	0.007254
	Dump Truck	Loaded Trucks	9	0.684	0.013058
	Small Excavator	Small bulldozer	1	0.003	0.000057
	4-foot rollers compactor with blade	Vibratory Roller	2	0.420	0.008018
	Medium Excavator with Vibratory Plate Compactor	Vibratory Roller	1	0.210	0.004009
	Road Grader	Large Bulldozer	1	0.089	0.001699
Stabilize Canal Banks Along Earth-lined Segment Total				**N/A**	**0.034209**

Phase	Equipment Description	Equivalent Equipment Types	Distance (ft):	At Source 25	Residence off Dirt Road 515
			Number of Equipment	PPV (in/sec)	PPV (in/sec)
Concrete Lining Repairs	Excavator	Large Bulldozer	1	0.089	0.000952
	Dump Truck	Loaded Trucks	2	0.152	0.001626
	Skid Steer	Small bulldozer	1	0.003	0.000032
Concrete Lining Repairs Total				**N/A**	**0.002610**

Phase	Equipment Description	Equivalent Equipment Types	Distance (ft):	At Source 25	Residence off S Lammers Road 145
			Number of Equipment	PPV (in/sec)	PPV (in/sec)
Replace Impacted Vehicle Bridges	Service Truck	Loaded Trucks	1	0.076	0.005441
	Crane	Large Bulldozer	2	0.178	0.012743
	Sawcut	n/a	1	n/a	n/a
	Dozer	Small bulldozer	1	0.003	0.000215
	End Dumps	Loaded Trucks	6	0.456	0.032645
	Compactor	Vibratory Roller	1	0.210	0.015034
	Excavator	Large Bulldozer	1	0.089	0.006372
	Tractor	Large Bulldozer	1	0.089	0.006372
	Drill Rig	Pile Driver (impact)	1	0.644	0.046105
	Skid Steer	Large Bulldozer	1	0.089	0.006372
	Trucks	Loaded Trucks	4	0.304	0.021764
	Snooper Truck	Large Bulldozer	1	0.089	0.006372
	Paver	Vibratory Roller	1	0.210	0.015034
Replace Impacted Vehicle Bridges Total				**N/A**	**0.174467**

Phase	Equipment Description	Equivalent Equipment Types	Distance (ft):	At Source 25	Residence off N Oxford Ave 227
			Number of Equipment	PPV (in/sec)	PPV (in/sec)
Replace Impacted Pipeline Crossings	Small Excavator	Small bulldozer	1	0.003	0.000110
	Skid Steer	Large Bulldozer	1	0.089	0.003253
	Crane	Large Bulldozer	1	0.089	0.003253
	Front end Loader	Loaded Trucks	1	0.076	0.002778
	Dump Trucks	Loaded Trucks	2	0.152	0.005555
Replace Impacted Pipeline Crossings Total				**N/A**	**0.014948**

Phase	Equipment Description	Equivalent Equipment Types	Distance (ft):	At Source 25	Residence off Moranga Road 273
			Number of Equipment	PPV (in/sec)	PPV (in/sec)
Modifications to Check Structures and Wasteways	Crane	Large Bulldozer	2	0.178	0.004933
	Aerial Lifts	Large Bulldozer	3	0.267	0.007399
Modifications to Check Structures and Wasteways Total				**N/A**	**0.012332**

Phase	Equipment Description	Equivalent Equipment Types	Distance (ft):	At Source 25	Residence off Gravel Pit Road 178
			Number of Equipment	PPV (in/sec)	PPV (in/sec)
Modifications to Turnouts	Service Truck	Loaded Trucks	2	0.152	0.008001
	Crane	Large Bulldozer	2	0.178	0.009369
	Skid Steer	Large Bulldozer	1	0.089	0.004685
Modifications to Turnouts Total				**N/A**	**0.022054**

Phase	Equipment Description	Equivalent Equipment Types	Distance (ft):	At Source 25	Residence off West Side Freeway 174
			Number of Equipment	PPV (in/sec)	PPV (in/sec)
Modifications to Drainage Structures	Excavator	Large Bulldozer	2	0.178	0.009694
	Skid Steer	Large Bulldozer	2	0.178	0.009694
	Dump Truck	Loaded Trucks	1	0.076	0.004139
Modifications to Drainage Structures Total				**N/A**	**0.023527**

Significance Threshold

0.3 in/sec

Table 4. Construction Vibration Summary Table

Construction Component	Maximum PPV (in/sec)
Canal Lining and Embankment Raises	0.133800
Stabilize Canal Banks Along Earth-lined Segment	0.034209
Concrete Lining Repairs	0.002610
Replace Impacted Vehicle Bridges	0.174467
Replace Impacted Pipeline Crossings	0.014948
Modifications to Check Structures and Wasteways	0.012332
Modifications to Turnouts	0.022054
Modifications to Drainage Structures	0.023527

Significance Threshold

0.3 in/sec

Table 5. Vibration Source Levels for Construction Equipment

Equipment	PPV at 25 ft (in/sec)	Approximate Lv† at 25 ft
Pile Driver (impact)	0.644	104
Pile Driver (sonic)	0.17	93
Clam shovel drop (slurry wall)	0.202	94
Hydromill (slurry wall) - in soil	0.008	66
Hydromill (slurry wall) - in rock	0.017	75
Vibratory Roller	0.21	94
Hoe Ram	0.089	87
Large Bulldozer	0.089	87
Caisson Drilling	0.089	87
Loaded Trucks	0.076	86
Jackhammer	0.035	79
Small bulldozer	0.003	58

Source: Federal Transit Administration. 2006. Transit Noise and Vibration Impact Assessment. FTA-VA-90-1003-06. May.
Note:
Values for pile drivers are based on the typical vibration source levels.
† RMS velocity in decibels (VdB) re 1 micro-inch/second

Delta-Mendota Canal Subsidence Correction Project Environmental Assessment/Initial Study

Appendix L: Traffic and Transportation Technical Appendix

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Appendix L Traffic and Transportation Technical Appendix

This appendix documents the traffic and transportation technical analysis to support the impact analysis in the Environmental Assessment/Initial Study (EA/IS) and describes the traffic and transportation operations that could be potentially affected by the implementation of the No Action/No Project Alternative (subsequently identified as the No Action Alternative) and the Proposed Action/Proposed Project (subsequently identified as the Proposed Action) considered by the EA/IS. Effects on traffic and transportation operations resulting from the construction and operation associated with the Proposed Action may occur in the San Joaquin Valley region alongside the Delta-Mendota Canal (DMC). The appendix provides detailed information about traffic flow assessment methods, trip generation, and roadway operations under the Proposed Action.

L.1 Existing Conditions

A performance measure called "Level of Service" (LOS) is used to characterize traffic operating conditions of a circulation element. Progressively worsening traffic operating conditions are given the letter grades "A" through "F." Table L-1 summarizes the traffic operating conditions associated with each LOS designation.

Table L-1. Level of Service Characteristics

LOS	Traffic Condition
A	Free flow conditions; Low volumes; high operating speeds; uninterrupted flow; no restriction on maneuverability; drivers maintain desired speeds; little or no delays.
B	Stable flow conditions; operating speeds beginning to be restricted.
C	Stable flow but speed and maneuverability restricted by higher traffic volumes; satisfactory operating speed for urban conditions; delays at signals.
D	Approaching unstable flow; low speeds; major delays at signals; little freedom to maneuver.
E	Lower operating speeds; volume at or near capacity; unstable flow; major delays and stoppages.
F	Forced flow conditions; low speeds; volumes below capacity, may be zero; stoppages for long periods because of downstream congestion.

Source: Transportation Research Board 2016

Key: LOS = level of service

Traffic analysis in the state of California is guided by standards set at the state level by the California Department of Transportation (Caltrans), and by local jurisdictions. State highways fall under the jurisdiction of Caltrans. Other roadways fall under the local jurisdiction, either city or county, in which they are located.

The locations selected for analysis are all regional routes, including state routes and interstate highways. Therefore, Caltrans' standard regarding the desired performance level of traffic conditions on roadways is referenced. Caltrans' *Guide for the Preparation of Traffic Impact Studies* (California Department of Transportation [Caltrans] 2002) mentions that Caltrans endeavors to maintain a target LOS at the transition between LOS "C" and LOS "D" on State highway facilities. However, Caltrans acknowledges that this may not always be feasible and recommends that the lead agency consult with Caltrans to determine the appropriate target LOS. Therefore, LOS D is considered to be the applicable standard in this analysis, and a change in LOS from D to E would be considered a Project impact. It is also stated in Caltrans' *Highway Design Manual* (Caltrans 2020) that the target LOS is E for urban areas and D for rural areas. Since the DMC crossings within the Project limits are mostly in rural area, LOS D is identified as the appropriate significance threshold for this analysis.

Table L-2 provides LOS criteria (thresholds) for Merced County roadways for identifying daily LOS. Because LOS criteria are not available or applicable from the general plan documents of other counties, the generalized LOS volumes from *Highway Capacity Manual* (HCM), Sixth Edition was used for identifying daily LOS. Table L-3 through Table L-6 shows the LOS criteria for relevant roadway types. The Highway Capacity Software, version 7.9.6, which is based on the HCM methodology, was used to identify LOS for the study roadway segments in the a.m. and p.m. peak hours.

Table L-2. Level of Service Criteria for Roadways – Merced County

#	Area	Facility	Interchanges	Intersections	Flow	Lanes	Median	Level of Service (Average Annual Daily Traffic)				
								A	B	C	D	E
1	Urban	Freeway	< 2 miles apart	-	-	4	N/A	22,000	36,000	52,000	67,000	76,500
2	Urban	Expressway	-	-	-	4	Divided	-	-	21,400	31,100	32,900
3	Urban	Highway	-	-	Uninterrupted	2	Undivided	2,000	7,000	13,800	19,600	27,000
4	Urban	Highway	-	< 2/mile	-	2	Undivided	-	4,200	13,800	16,400	16,900
5	Urban	Highway	-	< 4.5/mile	-	2	Undivided	-	1,900	11,200	15,400	16,300
6	Urban	Collector	-	-	-	2	Undivided	-	-	4,800	10,000	12,600
7	Urban	Highway	-	< 4.5/mile	-	4	Undivided	-	3,500	23,200	29,100	30,600
8	Urban	Arterial	-	-	-	4	Undivided	-	-	15,600	27,800	29,400
9	Urban	Highway	-	< 2/mile	-	4	Undivided	3,500	20,900	24,600	25,700	-
10	Urban	Collector	-	-	-	4	Undivided	-	-	9,800	19,200	22,800
11	Urban	Highway	-	< 2/mile	-	2	Undivided	-	4,000	13,100	15,500	16,300
12	Urban	Arterial	-	-	-	2	Undivided	-	-	7,000	13,600	14,600
13	Transition	Freeway	-	-	-	4	-	23,500	38,700	52,500	62,200	69,100
14	Transition	Collector	-	-	-	2	Undivided	-	-	4,400	9,400	12,000
15	Rural	Freeway	-	-	-	6	-	33,100	54,300	73,900	87,400	97,200
16	Rural	Freeway	-	-	-	4	-	21,300	35,300	47,900	56,600	63,000
17	Rural	Nonfreeway	-	-	Uninterrupted	4	Divided	17,500	28,600	40,800	52,400	58,300
18	Rural	Nonfreeway	-	-	Isolated Stops	4	-	-	2,900	17,400	23,000	25,200
19	Rural	Nonfreeway	-	-	Uninterrupted	2	Undivided	2,600	5,300	8,600	13,800	22,300
20	Rural	Nonfreeway	-	-	Isolated Stops	2	Undivided	-	1,900	8,000	10,700	12,100
21	Suburban	Nonfreeway	-	-	Interrupted	4	Divided	-	5,300	25,200	29,400	31,200
22	Suburban	Highway	-	-	Uninterrupted	2	Undivided	2,500	7,200	12,700	17,300	23,500
23	Suburban	Arterial	-	-	Interrupted	2	Undivided	-	2,200	11,000	13,900	14,900
24	Suburban	Collector	-	-	-	2	Undivided	-	-	1,900	7,600	10,100

Source: Merced County 2013

Key: N/A = not applicable; < = less than

Table L-3. Daily Service Volume Table for Rural Basic Freeway Segments

		Four-Lane Freeways				Six-Lane Freeways				Eight-Lane Freeways			
K	D	LOS B	LOS C	LOS D	LOS E	LOS B	LOS C	LOS D	LOS E	LOS B	LOS C	LOS D	LOS E
Level Terrain													
0.08	0.50	52.8	72.8	88.7	100.7	79.3	109.2	133.0	151.1	105.7	145.5	177.3	201.4
	0.55	48.0	66.2	80.6	91.6	72.1	99.2	120.9	137.3	96.1	132.3	161.2	183.1
	0.60	44.0	60.6	73.9	83.9	66.1	91.0	110.8	125.9	88.1	121.3	147.8	167.9
	0.65	40.6	56.0	68.2	77.5	61.0	84.0	102.3	116.2	81.3	112.0	136.4	154.9
0.09	0.50	47.0	64.7	78.8	89.5	70.5	97.0	118.2	134.3	93.9	129.4	157.6	179.0
	0.55	42.7	58.8	71.6	81.4	64.1	88.2	107.5	122.1	85.4	117.6	143.3	162.8
	0.60	39.1	53.9	65.7	74.6	58.7	80.9	98.5	111.9	78.3	107.8	131.3	149.2
	0.65	36.1	49.8	60.6	68.9	54.2	74.6	90.9	103.3	72.3	99.5	121.2	137.7
0.10	0.50	42.3	58.2	70.9	80.6	63.4	87.3	106.4	120.9	84.6	116.4	141.8	161.1
	0.55	38.4	52.9	64.5	73.2	57.6	79.4	96.7	109.9	76.9	105.9	129.0	146.5
	0.60	35.2	48.5	59.1	67.1	52.8	72.8	87.9	100.7	70.5	97.0	118.2	134.3
	0.65	32.5	44.8	54.6	62.0	48.8	67.2	80.6	93.0	65.0	89.6	109.1	124.0
0.11	0.50	38.4	52.9	64.5	73.2	57.6	79.4	74.4	109.9	76.9	105.9	129.0	146.5
	0.55	34.9	48.1	58.6	66.6	52.4	72.2	88.7	99.9	69.9	96.2	117.2	133.2
	0.60	32.0	44.1	53.7	61.0	48.0	66.2	81.8	91.6	64.1	88.2	107.5	122.1
	0.65	29.6	40.7	49.6	56.3	44.3	61.1	96.7	84.5	59.1	81.4	99.2	112.7
0.12	0.50	35.2	48.5	59.1	67.1	52.8	72.8	87.9	100.7	70.5	97.0	118.2	134.3
	0.55	32.0	44.1	53.7	61.0	48.0	66.2	80.6	91.6	64.1	88.2	107.5	122.1
	0.60	29.4	40.4	49.3	56.0	44.0	60.6	73.9	83.9	58.7	80.9	98.5	111.9
	0.65	27.1	37.3	45.5	51.6	40.6	56.0	68.2	77.5	54.2	74.6	90.9	103.3

Source: Transportation Research Board 2016

Key: LOS = level of service, Unit: 1,000 veh/day

Table L-4. Generalized Daily Service Volumes for Rural Multilane Highways

		Four-Lane Freeways				Six-Lane Freeways				Eight-Lane Freeways			
K	D	LOS B	LOS C	LOS D	LOS E	LOS B	LOS C	LOS D	LOS E	LOS B	LOS C	LOS D	LOS E
Level Terrain													
0.08	0.50	42.4	60.9	75.8	86.4	63.6	91.3	113.7	129.6	84.9	121.8	151.6	172.9
	0.55	38.6	55.4	68.9	78.6	57.9	83.0	103.4	117.9	77.1	110.7	137.8	157.1
	0.60	35.4	50.7	63.2	72.0	53.0	76.1	94.8	108.0	70.7	101.5	126.3	144.0
	0.65	32.6	46.8	58.3	66.5	49.0	70.3	87.5	99.7	65.3	93.7	116.6	133.0
0.09	0.50	37.7	54.1	67.4	76.8	56.6	81.2	101.1	115.2	75.4	108.2	134.8	153.7
	0.55	34.3	49.2	61.3	69.8	51.4	73.8	91.9	104.8	68.6	98.4	122.5	139.7
	0.60	31.4	45.1	56.2	64.0	47.1	67.7	84.2	96.0	62.9	90.2	112.3	128.0
	0.65	29.0	41.6	51.8	59.1	43.5	62.4	77.7	88.6	58.0	83.3	103.7	118.2
0.10	0.50	33.9	48.7	60.6	69.1	50.6	73.1	91.0	106.7	67.9	97.4	121.3	138.3
	0.55	30.9	44.3	55.1	62.9	46.3	66.4	82.7	94.3	61.7	88.6	110.3	125.7
	0.60	28.3	40.6	50.5	57.6	42.4	60.9	75.8	86.4	56.6	81.2	101.1	115.2
	0.65	26.1	37.5	46.6	53.2	39.2	56.2	70.0	79.8	52.2	74.9	93.3	106.4
0.11	0.50	30.9	44.3	55.1	62.9	46.3	66.4	82.7	94.3	61.7	88.6	110.3	125.7
	0.55	28.1	40.3	50.1	57.1	42.1	60.4	75.2	85.7	56.1	80.5	100.2	114.3
	0.60	25.7	36.9	45.9	52.4	38.6	55.4	68.9	78.6	51.4	73.8	91.9	104.8
	0.65	23.7	34.1	42.4	48.4	35.6	51.1	63.6	72.5	47.5	68.1	84.8	96.7
0.12	0.50	28.3	40.6	50.5	57.6	42.4	60.9	75.8	86.4	56.6	81.2	101.1	115.2
	0.55	25.7	36.9	45.9	52.4	38.6	55.4	68.9	78.6	51.4	73.8	91.9	104.8
	0.60	23.6	33.8	42.1	48.0	35.4	50.7	63.2	72.0	47.1	67.7	84.2	96.0
	0.65	21.8	31.2	38.9	44.3	32.6	46.8	58.3	66.5	43.5	62.4	77.7	88.6

Source: Transportation Research Board 2016

Key: N/A = not applicable; LOS = level of service. K factor: The percentage of the Annual Average Daily Traffic in both directions during the peak hour; D factor: The percentage of traffic in the peak direction during the peak hour. Unit: 1,000 vehicles per day

Table L-5. Generalized Daily Service Volumes for Two-Lane Highways

		Class I - Level				Class I - Rolling				Class II - Rolling			
K-Factor	D-Factor	LOS B	LOS C	LOS D	LOS E	LOS B	LOS C	LOS D	LOS E	LOS B	LOS C	LOS D	LOS E
0.09	50%	5.5	9.3	16.5	31.2	4.2	8.4	15.7	30.3	5.0	9.8	18.2	31.2
	55%	4.9	8.7	14.9	30.2	3.7	7.9	14.0	29.2	4.1	8.7	16.0	30.2
	60%	4.4	8.1	13.9	27.6	3.7	6.2	12.8	26.8	3.7	7.9	14.6	27.6
	65%	4.1	7.9	12.9	25.5	3.4	5.9	11.4	24.7	3.3	5.9	13.2	25.5
0.10	50%	5.0	8.4	14.8	28.0	3.8	7.6	14.2	27.2	4.4	8.8	16.3	28.0
	55%	4.4	7.9	13.4	27.1	3.3	7.1	12.6	26.3	3.7	7.9	14.4	27.1
	60%	4.0	7.3	12.5	24.9	3.3	5.6	11.5	24.1	3.3	7.1	13.1	24.9
	65%	3.7	7.1	11.6	23.0	3.0	5.3	10.3	22.3	3.0	5.3	11.9	23.0
0.12	50%	4.1	7.0	12.4	23.4	3.1	6.3	11.8	22.7	3.7	7.4	13.6	23.4
	55%	3.7	6.5	11.2	22.6	2.8	5.9	10.5	21.9	3.1	6.5	12.0	22.6
	60%	3.3	6.1	10.4	20.7	2.7	4.7	9.6	20.1	2.7	5.9	10.9	20.7
	65%	3.1	5.9	9.6	19.1	2.5	4.4	8.5	18.5	2.4	4.4	9.9	19.1
0.14	50%	3.5	6.0	10.6	20.0	2.7	5.4	10.1	19.4	3.2	6.3	11.7	20.0
	55%	3.1	5.6	9.6	19.4	2.4	5.1	9.0	18.8	2.6	5.6	10.3	19.4
	60%	2.8	5.2	8.9	17.7	2.3	4.0	8.2	17.2	2.3	5.1	9.4	17.7
	65%	2.6	5.1	8.2	16.4	2.1	3.8	7.3	15.9	2.1	3.8	8.5	16.4

Source: Transportation Research Board 2016

Notes: Volumes are thousands of vehicles per day.

Assumed values for all entries: 10% trucks, peak hour factor (PHF) = 0.88, 12-foot lanes, 6-foot shoulders, 10 access points per mile.

Assumed values for Class I – Level: Base free flow speed (BFFS) = 65 miles per hour (mph), 20% no-passing zones.

Assumed values for Class I – Rolling: BFFS = 60 mph, 40% no-passing zones.

Assumed values for Class II – Rolling: BFFS = mph, 60% no-passing zones.

Key: N/A = not applicable; LOS = level of service. K factor: The percentage of the Annual Average Daily Traffic in both directions during the peak hour; D factor: The percentage of traffic in the peak direction during the peak hour.

Unit: 1,000 vehicles per day

Table L-6. Generalized Daily Service Volumes for Urban Street Facilities

Daily Service Volume by Lanes, LOS, and Speed (1,000 vehicles per day)													
		Four-Lane Freeways				Six-Lane Freeways				Eight-Lane Freeways			
K-Factor	D-Factor	LOS B	LOS C	LOS D	LOS E	LOS B	LOS C	LOS D	LOS E	LOS B	LOS C	LOS D	LOS E
Posted Speed = 30 miles per hour													
0.09	0.55	N/A	1.7	11.8	17.8	N/A	2.2	24.7	35.8	N/A	2.6	38.7	54.0
	0.56	N/A	1.6	10.8	16.4	N/A	2.0	22.7	32.8	N/A	2.4	35.6	49.5
0.10	0.55	N/A	1.6	10.7	16.1	N/A	2.0	22.3	32.2	N/A	2.4	34.9	48.6
	0.60	N/A	1.4	9.8	14.7	N/A	1.8	20.4	29.5	N/A	2.2	32.0	44.5
0.11	0.55	N/A	1.4	9.7	14.6	N/A	1.8	20.3	29.3	N/A	2.1	31.7	44.1
	0.60	N/A	1.3	8.9	13.4	N/A	1.7	18.6	26.9	N/A	2.0	29.1	40.5
Posted Speed = 45 miles per hour													
0.09	0.55	N/A	7.7	15.9	18.3	N/A	16.5	33.6	36.8	N/A	25.4	51.7	55.3
	0.60	N/A	7.1	14.5	16.8	N/A	15.1	30.8	33.7	N/A	23.4	47.4	50.7
0.10	0.55	N/A	7.0	14.3	16.5	N/A	14.9	30.2	33.1	N/A	23.0	46.5	49.7
	0.60	N/A	6.4	13.1	15.1	N/A	13.6	27.7	30.3	N/A	21.0	42.7	45.6
0.11	0.55	N/A	6.3	13.0	15.0	N/A	13.5	27.5	30.1	N/A	20.9	42.3	45.2
	0.60	N/A	5.8	11.9	13.8	N/A	12.4	25.2	27.6	N/A	19.1	38.8	41.5

Source: Transportation Research Board 2016

Key: N/A = not applicable; LOS = level of service. K factor: The percentage of the Annual Average Daily Traffic in both directions during the peak hour; D factor: The percentage of traffic in the peak direction during the peak hour.
LOS cannot be achieved with the following assumptions: no roundabouts or all-way STOP-controlled intersections along the facility; coordinated, semiactuated traffic signals; Arrival Type 4; 120-s cycle time; protected left-turn phases; 0.45 weighted average g/C ratio; exclusive left-turn lanes with adequate queue storage provided at traffic signals; no exclusive right-turn lanes provided; no restrictive median; two-mile facility length; 10 percent of traffic turns left and 10 percent of traffic turns right at each traffic signal; peak hour factor = 0.92; and base saturation flow rate = 1,900 passenger cars per hour per lane.
Additional assumptions for 30-mile per hour facilities: signal spacing = 1,050 feet and 20 access points per mile.
Additional assumptions for 45-mile per hour facilities: signal spacing = 1,500 feet and 10 access points per mile.
Unit: 1,000 veh/day

Table L-7 shows the roadway locations in different areas surrounding the proposed construction sites along the Project limits for the traffic and transportation impact analysis. These locations represent key regional roadways where the trucks hauling materials and personnel trips would occur near DMC crossings. Daily traffic volumes and K and D factors[1] for these locations were collected from Caltrans' Traffic Census Program (Caltrans 2019) to develop the existing traffic volumes. In cases where the peak hour data was not available, the K and D factors of a nearby location along the same study roadway were used to derive the peak hour volumes.

[1] K factor: The percentage of the Annual Average Daily Traffic in both directions during the peak hour; D factor: The percentage of traffic in the peak direction during the peak hour.

Table L-7. Study Roadway Locations

Roadway	Location
Fresno County Area	
SR 33	S of DMC (FRE 62.506), N of DMC (FRE 79.905)
Merced County/Los Banos Area	
SR 165	S of DMC (MER 0.000), N of DMC (MER 3.749)
SR 152	W of DMC (MER 13.848), E of DMC (MER 19.268)
SR 33	S of DMC (MER 13.238), N of DMC (MER 15.6)
I-5	At SR 152 (MER 17.578)
Stanislaus County Area	
I-5	At SR 130 (STA 15.855)
San Joaquin County/Tracy Area	
SR 132	E of DMC (SJ 3.24), W of DMC (SJ 3.24)
I-5	N of DMC (SJ 3.444), S of DMC (SJ 3.444)
I-205	W of DMC (SJ 0.000), E of DMC (SJ 1.377)
Alameda County Area	
I-580	W of I-205/I-580 split

Key: DMC = Delta-Mendota Canal; E = east; FRE = Fresno; I = Interstate; MER = Merced; N = North; S = South; SJ = San Joaquin; SR = state route; W = west

L.2 Traffic Flow Assessment Methodology

The Proposed Action would result in increases in traffic during construction and small or no changes during operations. This impact assessment analyzes the increase in traffic that would occur during construction based on changes to the LOS. Because all the roadway segments being analyzed are either Interstates or state highways that fall under Caltrans' jurisdiction, Caltrans' standard of LOS D is used to identify traffic impacts. In addition to daily operations, the impact assessment includes a.m. and p.m. peak hours. It is assumed that the a.m. peak hour occurs between 7 a.m. and 9 a.m., and the p.m. peak hour occurs between 4 p.m. and 6 p.m.

For the Proposed Action, construction data (number of construction trucks, construction locations and schedule, number of workers, and worker schedule) were used to identify anticipated short-term construction-related trip generation. There is no long-term operations-related trip generation anticipated. These additional short-term trips were assigned to roadways located near the service areas to determine traffic operations under the Proposed Action. Using the traffic operations' assessment methods mentioned above, potential transportation impacts to neighboring roadways were determined for the Proposed Action.

L.3 Trip Generation

L.3.1 No Action Alternative

No additional construction truck trips and personnel trips would be generated on top of background trip under the No Action Alternative.

L.3.2 Raise Deficient Structures Alternative (Proposed Action)

The maximum daily delivery/hauling truck trips and maximum daily personnel for relevant Project elements for the Proposed Action were identified from Appendix G – Construction Schedules and Assumptions of the Bureau of Reclamation's (Reclamation's) 2021 *Delta-Mendota Canal Subsidence Project- Feasibility Study of the Structural Alternatives*. These numbers were then converted to maximum daily one-way truck trips and worker trips as summarized in Table L-8. For worker trips, the number of personnel was multiplied by two to derive total one-way in and out trips. For the "Bridge Replacement" Project element, up to three bridge replacements are anticipated to occur concurrently; therefore, the number was further multiplied by three. For the "Check Structures and Wasteways Modifications" Project element, up to two check structures/wasteways are anticipated to be modified concurrently; therefore, the number was multiplied by two.

Table L-8. Trip Generation Under the Proposed Action

Project Element	Truck Trips		Worker Trips		Impact Location
	Unit One-Way	Total In & Out	Number of Personnel	Total In & Out	
Bridge Replacement	12	36	12	72	Throughout Project
Concrete Lining with Embankment Raise	32	32	23	46	Throughout Project
Concrete Lining Repairs	8	8	6	12	Throughout Project
Stabilize Canal Banks Along Earthen-lined Segment	119	119	26	52	MP 98.64 - 116.41 (Between Stations 4535+00 and 5476+35)
Impacted Pipeline Crossing Replacements	5	5	16	32	Throughout Project
Check Structures and Wasteways Modifications	2	4	14	56	Throughout Project
Turnout Modifications	4	4	6	12	Throughout Project
Drainage Structure Modifications	16	16	6	12	Throughout Project

Key: MP = Mile Post

All Project elements except "Stabilize Canal Banks Along Earthen-lined Segment" are located throughout the Project limits, and construction activities move along the Project limits. Therefore, the trips from these construction activities are assumed to occur in all study areas listed above. For the "Stabilize Canal Banks Along Earthen-lined Segment" Project element, the construction activities are limited to the segment between Mile Post (MP) 98.64 - 116.41 (between Stations 4535+00 and 5476+35), so the impact location is limited to the Fresno County area.

These trips were distributed into the study roadways in different areas based on the assumed labor and material sources. The distributed trips represent the maximum possible trips that could occur at the study roadway locations on a daily level. Figure L-1 through Figure L-5 illustrate conceptually where the study roadways are located and the percentage distributions of the truck and worker trips, for each focused study area.

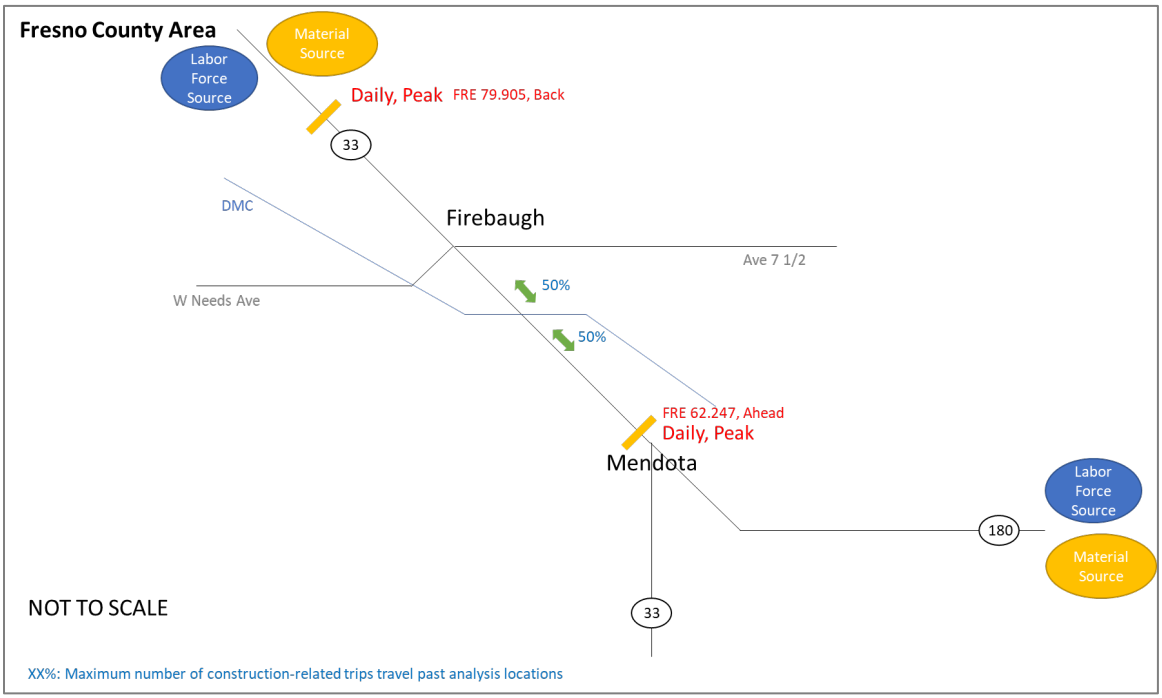


Figure L-1. Study Roadways and Construction Trips Distribution in Fresno County Area

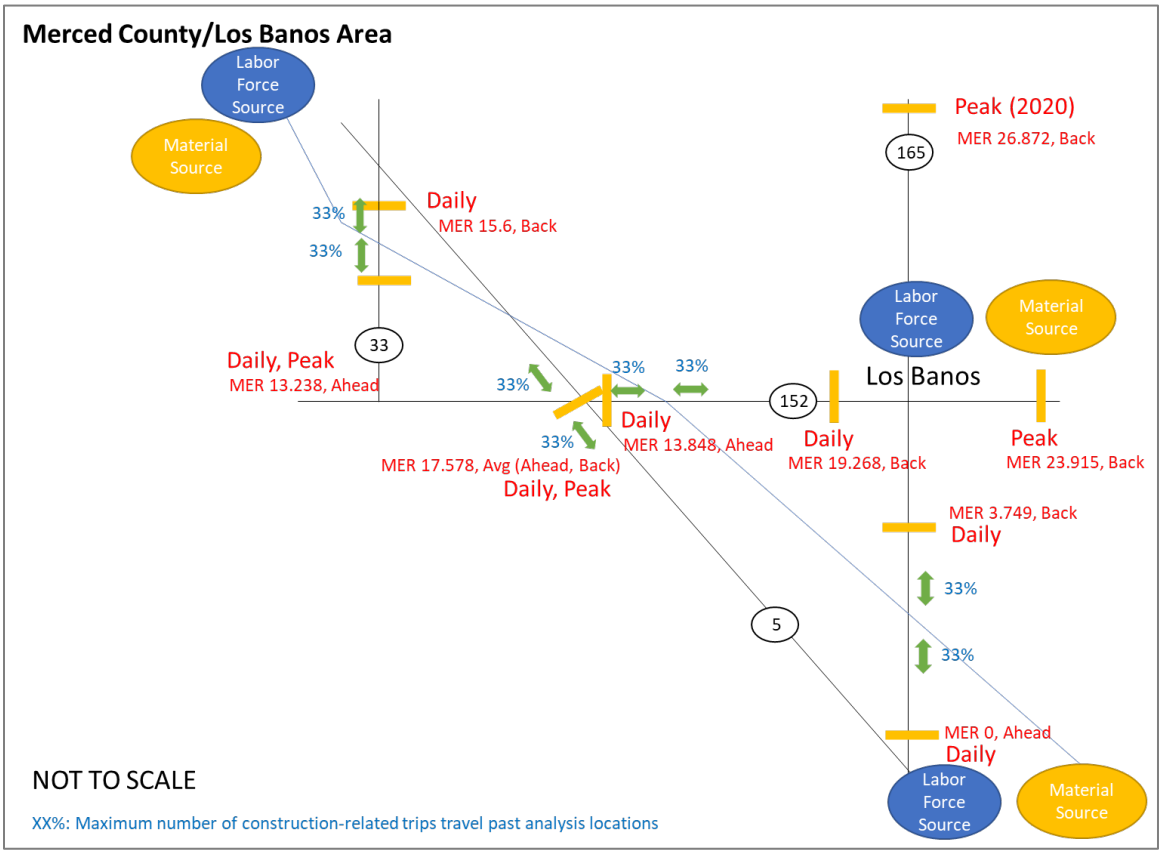


Figure L-2. Study Roadways and Construction Trips Distribution in Merced County/ Los Banos Area

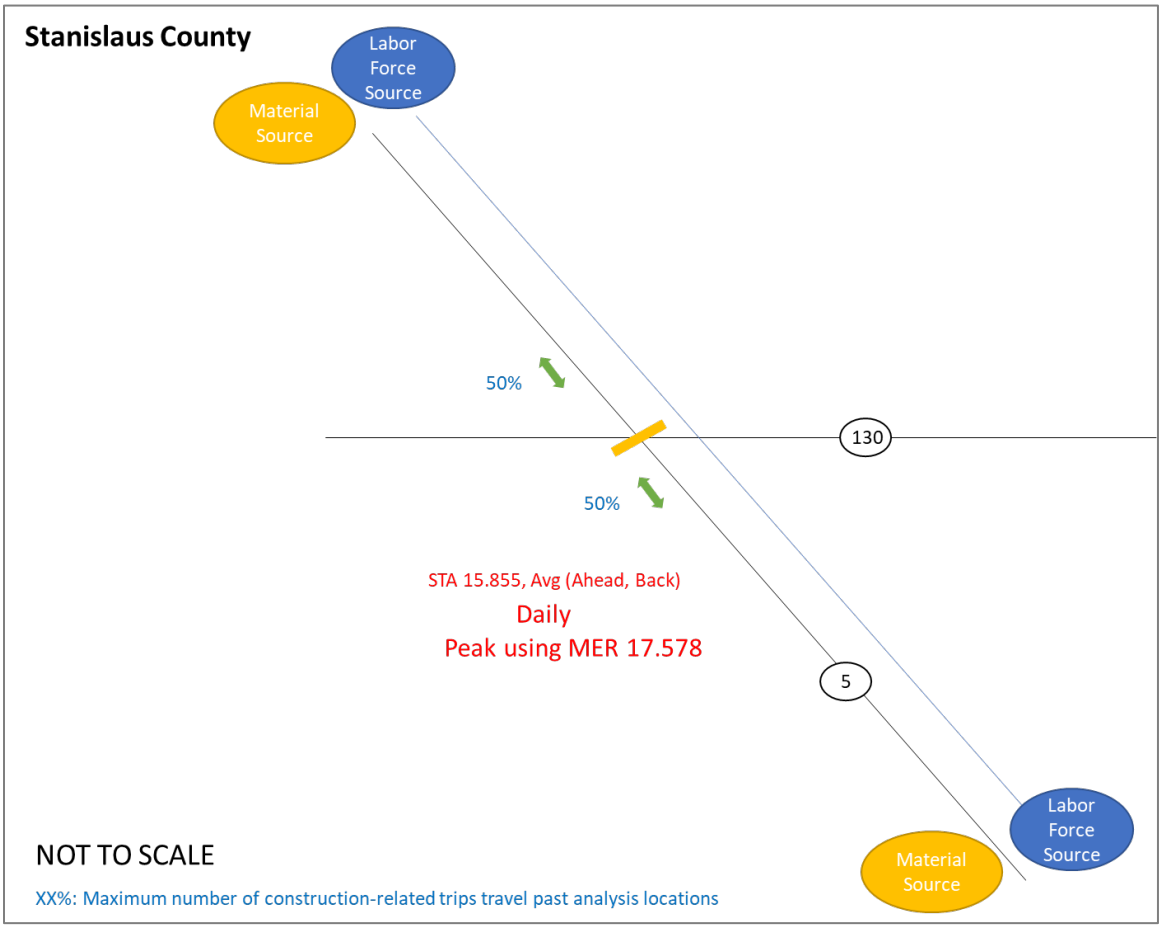


Figure L-3. Study Roadways and Construction Trips Distribution in Stanislaus County Area

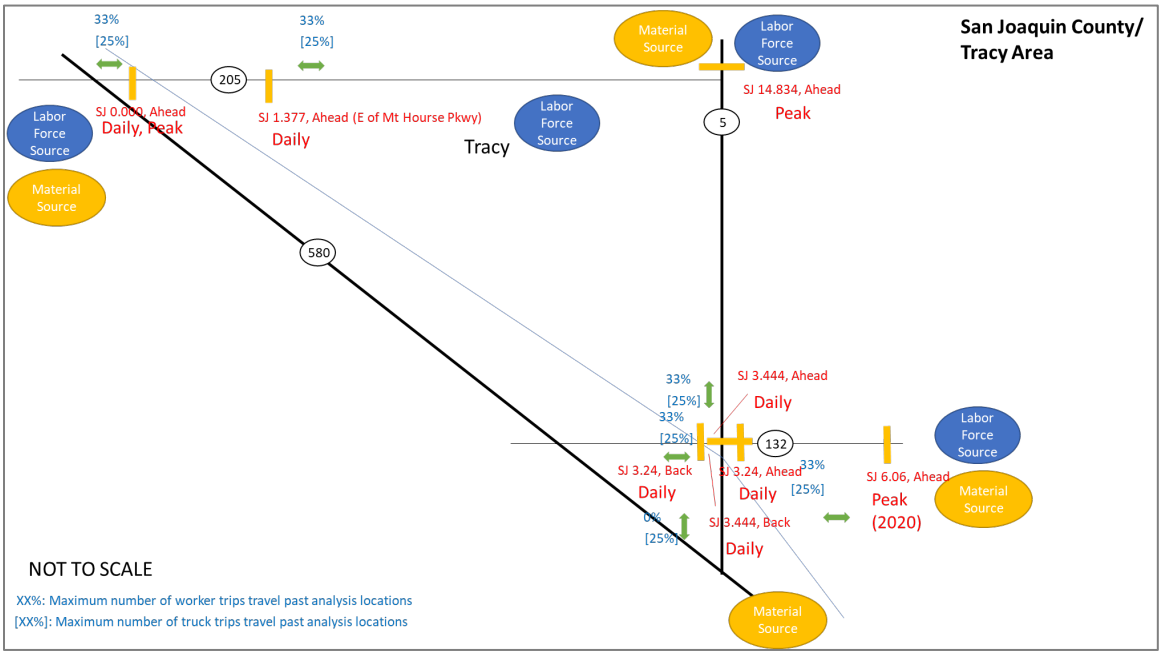


Figure L-4. Study Roadways and Construction Trips Distribution in San Joaquin County/Tracy Area

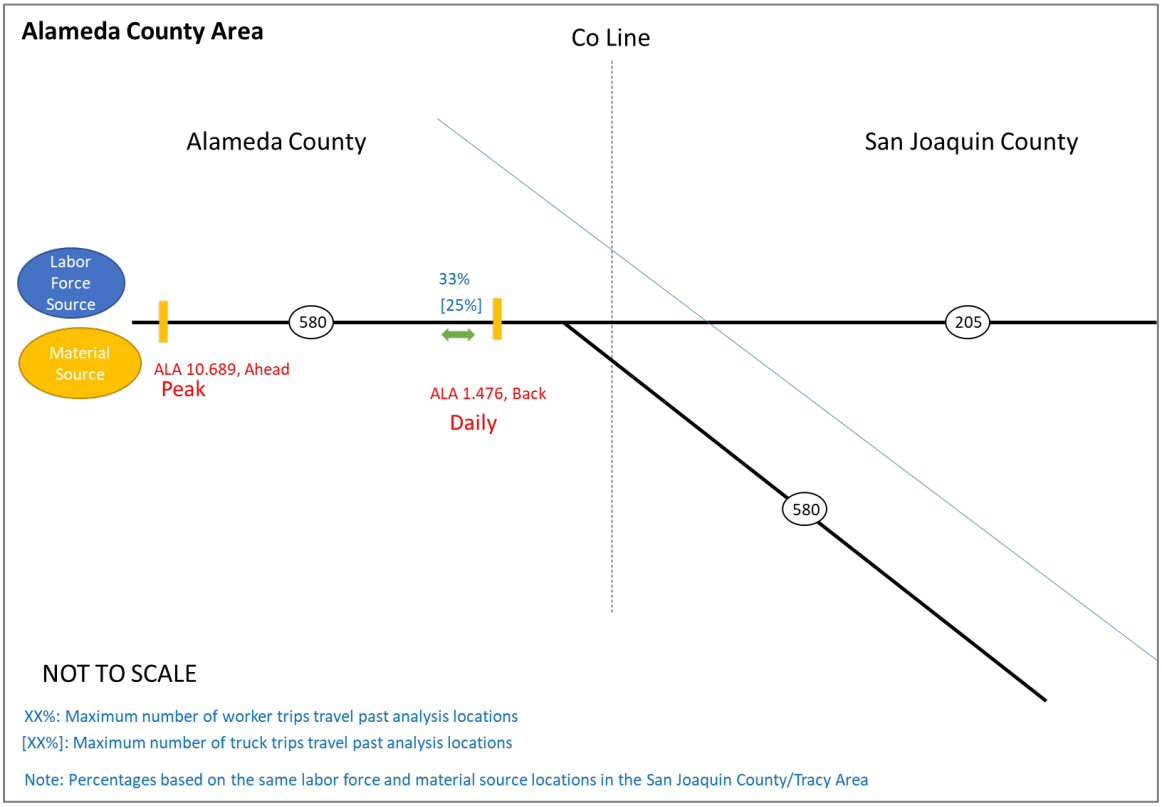


Figure L-5. Study Roadways and Construction Trips Distribution in Alameda County Area

A maximum of 224 truck trips and 294 worker trips would be involved with implementation of the Proposed Action. The construction year considered for analyzing the Proposed Action is 2026. It is assumed that all of the construction truck trips would be distributed throughout the 24-hour construction, so that 10 percent of the daily trips would occur during the a.m./p.m. peak hour. From Appendix G – Construction Schedules and Assumptions of Reclamation's 2021 *Delta-Mendota Canal Subsidence Project: Feasibility Study of the Structural Alternatives*, there would be two 10-hour shifts per day. It is assumed that the construction personnel are equally distributed between these two shifts, and trips would occur inbound before 6 a.m. and before 6 p.m., and outbound after 6 a.m. and after 6 p.m. Therefore, only the nighttime worker trips would occur during the a.m./p.m. peak hours. Nighttime workers would leave the site during the a.m. peak period and enter the site during the p.m. peak period. The Proposed Action is not expected to add any long-term trips to the Project site after construction is complete.

L.4 Roadway Operations

Existing traffic conditions are based on 2019 traffic volumes derived from Caltrans' Traffic Census Program (Caltrans 2019). Since the Project limits are in rural area, background traffic growth is expected to be minimal. For this analysis, it was assumed that background traffic would increase at 0.5 percent annually from 2019 to 2026.

L.4.1 No Action Alternative

Since there are no additional construction-related trips generated under the No Action Alternative, traffic volumes under this alternative only include projected background traffic. Therefore, roadway operations under this alternative are expected to be the same as background roadway operations.

L.4.2 Raise Deficient Structures Alternative (Proposed Action)

Roadway operations during construction of the Proposed Action are summarized in Table L-9 through Table L-11, respectively for daily, a.m. and p.m. peak hour periods.

For daily operations, the added construction-related trips would not change the LOS at any of the study roadway segments, except at the location of Interstate 5 (I-5) at State Route (SR) 130 in Stanislaus County. Even though LOS degrades from C to D after the construction-related trips are added on this segment, the LOS during construction does not exceed the threshold of significance (LOS D).

For a.m. and p.m. peak hour operations, the added construction-related trips would not change the LOS at any of the study roadway segments or intersections, except at the following locations in Fresno County:

- SR 33 northbound segment north of DMC (a.m. and p.m. peak hours)
- SR 33 southbound segment north of DMC (p.m. peak hour)

Even though LOS degrades after the construction-related trips are added on this segment during these peak hours, the LOS during construction does not exceed the threshold of significance (LOS D).

Table L-9. Daily Roadway Operations Under the Proposed Action

Roadway	No Action (2026) Volume (AADT)	No Action LOS (2026)	Maximum Daily Truck Trips	Maximum Daily Worker Trips	Total Volume (2026) (AADT)	LOS (2026)	LOS Change
Fresno County Area							
SR 33 south of DMC	13,500	D	112	147	13,759	D	No Change
SR 33 north of DMC	2,700	C	112	147	2,959	C	No Change
Merced County/Los Banos Area							
SR 165 south of DMC	1,400	A	35	80	1,515	A	No Change
SR 165 north of DMC	1,600	A	35	80	1,715	A	No Change
SR 152 west of DMC	28,000	B	35	80	28,115	B	No Change
SR 152 east of DMC	23,800	C	35	80	23,915	C	No Change
SR 33 south of DMC	11,700	D	35	80	11,815	D	No Change
SR 33 north of DMC	12,200	D	35	80	12,315	D	No Change
I-5 at SR 152	39,500	C	70	162	39,732	C	No Change
Stanislaus County Area							
I-5 at SR 130	50,100	C	105	242	50,447	D	Higher but does not exceed LOS D
San Joaquin County/Tracy Area							
SR 132 east of DMC	14,600	B	26	80	14,706	B	No Change
SR 132 west of DMC	17,600	B	26	80	17,706	B	No Change
I-5 north of DMC	32,500	B	26	80	32,606	B	No Change
I-5 south of DMC	31,600	B	26	80	31,706	B	No Change
I-205 west of DMC	135,700	F	26	80	135,806	F	No Change
I-205 east of DMC	109,800	C	26	80	109,906	C	No Change

Roadway	No Action (2026) Volume (AADT)	No Action LOS (2026)	Maximum Daily Truck Trips	Maximum Daily Worker Trips	Total Volume (2026) (AADT)	LOS (2026)	LOS Change
Alameda County Area							
I-580 west of I-205/I-580 Split	151,500	E	26	80	151,606	E	No Change

Key: AADT = annual average daily traffic; DMC = Delta-Mendota Canal; I = interstate; LOS = level of service; SR = state route

Table L-10. A.M. Peak Hour Roadway Operations Under the Proposed Action

Roadway	No Action (2026) Volume (AADT)	No Action LOS (2026)	Maximum Truck Trips	Maximum Worker Trips	Total Volume (2026) (AADT)	LOS (2026)	LOS Change
Fresno County Area							
SR 33 south of DMC NB	450	C	6	0	456	C	No Change
SR 33 south of DMC SB	450	C	6	74	530	C	No Change
SR 33 north of DMC NB	450	B	6	74	530	C	Higher but does not exceed LOS D
SR 33 north of DMC SB	50	A	6	0	56	A	No Change
Merced County/Los Banos Area							
SR 165 south of DMC NB	50	A	2	0	52	A	No Change
SR 165 south of DMC SB	50	A	2	40	92	A	No Change
SR 165 north of DMC NB	50	A	2	40	92	A	No Change
SR 165 north of DMC SB	50	A	2	0	52	A	No Change
SR 152 west of DMC EB	900	A	2	0	902	A	No Change
SR 152 west of DMC WB	1,350	B	2	40	1,392	B	No Change
SR 152 east of DMC EB	700	A	2	40	742	A	No Change
SR 152 east of DMC WB	1,150	B	2	0	1,152	B	No Change

Roadway	No Action (2026) Volume (AADT)	No Action LOS (2026)	Maximum Truck Trips	Maximum Worker Trips	Total Volume (2026) (AADT)	LOS (2026)	LOS Change
SR 33 south of DMC NB	700	E	2	0	702	E	No Change
SR 33 south of DMC SB	400	C	2	40	442	C	No Change
SR 33 north of DMC NB	700	D	2	40	742	D	No Change
SR 33 north of DMC SB	450	D	2	0	452	D	No Change
I-5 at SR 152 NB	1,000	A	4	81	1,085	A	No Change
I-5 at SR 152 SB	2,300	C	4	81	2,385	C	No Change
Stanislaus County Area							
I-5 at SR 130 NB	1,250	B	5	121	1,376	B	No Change
I-5 at SR 130 SB	2,900	D	5	121	3,026	D	No Change
San Joaquin County/Tracy Area							
SR 132 east of DMC EB	50	A	1	40	91	A	No Change
SR 132 east of DMC WB	1,350	B	1	0	1,351	B	No Change
SR 132 west of DMC EB	50	A	1	0	51	A	No Change
SR 132 west of DMC WB	1,600	B	1	40	1,641	B	No Change
I-5 north of DMC NB	1,200	B	1	40	1,241	B	No Change
I-5 north of DMC SB	1,100	A	1	0	1,101	A	No Change
I-5 south of DMC NB	1,150	A	1	0	1,151	A	No Change
I-5 south of DMC SB	1,100	A	1	0	1,101	A	No Change
I-205 west of DMC EB	5,000	D	1	0	5,001	D	No Change
I-205 west of DMC WB	4,950	D	1	40	4,991	D	No Change
I-205 east of DMC EB	4,050	B	1	40	4,091	B	No Change

Roadway	No Action (2026) Volume (AADT)	No Action LOS (2026)	Maximum Truck Trips	Maximum Worker Trips	Total Volume (2026) (AADT)	LOS (2026)	LOS Change
I-205 east of DMC WB	4,050	B	1	0	4,051	B	No Change
Alameda County Area							
I-580 west of I-205/I-580 Split EB	5,700	C	1	0	5,701	C	No Change
I-580 west of I-205/I-580 Split WB	3,450	B	1	40	3,491	B	No Change

Key: DMC = Delta-Mendota Canal; AADT = annual average daily traffic; I = interstate; LOS = level of service; NB = northbound; SB = southbound; EB = eastbound; WB = westbound.

Table L-11. P.M. Peak Hour Roadway Operations Under the Proposed Action

Roadway	No Action (2026) Volume (AADT)	No Action LOS (2026)	Maximum Truck Trips	Maximum Worker Trips	Total Volume (2026) (AADT)	LOS (2026)	LOS Change
Fresno County Area							
SR 33 south of DMC NB	650	D	6	74	730	D	No Change
SR 33 south of DMC SB	700	D	6	0	706	D	No Change
SR 33 south of DMC NB	800	C	6	0	806	D	Higher but does not exceed LOS D
SR 33 north of DMC SB	50	A	6	74	130	B	Higher but does not exceed LOS D
Merced County/Los Banos Area							
SR 165 south of DMC NB	50	A	2	40	92	A	No Change
SR 165 south of DMC SB	50	A	2	0	52	A	No Change
SR 165 north of DMC NB	100	B	2	0	102	A	No Change
SR 165 north of DMC SB	50	A	2	40	92	A	No Change
SR 152 west of DMC EB	1,350	B	2	40	1,392	B	No Change

Roadway	No Action (2026) Volume (AADT)	No Action LOS (2026)	Maximum Truck Trips	Maximum Worker Trips	Total Volume (2026) (AADT)	LOS (2026)	LOS Change
SR 152 west of DMC WB	1,150	A	2	0	1,152	A	No Change
SR 152 east of DMC EB	1,150	B	2	0	1,152	B	No Change
SR 152 east of DMC WB	1,000	B	2	40	1,042	B	No Change
SR 33 south of DMC NB	650	E	2	40	692	E	No Change
SR 33 south of DMC SB	400	C	2	0	402	C	No Change
SR 33 north of DMC NB	650	D	2	0	652	D	No Change
SR 33 north of DMC SB	400	C	2	40	442	C	No Change
I-5 at SR 152 NB	2,400	C	4	81	2,485	C	No Change
I-5 at SR 152 SB	2,150	C	4	81	2,235	C	No Change
Stanislaus County Area							
I-5 at SR 130 NB	3,000	D	5	121	3,126	D	No Change
I-5 at SR 130 SB	2,750	D	5	121	2,876	D	No Change
San Joaquin County/Tracy Area							
SR 132 east of DMC EB	1,200	A	1	0	1,201	A	No Change
SR 132 east of DMC WB	250	A	1	40	291	A	No Change
SR 132 west of DMC EB	1,450	B	1	40	1,491	B	No Change
SR 132 west of DMC WB	300	A	1	0	301	A	No Change
I-5 north of DMC NB	1,250	B	1	0	1,251	B	No Change
I-5 north of DMC SB	900	A	1	40	941	A	No Change
I-5 south of DMC NB	1,200	A	1	0	1,201	A	No Change
I-5 south of DMC SB	900	A	1	0	901	A	No Change

Roadway	No Action (2026) Volume (AADT)	No Action LOS (2026)	Maximum Truck Trips	Maximum Worker Trips	Total Volume (2026) (AADT)	LOS (2026)	LOS Change
I-205 west of DMC EB	5,350	E	1	40	5,391	E	No Change
I-205 west of DMC WB	2,650	B	1	0	2,651	B	No Change
I-205 east of DMC EB	4,300	B	1	0	4,301	B	No Change
I-205 east of DMC WB	2,150	A	1	40	2,191	A	No Change
Alameda County Area							
I-580 west of I-205/I-580 Split EB	3,700	B	1	40	3,741	B	No Change
I-580 west of I-205/I-580 Split WB	7,250	C	1	0	7,251	C	No Change

Key: AADT = annual average daily traffic; DMC = Delta-Mendota Canal; I = interstate; LOS = level of service; NB = northbound; SB = southbound; EB = eastbound; WB = westbound

L.5 Significance Criteria

Impacts related to traffic and transportation would be considered significant if they result in one or more of the following conditions or situations: (1) conflict with a program, plan, ordinance, or policy addressing the circulation system, including transit, roadway, bicycle, and pedestrian facilities; (2) increase traffic substantially in relation to the existing traffic load and capacity of the street system; (3) substantially increase hazards because of a geometric design feature or incompatible uses; or (4) result in inadequate emergency access. The significance criteria apply to all transportation systems that could be affected by the Project.

L.6 Project Impacts and Mitigation Measures

L.6.1 No Action Alternative

L.6.1.1 Conflict with a program plan, ordinance, or policy addressing the circulation system, including transit, roadway, bicycle and pedestrian facilities.

Under the No Action Alternative, no actions would be taken to restore, or otherwise offset, conveyance capacity lost in the DMC. No construction or changes to existing operations in the study area would occur. Therefore, this alternative would not conflict with the goals and objectives of any applicable programs, plans, ordinances, or policies in relevant jurisdictions that establish roadway performance standards. **There would be no impact under the No Action Alternative.**

L.6.1.2 Cause a substantial increase in traffic in relation to the existing traffic load and capacity of the street system.

Under the No Action Alternative, no actions would be taken to restore, or otherwise offset, conveyance capacity lost in the DMC. No construction or changes to existing operations in the study area would occur. Therefore, this alternative would not result in a substantial increase in traffic in relation to the existing traffic load and roadway capacity. **There would be no impact under the No Action Alternative**.

L.6.1.3 Substantially increase traffic hazards because of a geometric design feature or incompatible uses.

Under the No Action Alternative, no actions would be taken to restore, or otherwise offset, conveyance capacity lost in the DMC. Therefore, this alternative would not result in a substantial increase in traffic hazards. **There would be no impact under the No Action Alternative**.

L.6.1.4 Result in inadequate emergency access.

Under the No Action Alternative, no actions would be taken to restore, or otherwise offset, conveyance capacity lost in the DMC. Therefore, this alternative would not result in inadequate emergency access. **There would be no impact under the No Action Alternative**.

L.6.2 Proposed Action

L.6.2.1 Conflict with a program plan, ordinance, or policy addressing the circulation system, including transit, roadway, bicycle and pedestrian facilities.

Construction-related and operation-related traffic under the Proposed Action would not permanently alter transit services or the physical characteristics of the roadway system; therefore, it would not conflict with the goals and objectives of any applicable programs, plans, ordinances, or policies in relevant jurisdictions that establish roadway performance standards. **There would be no impact under the Proposed Action.**

L.6.2.2 Cause a substantial increase in traffic in relation to the existing traffic load and capacity of the street system.

For daily operations, the added construction-related trips would not change the LOS at any of the study roadway segments, except for I-5 at SR 130 in Stanislaus County. Even though LOS degrades at this location, it does not exceed Caltrans' threshold of significance (LOS D). For peak hour operations, the added construction-related trips would not change the LOS at any of the study roadway segments, except at the following locations: SR 33 north of DMC northbound and southbound in Fresno County. Even though LOS degrades at these locations, it does not exceed Caltrans' threshold of significance. Therefore, construction-related and operation-related traffic under the Proposed Action would not result in a substantial increase in traffic in relation to the existing traffic load and roadway capacity. **This impact would be less than significant**.

L.6.2.3 Substantially increase traffic hazards because of a geometric design feature or incompatible uses.

Construction equipment and construction worker vehicle trips under the Proposed Action would increase traffic hazards at key roadway segments and intersections close to the DMC crossings, including SR 33 in Fresno County, SR 165, SR 152, and SR 33 in Merced County, and SR 132 in San Joaquin County. **Therefore, construction of the Proposed Action would increase the potential for traffic hazards at roadways segments and intersections, resulting in a potentially significant impact**. With implementation of Mitigation Measure (MM) TR-1, described in Section L.6.4, a temporary traffic control plan would be developed, which would outline that signage at roadways and intersections identified as dangerous would be installed warning motorists of slow-moving construction traffic and lane closures. In addition, traffic controls like flaggers or temporary traffic lights would be installed where construction equipment will be entering roadways to reduce conflicts during periods of high traffic volume in and around each construction site. **As such, potential traffic hazard impacts under the Proposed Action would be less than significant after mitigation.**

L.6.2.4 Result in inadequate emergency access.

Construction traffic has the potential to limit or slow this emergency access. Therefore, construction of the Proposed Action would potentially conflict with emergency vehicles, resulting in a significant impact. With implementation of MM TR-1, described in Section L.6.3, construction contractors must implement dust abatement and perform proper construction traffic management actions, including signage warning motorists of construction activity and traffic controls like flaggers or temporary traffic lights where construction equipment will be entering roadways, to avoid conflicts with emergency responders entering and existing the area during an emergency. As such, traffic emergency access impacts under the Proposed Action would be less than significant.

L.6.3 Mitigation Measures

MM TR-1: Develop a Temporary Traffic Control Plan. The following construction management actions will be documented in a temporary traffic control plan developed by the contractor as a requirement that will be included in its construction contract. The temporary traffic control plan will be submitted for Caltrans' review and approval during the Encroachment Permit process.

Construction contractors will install signage at roadways and intersections identified as dangerous in accordance with the California Manual on Uniform Traffic Control Devices guidelines warning motorists of slow-moving construction traffic and lane closures. Signage must also be posted at these locations one month in advance to allow motorists time to plan for delays or alternate routes.

Construction contractors must implement dust abatement and perform proper construction traffic management actions, including signage warning motorists of construction activity and traffic controls like flaggers or temporary traffic lights where construction equipment will be entering roadways, to reduce conflicts during periods of high traffic volume in and around each construction site and to avoid conflicts with emergency responders entering and existing the area during an emergency.

In addition to the temporary traffic control plan, before the initiation of any construction actions, construction contractors must develop and adhere to a health and safety plan outlining all applicable Occupational Safety and Health Administration requirements, and important traffic safety plans, including identification of emergency access routes in and through construction areas that would still need to be kept clear at all times during construction. The health and safety plan must include coordination with emergency service personnel to ensure adequate mitigation for all impacts.

L.7 References

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Delta-Mendota Canal Subsidence Correction Project Environmental Assessment/Initial Study

Appendix M: Biological Survey Report

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Appendix M Biological Survey Report

This appendix documents the biological resources technical analysis conducted to support the impact analysis presented in the Environmental Assessment/Initial Study (EA/IS). The analysis describes the biological resources that could be potentially affected by the implementation of the Proposed Action/Proposed Project (subsequently identified as the Proposed Action) considered in the EA/IS, provides an evaluation of potential impacts on those biological resources from construction and operation of the Proposed Action, and outlines the mitigation measures to be implemented to avoid or minimize impacts on biological resources.

M.1 Existing Conditions

A biological survey report (BSR) was prepared to identify special-status species and other sensitive biological resources that may occur in or near the Study Area (Attachment 1). The BSR presents findings from desktop research and field surveys conducted between March 31 and April 22, 2022; documents the potential for the occurrence of special-status plant and wildlife species protected by the federal and/or state governments within the study area and provides landscape-level reconnaissance mapping of vegetation and habitats. The existing conditions descriptions included in subsequent sections are summarized from the detailed information presented in the BSR.

The Study Area considered in the BSR is consistent with the Project area being evaluated for the biological resources analysis presented in this appendix. The study area (hereafter referred to as the Project area) includes approximately 5,461 acres along the Delta-Mendota Canal (DMC) alignment between the C.W. "Bill" Jones Pumping Plant (Jones Pumping Plant) at Mile 2.68 at Kelso Road near the northern end of the canal and the outlet at the Mendota Pool at Mile 116.48, the southern terminus of the canal. The northernmost segment between the Tracy Fish Facility and Kelso Road will not be affected by the Proposed Action under consideration, including related construction access or staging, and is therefore excluded from the Project area. Along the length of the DMC alignment, the Project area includes the inner canal banks, which are concrete-lined in certain areas and earthen-lined in others, the operations and maintenance access roads, the wetted channel of the canal itself, the outer embankment of the canal, and infrastructure, including bridges, overchutes, pipe crossings, culverts, and tunnels. In most areas along the length of the Project area, a portion of the adjacent land that lies at the toe of the outer canal embankment is also included.

At locations where streams or ditches cross over or under the canal at culverts, the Project area includes the area within the stream or ditch for 100 feet in both the upstream and downstream directions from the culvert wingwall. In addition, the Project area includes sections where the canal transitions to underground siphon or conveyance piping.

M.1.1 Existing Land Uses and Habitat Types

Habitat types mapped within the Project area include agriculture, annual grassland, alkaline emergent wetland, freshwater emergent wetland, freshwater forested wetland, intermittent stream channels, irrigation canals, maintained agricultural ditches and drainage features, ponds, riparian woodland, ruderal/developed, as well as riverine and emergent wetland within the channel of the DMC itself (identified as "DMC – Riverine" and "DMC - Freshwater Emergent Wetland" respectively). The acreage of each habitat type within the Project area and its classification as a sensitive habitat is

summarized in Table M-1. Sensitive habitats include riparian corridors, wetlands, habitats for legally protected species, areas of high biological diversity, areas supporting rare or special-status wildlife habitat, and unusual or regionally restricted habitat types. The habitats within the channel of the DMC itself (i.e., DMC – Riverine and DMC - Freshwater Emergent Wetland) are characterized by marginal conditions and generally demonstrate minimal emergent vegetative cover typically consisting of a narrow band of floating water primrose (*Ludwigia peploides*) along the canal edges. As such, areas within the DMC itself lack suitable habitat for special status species, and thus are not considered sensitive habitats.

Table M-1. Summary of Habitat Types by Area

Habitat Type	Area Sum (Acres)	Sensitive
Agriculture	284	
Annual Grassland	770	
Alkaline Emergent Wetland	7	X
Freshwater Emergent Wetland	21	X
Freshwater Forested Wetland	2	X
Intermittent Channel	10	X
Irrigation Canal	7	
Maintained Agriculture Ditches and Drainage Features	109	X
Pond	1	X
Riparian Woodland	1	X
Ruderal/Developed	2,667	
DMC - Riverine	1,527	
DMC - Freshwater Emergent Wetland	55	
Total	5,461	

Vegetation types considered sensitive include those identified as sensitive on the *California Natural Communities List* (i.e., those habitats that are rare or endangered within the borders of California) (California Department of Fish and Wildlife [CDFW] 2022a) and those that are occupied by species listed under the federal Endangered Species Act (ESA) or are designated critical habitat in accordance with ESA. Critical Habitat Mapping Unit CCS-2B for the California red-legged frog (*Rana draytonii*) lies immediately west of the Project area and overlaps a narrow approximately 0.6-acre section of the Project area along the west side of the canal between Kelso Road and Mountain House Road (U.S. Fish and Wildlife Service [USFWS] 2022). Mapping Unit (59 FR 65256 65279) for Delta smelt (*Hypomesus transpacificus*) designated by USFWS on January 18, 1995, lies north of, and also overlaps portions of the Project area between Mountain House Road and the Tracy Fish Facility.

Specific habitats may also be identified as sensitive in city or county general plans or ordinances. Sensitive habitats are regulated under federal regulations (such as the Clean Water Act [CWA] and Executive Order 11990 – Protection of Wetlands), state regulations (such as the California Environmental Quality Act [CEQA] and the CDFW Streambed Alteration Program), or local ordinances or policies (such as city or county tree ordinances and general plan policies).

The locations and areal extents of habitat types occurring within the Project area are depicted in Figure E, *Habitat Types*, in Attachment 1, and a discussion of each habitat type is included in Section 4.1 of Attachment 1.

M.1.2 Special-Status Species

Published occurrence data within the Project area and surrounding United States Geological Survey (USGS) quadrangles were evaluated to compile a table of special-status species known to occur in the vicinity of the Project area, as described in Section 4 of Attachment 1. Special-status species are defined as those plants and animals that are legally protected under the ESA, the California Endangered Species Act (CESA), or other regulations; and species that are considered sufficiently rare by the scientific community to qualify for such listing. Each special-status species known to occur in the vicinity of the Project area was evaluated for their likelihood to occur within and immediately adjacent to the Project area. Based on existing habitat conditions, species-specific habitat requirements, known occurrence records, and/or direct observations recorded during biological surveys, a total of 54 special-status species were identified has having the potential to occur in the Project area as summarized in Table M-2. Further information regarding the historical and current ranges, habitat preferences, and life histories of these species is provided in Section 4.3 of Attachment 1. All other special-status species evaluated are not expected to occur in the Project area based on the species-specific rationale presented in Attachment B of Attachment 1. Those species not expected to occur are therefore not expected to be impacted by the Proposed Action considered and are not discussed further. Special-status fish species that occur in the vicinity of the Project area are noted in Attachment B of Attachment 1 but are presumed absent from the Project area because the Project area is located downstream of the Tracy Fish Facility, which prevents fish from entering the DMC from the southern Delta.

Table M-2. Special-Status Wildlife Species with Potential to Occur in the Project Area

Species	Status (USFWS/CDFW/CNPS)	General Habitat	Potential Occurrence within Project Area
MAMMALS			
Antrozous pallidus Pallid bat	-- / CSC / --	Occurs in a wide variety of habitats including grasslands, shrublands, arid desert areas, oak savanna, coastal forested areas, and coniferous forests of the mountain regions of California. Most common in open, dry habitats with rocky areas for roosting. Day roosts include caves, crevices, mines, and occasionally hollow trees and buildings. Seems to prefer rocky outcrops, cliffs, and crevices with access to open habitats for foraging. Similar structures are used for night roosting and will also use more open sites such as eaves, awnings, and open areas under bridges for feeding roosts.	**Moderate:** Suitable foraging habitat is present in the Project area. This species has the potential to use bridges and other canal infrastructure for roosting. There are no California Natural Diversity Database (CNDDB) occurrences reported within 3.1 miles of the Project area.
Corynorhinus townsendii Townsend's big-eared bat	-- / CSC / --	Found primarily in rural settings from inland deserts to coastal redwoods, oak woodland of the inner Coast Ranges and Sierra foothills, and low to mid-elevation mixed coniferous-deciduous forests. Typically roost during the day in limestone caves, lava tubes, and mines, but can roost in buildings that offer suitable conditions. Night roosts are in more open settings and include bridges, rock crevices, and trees.	**Moderate:** Suitable foraging habitat is present in the Project area. This species has the potential to use bridges and other canal infrastructure for roosting. There are no CNDDB occurrences reported within 3.1 miles of the Project area.
Eumops perotis californicus Western mastiff bat	-- / CSC / --	Many open habitats including conifer and deciduous woodlands, coastal scrub, grassland, and chaparral. Roost in crevices in cliff faces, high buildings, trees, and tunnels.	**Moderate:** Suitable grassland and woodland foraging habitat is present within the Project area. This species has the potential to use bridges and other canal infrastructure for roosting. One CNDDB occurrence is recorded within 3.1 miles of the Project area, dated 1911.

Species	Status (USFWS/CDFW/CNPS)	General Habitat	Potential Occurrence within Project Area
Lasiurus blossevilii Western red bat	-- / CSC / --	Roosting habitat includes trees and sometimes shrubs in forests and woodlands from sea level up through mixed conifer forests. Roost sites are often in edge habitats adjacent to streams, fields, or urban areas. Feeds over a wide variety of habitats, including grasslands, shrublands, open woodlands and forests, and croplands.	**Moderate:** Suitable foraging habitat is present in the Project area. This species has the potential to use bridges and other canal infrastructure for roosting. One CNDDB record was recorded within 3.1 miles of the Project area, dated 1999.
Taxidea taxus American badger	-- / CSC / --	Dry, open grasslands, fields, pastures savannas, and mountain meadows near timberline are preferred. The principal requirements seem to be sufficient food, friable soils, and relatively open, uncultivated grounds.	**Moderate:** Suitable grassland, field, and pasture habitats are present within the Project area. There are 19 CNDDB occurrences reported within 3.1 miles of the Project area. There is one CNDDB occurrence reported within 1 mile of the Project area dated 2007.
Vulpes macrotis mutica San Joaquin Kit Fox	FE / ST / --	Open, level areas with loose-textured soils supporting scattered, shrubby vegetation with little human disturbance. Live in annual grasslands or grassy open stages dominated by scattered brush, shrubs, and scrub.	**Moderate:** Suitable grassland foraging habitat is present within and adjacent to the Project area. Potential prey is present, and burrows of suitable size were observed within the Project area. There are 57 CNDDB occurrences reported within 3.1 miles of the Project area. There are 25 CNDDB occurrences reported within 1 mile of the Project area, the most recent dated 2004.
BIRDS			
Agelaius tricolor Tricolored Blackbird	-- / ST&CSC / --	Nest in colonies in dense riparian vegetation, along rivers, lagoons, lakes, and ponds. Forages over grassland or aquatic habitats.	**Moderate (nesting):** Limited suitable riparian habitat is present within the Project area. There are 32 CNDDB occurrences reported within 3.1 miles of the Project area, the most recent is dated 2015.

Species	Status (USFWS/CDFW/CNPS)	General Habitat	Potential Occurrence within Project Area
Ammodramus savannarum Grasshopper Sparrow	-- / CSC / --	Open fields, grassland, hayfields, and prairies.	**Moderate:** Suitable grassland and open pasture habitat is present within the Project area. The Project area is within the species' known breeding range. There are no CNDDB occurrences reported within 3.1 miles of the Project area.
Aquila chrysaetos Golden Eagle	--/ CFP / --	Use rolling foothills, mountain terrain, wide arid plateaus deeply cut by streams and canyons, open mountain slopes, cliffs, and rocky outcrops. Nest in secluded cliffs with overhanging ledges as well as large trees.	**Moderate (nesting):** Suitable foothill grassland habitat is present within the Project area, but little nesting habitat was observed. This species was observed in flight during the April 2022 reconnaissance-level surveys.
Asio flammeus Short-Eared Owl	-- / CSC / --	Usually found in open areas with few trees, such as annual and perennial grasslands, prairies, meadows, dunes, irrigated lands, and saline and freshwater emergent marshes. Dense vegetation is required for roosting and nesting cover. This includes tall grasses, brush, ditches, and wetlands. Open, treeless areas containing elevated sites for perching, such as fence posts or small mounds, are also needed. Some individuals breed in northern California.	**Moderate (nesting):** Suitable grassland, pasture, and wetland habitats are present within the Project area. The Project area is within the species' known breeding range. There are no CNDDB occurrences reported within 3.1 miles of the Project area.
Athene cunicularia Burrowing Owl	-- / CSC / --	Year-round resident of open, dry grassland and desert habitats, and in grass, forb and open shrub stages of pinyon-juniper and ponderosa pine habitats. Frequent open grasslands and shrublands with perches and burrows. Use rodent burrows (often California ground squirrel) for roosting and nesting cover. Pipes, culverts, and nest boxes may be substituted for burrows in areas where burrows are not available.	**High:** Suitable open grassland habitat is present within and adjacent to the Project area. Presence of ground squirrel burrows provide suitable nesting habitat. There are 69 CNDDB occurrences reported within 3.1 miles of the Project area and 29 occurrences within one mile of the Project area.

Species	Status (USFWS/CDFW/CNPS)	General Habitat	Potential Occurrence within Project Area
Buteo swainsoni Swainson's Hawk	-- / ST / --	Generally found associated with plains, range, open hills, and sparse trees. Suitable nesting habitat includes trees within mature riparian forest or corridors, lone oak trees and oak groves, and mature roadside trees. Nest sites are generally adjacent to, or within easy flying distance to suitable foraging habitat that provides available prey resources. Within California, the majority of breeding for this species occurs within the Central Valley.	**Moderate (nesting):** This species was observed during the April 2022 surveys soaring above grassland and agricultural habitats. Suitable foraging and nest sites are present within the Project area. The Project area is within the known range of this species.
Circus hudsonius Northern Harrier	-- / CSC / --	Generally found in flat open areas with tall, dense grasses, shrubs, and edges for cover and breeding. Use tall grasses in wetlands or at wetland borders for nesting.	**Moderate (nesting):** This species was observed in flight during the April 2022 surveys. Suitable grassland foraging habitat is present within the Project area and limited wetland nesting habitat is present.
Elanus leucurus White-Tailed Kite	-- / CFP / --	Open groves, river valleys, marshes, and grasslands. Prefer such area with low roosts (fences etc.). Nest in shrubs and trees adjacent to grasslands.	**Moderate (nesting):** Suitable foraging and nesting habitat is present within the Project area. The Project area is within the known range of this species.
Lanius ludovicianus Loggerhead Shrike	-- / CSC / --	Resident in dry open grasslands and agricultural areas.	**Moderate (nesting):** Suitable foraging habitat is present within the Project area; limited nesting habitat was observed. The Project area is within the known breeding range for this species. There are two CNDDB occurrences within 3.1 miles of the Project area, the most recent dated 2005.

Species	Status (USFWS/CDFW/CNPS)	General Habitat	Potential Occurrence within Project Area
Melospiza melodia Song Sparrow ("Modesto" population)	-- / CSC / --	A common resident of most of California, except in higher mountains and southern deserts. Prefers riparian, fresh or saline emergent wetland, and wet meadows at all seasons. Breeds in riparian thickets of willows, other shrubs, vines, and tall herbs, and in fresh or saline emergent vegetation. In northern California also breeds in damp thickets and coastal scrub where fog drip and a moist climate compensate for a lack of surface water. Usually avoids densely wooded habitats, except along edges.	**Moderate (nesting):** Suitable wetland foraging and nesting habitat is present within the Project area. The Project area is within the known yearlong range for this species.
Xanthocephalus Yellow-Headed Blackbird	-- / CSC / --	Found in freshwater marshes and sloughs, fields, and open pastures. Breeds in freshwater sloughs, marshy lake borders, tall cattails growing in water up to 3-4' deep.	**Moderate (nesting):** Suitable foraging and nesting habitat is present within the Project area. The Project area is within the known range for this species. There are no CNDDB occurrences reported within 3.1 miles of the Project area.
AMPHIBIANS			
Ambystoma californiense California Tiger Salamander - Central California DPS	FT / ST / --	Annual grassland and grassy understory of valley-foothill hardwood habitats in central and northern California. Need underground refuges and vernal pools or other seasonal water sources.	**Moderate:** Suitable upland and breeding habitat is present within and adjacent to the Project area. The Project area is within the known range of this species. There are five CNDDB occurrences reported within 1.3 miles of the Project area, the most recent dated 2016.

Species	Status (USFWS/CDFW/CNPS)	General Habitat	Potential Occurrence within Project Area
Rana draytonii California red-legged frog	FT / CSC / --	Lowlands and foothills in or near permanent or late-season sources of deep water with dense, shrubby, or emergent riparian vegetation. During late summer or fall adults are known to use a variety of upland habitats with leaf litter or mammal burrows.	**Moderate:** Suitable upland and breeding habitat is present within and adjacent to the Project area. There are 48 CNDDB occurrences reported within 3.1 miles of the Project area and 11 occurrences within one mile of the Project area, the most recent dated 2017.
Spea hammondii Western spadefoot toad	-- / CSC / --	Grasslands with shallow temporary pools are optimal habitats for the western spadefoot. Occur primarily in grassland habitats but can be found in valley and foothill woodlands. Vernal pools are essential for breeding and egg laying.	**Moderate:** Potential ephemeral pool breeding habitat was observed in the Project area. The Project area is within the known range of this species.
REPTILES			
Anniella pulchra Northern California legless lizard	-- / CSC / --	Requires moist, warm habitats with loose soil for burrowing and prostrate plant cover, often forages in leaf litter at plant bases; may be found on beaches, sandy washes, and in woodland, chaparral, and riparian areas.	**Moderate:** The Project area is within the known range of this species. There are no CNDDB occurrences reported within 3.1 miles of the Project area. Suitable habitat may occur within sandy washes where shrubs and leaf litter are present.
Arizona elegans occidentalis California glossy snake	-- / CSC / --	Inhabits arid scrub, rocky washes, grasslands, chaparral. Appears to prefer microhabitats of open areas and areas with soil loose enough for easy burrowing.	**Moderate:** Suitable foraging and burrowing habitat is present within the Project area. The Project area is within the known range for this species. There are three CNDDB occurrences reported within 3.1 miles of the Project area, the most recent dated 1986.

Species	Status (USFWS/CDFW/CNPS)	General Habitat	Potential Occurrence within Project Area
Emys marmorata Western pond turtle	-- / CSC / --	Associated with permanent or nearly permanent water in a wide variety of habitats including streams, lakes, ponds, irrigation ditches, etc. Require basking sites such as partially submerged logs, rocks, mats of vegetation, or open banks.	**Present:** This species was observed in an intermittent channel just south of Mountain House Road. Other freshwater habitats such as ponds and irrigation ditches are present in the Project area and could provide habitat for this species.
Masticophis flagellum ruddocki San Joaquin whipsnake	-- / CSC / --	Variety of habitats-deserts, scrub land, juniper-grassland, woodland, thorn forest, and farmland. Generally avoid dense vegetation. Ranges from Arbuckle in the Sacramento southward to the Grapevine in the Kern County portion of the San Joaquin Valley and westward into the inner South Coast Ranges. An isolated population also occurs in the Sutter Buttes.	**Moderate:** Suitable habitat is present within the Project area. The Project area is within the known range of this species. There are eight CNDDB occurrences reported within 3.1 miles of the Project area, the most recent dated 2004.
Phrynosoma blainvillii Coast horned lizard	-- / CSC / --	Associated with open patches of sandy soils in washes, chaparral, scrub, and grasslands.	**Moderate:** Limited suitable habitat is present in the Project area. The Project area is within the known range for this species. There are four CNDDB occurrences reported within 3.1 miles of the Project area, the most recent dated 1992.
Thamnophis gigas Giant garter snake	FT / ST / --	Essential habitat components include adequate water during early spring through mid-fall, emergent, herbaceous wetland vegetation (e.g., cattail and bulrush), grassy banks and opening in waterside vegetation, and higher elevation upland for refuge from flood waters in the winter.	**Moderate:** Limited suitable aquatic foraging habitat was observed within the Project area. The Project area is within the known range of this species.

Species	Status (USFWS/CDFW/CNPS)	General Habitat	Potential Occurrence within Project Area
INVERTEBRATES			
Bombus crotchii Crotch bumble bee	-- / SC / --	Grasslands and upland scrub that contain requisite habitat elements including suitable nesting sites, floral resources, and overwintering sites for queens.	**Moderate:** The Project area is within the known species range. Potentially suitable annual grassland habitat is present throughout the Project area. However, existing grassland habitats are fragmented and highly degraded because of regular maintenance to control weedy vegetation. There are three occurrences reported within 3.1 miles of the Project area, all of which were recorded prior to 1960. Despite the marginal nature of existing grassland habitats and the lack of recent occurrences documented in the vicinity, the Crotch bumble bee is conservatively considered to have moderate potential to occur within the Project area where potentially suitable habitats are present.
Branchinecta longiantenna Longhorn fairy shrimp	FE / -- / --	Require ephemeral pools with no flow. Restricted distribution; Eastern edge of the Central Coast Mountains Region. Require ephemeral pools, typically associated with clear to turbid, clay and grass-bottomed pools.	**Moderate:** Limited ephemeral pool habitat was observed in the Project area. There is one CNDDB occurrence reported within 3.1 miles of the Project area.
Branchinecta lynchi Vernal pool fairy shrimp	FT / -- / --	Require ephemeral pools with no flow. Associated with vernal pool/grasslands from near Red Bluff (Shasta County), through the central valley, and into the South Coast Mountains Region. Require ephemeral pools with no flow.	**Moderate:** The Project area is within the known species range. Potential ephemeral pool, ditch and pond habitat was observed in the Project area.

Species	Status (USFWS/CDFW/CNPS)	General Habitat	Potential Occurrence within Project Area
Lepidurus packardi Vernal pool tadpole shrimp	FE / -- / --	Endemic to vernal pools in grasslands of the Central Valley, Central Coast mountains, and South Coast mountains.	**Moderate:** The Project area is within the known species range. Potential ephemeral pool, ditch, alkaline wetland, and pond habitat was observed in the Project area.
PLANTS			
Astragalus tener var. tener Alkali milk-vetch	-- / -- / 1B	Playas, valley and foothill grassland on adobe clay, and vernal pools on alkaline soils at elevations of approximately 3-200 feet. Annual herb in the Fabaceae family; blooms March-June.	**Moderate:** Suitable grassland and alkaline habitats are present within the Project area.
Atriplex cordulata var. cordulata Heartscale	-- / -- / 1B	Chenopod scrub, meadows and seeps, and (sandy) valley and foothill grassland on saline or alkaline soils, at elevations of approximately 0-1,840 feet. Annual herb in the Chenopodiaceae family; blooms April-October.	**Moderate:** Suitable grassland and alkaline habitats are present within the Project area.
Atriplex coronata var. vallicola Lost Hills crownscale	-- / -- / 1B	Chenopod scrub, valley and foothill grasslands, and vernal pools on alkaline soils at elevations of approximately 164-2,085 feet. Annual herb in the Chenopodiaceae family; blooms April-September.	**Moderate:** Suitable grassland and alkaline habitats are present within the Project area.
Atriplex depressa Brittlescale	-- / -- / 1B	Chenopod scrub, meadows and seeps, playas, valley and foothill grassland, and vernal pools on alkali scalds or clay soils at elevations of approximately 3-1,050 feet. Annual herb in the Chenopodiaceae family; blooms April-October.	**Moderate:** Suitable grassland and alkaline habitats are present within the Project area. The Project area is near the edge of the limited range of this species.
Atriplex minuscula Lesser saltscale	-- / -- / 1B	Chenopod scrub, playas, and valley and foothill grassland on alkali or sandy soils at elevations of approximately 50-660 feet. Annual herb in the Chenopodiaceae family; blooms May-October.	**Moderate:** Suitable grassland and alkaline habitats are present within the Project area. The Project area is near the edge of the limited range of this species.

Species	Status (USFWS/CDFW/CNPS)	General Habitat	Potential Occurrence within Project Area
Atriplex persistens Vernal pool smallscale	-- / -- / 1B	Usually occurs in wetlands and alkaline vernal pools up to approximately 380 feet in elevation, occasionally occurs in non-wetlands. Annual herb in the Chenopodiaceae family; blooms June-October.	**Moderate:** Suitable grassland and alkaline habitats are present within the Project area. The Project area is near the edge of the limited range of this species.
Atriplex subtilis Subtle orache	-- / -- / 1B	Valley, foothill grassland, and saline depressions up to approximately 230 feet in elevation. Annual herb in the Chenopodiaceae family; blooms June-October.	**Moderate:** Suitable grassland and alkaline habitats are present within the Project area. The Project area is near the edge of the limited range of this species.
Blepharizonia plumosa Big tarplant	-- / -- / 1B	Valley and foothill grassland at elevations of approximately 98-1,660 feet. Annual herb in the Asteraceae family; blooms July-October.	**Moderate:** Suitable grassland habitat is present within the Project area.
Caulanthus lemmonii Lemmon's jewel flower	-- / -- / 1B	Open, grassy areas on hillside slopes and in fields, canyons, and arroyos. Soils include alkaline soils, shaley clay, sandstone talus, and decomposed serpentine. Predominantly found within valley and foothill grassland and occasionally in pinyon and juniper woodland at elevations of approximately 260-4,010 feet. Annual herb in the Brassicaceae family; blooms March-May.	**Moderate:** Suitable grassland and alkaline habitats are present within the Project area. There are no serpentine soils or talus slopes observed within the Project area.
Chloropyron molle ssp. hispidum Hispid salty bird's-beak	-- / -- / 1B	Meadows, seeps, playas, and valley and foothill grassland on alkaline soils at elevations of 1-155 meters. Annual hemiparasitic herb in the Orobanchaceae family; blooms June-September.	**Moderate:** The Project area is near the edge of the limited range of this species. Suitable grassland and alkaline habitats are present within the Project area.
Delphinium recurvatum Recurved larkspur	-- / -- / 1B	Chenopod scrub, cismontane woodlands, and valley and foothill grasslands on alkaline soils at elevations of approximately 3-2,500 feet. Perennial herb in the Ranunculaceae family; blooms March-June.	**Moderate:** The Project area is near the edge of the limited range of this species. Suitable grassland and alkaline habitats are present within the Project area.

Species	Status (USFWS/CDFW/CNPS)	General Habitat	Potential Occurrence within Project Area
Eryngium spinosepalum Spiny-sepaled button-celery	-- / -- / 1B	Valley and foothill grassland and vernal pools at elevations of approximately 260-3,200 feet. Annual/perennial herb in the Apiaceae family; blooms April-June.	**Moderate:** The Project area is near the edge of the limited range of this species. Suitable grassland habitats are present within the Project area.
Eschscholzia rhombipetala Diamond-petaled California poppy	-- / -- / 1B	Valley and foothill grassland on alkaline and clay soils at elevations of approximately 0-3,200 feet. Annual herb in the Papaveraceae family; blooms March-April.	**Moderate:** The Project area is near the edge of the limited range of this species. Suitable grassland and alkaline habitats are present within the Project area.
Extriplex joaquiniana San Joaquin spearscale	-- / -- / 1B	Meadows and seeps, playas, chenopod scrub, and valley and foothill grassland on alkaline soils at elevations of approximately 3-2,740 feet. Annual herb in the Chenopodiaceae family; blooms April-October.	**Moderate:** The Project area is near the edge of the limited range of this species. Suitable grassland and alkaline habitats are present within the Project area.
Hibiscus lasiocarpus var. occidentalis Wooly rose-mallow	-- / -- / 1B	Freshwater marshes, swamps at elevations of approximately 0-395 feet. Perennial rhizomatous herb in the Malvaceae family; blooms June-September.	**Moderate:** The Project area is near the southern edge of the known range of this species. Limited wetland habitats are present within the Project area.
Layia munzii Munz's tidy-tips	-- / -- / 1B	Chenopod scrub and valley and foothill grasslands on alkaline clay soils at elevations of approximately 490-2,300 feet. Annual herb in the Asteraceae family; blooms March-April.	**Moderate:** Suitable grassland and alkaline habitats are present within the Project area. There are two CNDDB occurrences reported within one mile of the Project area.
Lepidium jaredii ssp. album Panoche pepper-grass	-- / -- / 1B	Valley and foothill grassland in clay soils on steep slopes at elevations of approximately 610-905 feet. Annual herb in the Brassicaceae family; blooms February-June.	**Moderate:** The Project area is near the eastern edge of this species' known range. Suitable valley grassland habitat is present within the Project area.
Navarretia nigelliformis ssp. radians Shining navarretia	-- / -- / 1B	Cismontane woodland, valley and foothill grasslands, and vernal pools at elevations of approximately 250-3,280 feet. Annual herb in the Polemoniaceae family; blooms April-July.	**Moderate:** The Project area is near the edge of this species' known range. Suitable valley grassland habitat is present within the Project area.

Species	Status (USFWS/CDFW/CNPS)	General Habitat	Potential Occurrence within Project Area
Navarretia prostrata Prostrate vernal pool navarretia	-- / -- / 1B	Meadows, seeps, vernal pools, and mesic areas of coastal scrub and valley and foothill grassland at elevations of approximately 50-6,925 feet. Annual herb in the Polemoniaceae family; blooms April-July.	**Moderate:** The Project area is near the edge of this species' known range. Suitable valley grassland and wetland habitats are present within the Project area.
Puccinellia simplex California alkali grass	-- / -- / 1B	Valley and foothill grasslands, chenopod scrub, meadows and seeps, and vernal pools. Found in alkaline, vernally mesic, sinks, flats, and lake margins. Occurs at elevations of approximately 7-3,050 feet. Annual herb in the Poaceae family; blooms March-May.	**Moderate:** Suitable grassland and alkaline habitats are present within the Project area. There are two CNDDB occurrences reported within five kilometers of the Project area, the most recent dated 2006.
Sagittaria sanfordii Sanford's arrowhead	-- / -- / 1B	Freshwater wetlands and ponds up to approximately 985 feet in elevation. Perennial herb in the Alismataceae family; blooms May-October.	**Moderate:** Limited freshwater wetland habitat is present within the Project area. There is one CNDDB occurrence within one mile of the Project area, dated 1980.
Spergularia macrotheca var. longistyla long-styled sand-spurrey	-- / -- / 1B	Meadows, seeps, marshes, and swamps in alkaline soils at elevations approximately 0-840 feet. Perennial herb in the Caryophyllaceae family; blooms February-May.	**Moderate:** The Project area is near the eastern edge of this species' known range. Limited alkaline wetland habitat is present within the Project area.
Trichocoronis wrightii var. wrightii Wright's trichocoronis	-- / -- / 2B	Riparian, meadows, marsh, and vernal-pools habitats up to approximately 1,640 feet in elevation. Annual herb in the Asteraceae family; blooms May-September.	**Moderate:** The Project area is near the edge of this species' known range. Limited suitable wetland habitat is present within the Project area.
Tropidocarpum capparideum Caper-fruited tropidocarpum	-- / -- / 1B	Alkaline hills in valley and foothill grassland at elevations of 3-1,495 feet. Annual herb in the Brassicaceae family; blooms March-April.	**Moderate:** Limited suitable habitat is present within the Project area. There is one recent CNDDB occurrence within five kilometers of the Project area dated 2019.

Sources: California Native Plant Society (CNPS) 2022; Calflora 2022; CDFW 2022b; Jepson 2022

STATUS DEFINITIONS

Federal

FE = listed as Endangered under the federal Endangered Species Act

FT = listed as Threatened under the federal Endangered Species Act

FC = Candidate for listing under the federal Endangered Species Act
UR = Species that have been petitioned for listing under the ESA and for which a 90 day and/or 12 Month finding has not been published in the Federal Register, as well as species being reviewed through the candidate process but the CNOR has not yet been signed
-- = no listing

State

SE = listed as Endangered under the California Endangered Species Act
ST = listed as Threatened under the California Endangered Species Act
SC = Candidate for listing under California Endangered Species Act
SR = listed as Rare under the California Endangered Species Act
CFP = California Fully Protected Species
CSC = CDFW Species of Concern
-- = no listing
CNPS = California Native Plant Society
1B = California Rare Plant Rank 1B species; plants rare, threatened, or endangered in California and elsewhere
2B = California Rare Plant Rank 2B species; plants rare, threatened, or endangered in California, but more common elsewhere
-- = no listing

POTENTIAL TO OCCUR

Present = known occurrence of species within the Project area; presence of suitable habitat conditions; or observed during field surveys
High = known occurrence of species in the vicinity from the CNDDB or other documentation; presence of suitable habitat conditions
Moderate = known occurrence of species in the vicinity from the CNDDB or other documentation; presence of marginal habitat conditions within the Project area

M.2 Assessment Methodology

The impact analysis for biological resources was conducted by evaluating the potential for construction and/or operation of the Proposed Action to result in adverse effects on special-status species or sensitive habitats that would meet or exceed any of the significance criteria described below.

M.3 Significance Criteria

The significance criteria described below were developed in accordance with the CEQA Guidelines to determine the significance of potential impacts related to biological resources. Impacts would be significant if implementing the Proposed Action would:

- Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the CDFW, USFWS, or National Marine Fisheries Service (NMFS).
- Have a substantial adverse effect on any riparian habitat or other sensitive natural community or critical habitat identified in local or regional plans, policies, or regulations or by the CDFW, USFWS, or NMFS.
- Have a substantial adverse effect on state or federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means.
- Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors or impede the use of native wildlife nursery sites.
- Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance.

M.4 Project Impacts and Mitigation Measures

M.4.1 No Action/No Project Alternative

Under the No Action/No Project Alternative (subsequently identified as the No Action Alternative), no construction activities would occur and impacts on biological resources would remain similar to those experienced under existing conditions. Operations and maintenance activities would be similar to or would slightly increase over existing conditions as a result of increased effort required to address issues that may arise due to aging infrastructure. The Bureau of Reclamation (Reclamation) would continue to maintain the facilities in compliance with USFWS biological opinion titled *Formal Endangered Species Consultation on the Operations and Maintenance Program Occurring on Bureau of Reclamation Lands within the South-Central California Area Office* that was issued on February 17, 2005 (herein referred as 2005 USFWS biological opinion) (USFWS 2005), the 2019 USFWS and National Marine Fisheries Service (NMFS) Biological Opinions (USFWS 2019; NMFS 2019), the 2020 Reinitiation of Consultation on Long-Term Water Transfers Record of Decision (Reclamation 2020), and all future applicable biological opinions. Operations and maintenance of the DMC,

including minor construction and earth-moving activities, soil erosion control, and weed and pest control activities, would occur within the existing canal footprint and canal Right-of-Way (ROW) and would not result in significant impacts on biological resources.

Under the No Action Alternative, deficient bridges would be partially submerged when the canal is operated at the design flow. These deficient bridges provide potential roosting habitat for the three special-status bat species with the potential to occur in the Project area—pallid bat, Townsend's big-eared bat, and western mastiff bat. Reduction in roosting habitat would be localized and temporary, and any resultant adverse effects on these species would likely be short-term and minor**. Therefore, such impacts would be less than significant.**

M.4.2 Raise Deficient Structures Alternative (Proposed Action)

Under the Proposed Action, south-of-Delta exports are expected to increase compared to existing conditions, as operation of the DMC at design capacity would allow for the full use of Jones Pumping Plant. Increased south-of-Delta exports could impact biological resources through resultant changes to hydrodynamic conditions that could impact water quality conditions (e.g., salinity, temperature, total dissolved solids levels) in the central and southern Delta. However, south-of-Delta export rates that would occur as a consequence of the Proposed Action are within the range considered in the 2019 USFWS and NMFS Biological Opinions (USFWS 2019; NMFS 2019), and thus, are already addressed by the terms and conditions specified in these documents. Furthermore, operation and maintenance of the Proposed Action would be conducted in accordance with all relevant existing or future regulatory requirements and the terms and conditions specified in all applicable future biological opinions. Additionally, operation of the Proposed Action could affect the water elevation (i.e., storage levels) at Lake Oroville, Folsom Lake, Shasta Reservoir, and San Luis Reservoir, which could impact biological resources occurring at these locations. However, the expected percentage change in storage levels at these reservoirs relative to existing conditions would be less than five percent across all water year types, as summarized in Table M-3 through Table M-6, which is within the range attributable to noise associated with the model outputs. **As such, the Proposed Action would have less than significant operational impacts on biological resources.**

Table M-3. Averaged Modeled Difference in Total Annual Storage at Lake Oroville between Existing Conditions and the Proposed Action by Water Year Type (1,000 acre-feet)

Sacramento River Water Year Type	Total Average Existing Conditions	Proposed Action	Difference from Existing Conditions	Percent Change
Wet	33,906	33,877	-29	0%
Above Normal	30,073	29,969	-104	0%
Below Normal	26,324	26,153	-170	-1%
Dry	21,439	21,358	-81	0%
Critical	16,552	16,411	-141	-1%
All	26,774	26,682	-92	0%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling. CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.

Table M-4. Averaged Modeled Difference in Total Annual Storage at Folsom Lake between Existing Conditions and the Proposed Action by Water Year Type (1,000 acre-feet)

Sacramento River Water Year Type	Total Average Existing Conditions	Proposed Action	Difference from Existing Conditions	Percent Change
Wet	8,598	8,564	-34	0%
Above Normal	8,018	7,985	-33	0%
Below Normal	7,872	7,777	-95	-1%
Dry	6,999	6,893	-106	-2%
Critical	5,411	5,295	-116	-2%
All	7,572	7,500	-72	-1%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling. CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.

Table M-5. Averaged Modeled Difference in Total Annual Storage at Shasta Reservoir between Existing Conditions and the Proposed Action by Water Year Type (1,000 acre-feet)

Sacramento River Water Year Type	Total Average Existing Conditions	Proposed Action	Difference from Existing Conditions	Percent Change
Wet	44,377	44,294	-84	0%
Above Normal	42,620	42,467	-154	0%
Below Normal	41,840	41,513	-327	-1%
Dry	39,215	38,685	-530	-1%
Critical	31,417	30,608	-809	-3%
All	40,657	40,318	-340	-1%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling. CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.

Table M-6. Averaged Modeled Difference in Total Annual Storage at San Luis Reservoir between Existing Conditions and the Proposed Action by Water Year Type (1,000 acre-feet)

Sacramento River Water Year Type	Total Average Existing Conditions	Proposed Action	Difference from Existing Conditions	Percent Change
Wet	14,898	15,037	139	1%
Above Normal	11,555	11,534	-21	0%
Below Normal	12,569	12,708	139	1%
Dry	11,176	11,245	69	1%
Critical	10,118	10,261	142	1%
All	12,495	12,595	101	1%

Notes: Modeling Period 1922-2003, Data results from CalSim II modeling. CalSim II model output includes minor fluctuations of up to five percent because of model assumptions and approaches.

M.4.2.1 Impact BIO-1: Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the CDFW, USFWS, or NMFS.

The Proposed Action would have potentially significant direct and indirect impacts on sensitive species under the jurisdiction of CDFW and/or USFWS. As described in the discussion of impacts on specific biological resources provided below, these impacts include the potential for direct injury, mortality, stress, or behavioral effects from construction noise and activity and indirect impacts such as increased risk of predation, increased competition, and reproductive failure from disturbance or loss of habitat. Estimated temporary and permanent impacts on existing habitat types within the Project area are presented in Table M-7.

Table M-7. Estimated Habitat Impacts Under the Proposed Action

Habitat Type	Temporary Impact (Acres)	Permanent Impact (Acres)
Agriculture	283.7	0.4
Annual Grassland	765.8	4.1
Alkaline Emergent Wetland	7.2	0
Freshwater Emergent Wetland	21.2	0
Freshwater Forested Wetland	2.1	0
Intermittent Channel	10.3	0
Irrigation Canal	6.7	0.1
Maintained Agriculture Ditches and Drainage Features	108.6	0.7
Pond	1.4	0
Riparian Woodland	1.4	0
Ruderal/Developed	2,624.9	41.7
DMC - Riverine	1,526.7	0
DMC - Freshwater Emergent Wetland	54.5	0
Total	5,414.5	47

Mitigation measures (MMs) BIO-1 through BIO-15 include the following requirements to avoid or minimize impacts to the extent practicable: pre-construction surveys for special-status plants and animals to determine the presence of these species, implementation of a biological resources monitoring and management plan, environmental awareness training for construction personnel, implementation of general (e.g., litter control, marking construction areas, and appropriate erosion control materials) and species-specific measures (e.g., avoidance buffers, modifying timing of construction activities, biological monitoring, and preservation of habitats). **With implementation of MMs BIO-1 through BIO-15, impacts on special-status species would be less than significant**.

Special-Status Plants

As summarized in Table M-2, 24 special-status plant species have the potential to occupy portions of the Project area where suitable habitats, such as annual grassland, alkaline and freshwater wetlands, and ponds are present. These habitats occur primarily along the landward edge of the DMC ROW where ground-disturbing activities, including clearing/grubbing for construction access and materials staging as well as expansion of the existing canal embankment footprint along sections where the embankment would be raised could impact suitable habitat for special-status plant species, as well as existing plants. No special-status plants were observed during the surveys conducted in 2022, and existing habitats within the Project area generally represent marginal growing conditions for special-status plants due to ongoing and historical anthropogenic disturbance. However, if special-status plants are present in areas that would be subject to ground disturbance such plants could be harmed or killed through interactions with construction equipment or personnel or through habitat modification resulting in decreased habitat suitability. **With the implementation of MM BIO-1, construction-related impacts on special-status plants would be less than significant.**

Special-Status Animals

Multiple special-status animals were observed during the April 2022 surveys, as described in Section 4.3.1 of Attachment 1, and ground-disturbing activities associated with the Proposed Action could have significant temporary and permanent impacts on special-status animal species if they are present in or immediately adjacent to the areas subject to ground disturbance. MM BIO-2 includes general measures that are intended to avoid or minimize potential impacts on all special-status animal species. **With the implementation of these measures, in addition to the species-specific measures described in Section M.4.3, potential impacts on all special-status animal species would be less than significant.**

Pallid Bat, Townsend's Big-Eared Bat, and Western Mastiff Bat

No special-status bat species were observed during the April 2022 surveys, but suitable grassland and open agricultural foraging habitat is present along the outer edges of the canal ROW and potential roost sites provided by trees and canal infrastructure (e.g., bridges) occur throughout the Project area. Because individuals are generally expected to readily avoid active work sites, direct impacts on bats are not expected when bats are not using a roost site as a maternity colony (i.e., a breeding roost used to bear and rear young). Bats may form maternity colonies in trees, bridges, and tunnels within the Project area. If a tree or piece of canal infrastructure is removed that contains an active bat maternity colony, such actions could lead to bat mortality or injury. Additionally, indirect impacts may occur from construction-related noise if a maternity colony is present in or adjacent to the Project area. Substantial noise disturbance could result in adults temporarily or permanently leaving the maternity colony. To minimize potential impacts on special-status bat species MM BIO-3 would be incorporated into the Proposed Action. **With the implementation of these measures, impacts on bats would be less than significant**.

American Badger

The Project area and surrounding grassland, where present, may provide badgers with suitable foraging habitat, potential prey, and friable soils for denning. Although no badgers were observed during the April 2022 surveys, multiple suitable-sized dens were observed along the banks of the canal and in surrounding annual grassland habitat. Therefore, construction activities may lead to reproductive failure in badgers within or immediately adjacent to the Project area by disrupting

foraging activities and precluding the formation of natal dens. Additionally, direct disturbance from construction activities, such as operation of vehicles and heavy equipment and earth-moving operations around dens could result in significant impacts due to stress, injury, or mortality to individual badgers and/or destruction of their dens. These impacts would negatively affect American badgers if any were to be present in or adjacent to the Project area, and such impacts would be significant. **However, with the implementation of MM BIO-4, impacts on the American badger would be less than significant**.

San Joaquin Kit Fox

San Joaquin kit foxes (SJKF) are known to occupy human-altered habitats, where denning opportunities and suitable prey are available, and the species frequently uses man-made features (e.g., culverts in roadbeds and pipes) in developed landscapes. SJKF presence in the western San Joaquin Valley is largely limited to a narrow belt of suitable habitat between Interstate 5 and the Coast Range foothills. As such, known occurrences of the species are largely concentrated west of the Project area. Although no SJKFs were observed during the April 2022 field surveys, the Project area and surrounding grassland, where present, provide suitable foraging habitat, potential prey, and existing ground squirrel burrows for denning. Therefore, construction activities implemented under the Proposed Action could cause the destruction of potential kit fox dens—potentially resulting in mortality if dens are occupied—and may temporarily displace kit foxes from preferred habitats, thereby increasing intraspecific competition for resources and making displaced individuals more susceptible to predation or vehicle strikes. Construction may also result in reproductive failure by disrupting foraging activities, increasing human disturbance, and precluding the formation of natal dens in the Project area. The loss of potential dens and temporarily reduced habitat access would negatively affect SJKFs if any were to be present in the vicinity during Project implementation, and such impacts would likely be significant. **However, with the implementation of MM BIO-5, impacts on the SJKF would be less than significant**.

Tricolored Blackbird and Yellow-Headed Blackbird

Tricolored Blackbirds and Yellow-Headed Blackbirds both breed near fresh water, preferably in emergent wetlands with tall, dense cattails or tules. Preferred foraging habitats for the tricolored blackbird include crops such as rice, alfalfa, irrigated pastures, and ripening or cut grain fields (e.g., oats, wheat, silage), as well as annual grasslands, cattle feedlots, and dairies (Beedy and Hamilton 1999). The Yellow-Headed Blackbird uses similar foraging habitat, preferring open fields and areas near water. Although neither species was observed during were observed during the April 2022 surveys, suitable habitat for both species within the Project area includes freshwater emergent wetlands, ponds, and maintained agricultural ditches and drainage features with perennial water and sufficient vegetation. Activities associated with the Proposed Action, such as vegetation clearance to facilitate construction access, could result in the loss or alteration of breeding habitat for these species and/or indirect (noise) disturbance to nest sites, which could result in nest abandonment, loss of young, or reduced health and vigor of eggs and/or nestlings. **However, with the implementation of MM BIO-6 impacts on the Tricolored Blackbird and the Yellow-Headed Blackbird would be less than significant**.

Burrowing Owl

This species was not observed during the April 2022 surveys. However, suitable habitat featuring friable soils, existing small mammal burrows, and grazed grassland is present within and adjacent to the Project area. Open developed areas, canal embankments, and fallow agricultural fields also have the potential to support Burrowing Owls. In addition, this species has potential to use canal

infrastructure, such as culverts, for nesting. If Burrowing Owls are present during Project implementation, the Proposed Action could result in a temporary or permanent loss of Burrowing Owl habitat and displacement of owls where Project activities affect potential burrow sites. Direct disturbance from construction activities, such as operation of vehicles and heavy equipment and earth-moving operations around burrows could result in significant impacts due to stress, injury, or mortality to individual owls and/or destruction of their burrows. Potential impacts are considered to be largely temporary because small mammal burrows are expected to become reestablished along the earthen-lined segments of the DMC that would be modified under the Proposed Action once construction is complete. To minimize potential impacts on the Burrowing Owl, MM BIO-7 would be implemented. **With the implementation of these measures, impacts on Burrowing Owls would be less than significant**.

Golden Eagle, Swainson's Hawk, Northern Harrier, and White-Tailed Kite

Golden Eagle, Swainson's Hawk, and Northern Harrier were observed soaring over portions of the Project area during the April 2022 surveys. Although no White-Tailed Kites were observed, suitable foraging and nesting habitat for the species occurs throughout the Project area. Implementation of the Proposed Action could result in the temporary and permanent loss of foraging habitat (i.e., annual grassland and agricultural fields) through the staging of equipment, temporary construction access, and other construction activities that may occur along the outer edge of the canal ROW. Additionally, direct disturbance to nests and/or breeding adults may occur where Project activities occur near or involve the removal of suitable nesting trees for Swainson's Hawks and/or White-Tailed Kites or ground disturbance in or along suitable nesting habitat for Northern Harriers (i.e., tall grasses in wetlands or at wetland borders). Further, indirect disturbance due to construction activities, such as noise and vibration associated with the operation of vehicles and heavy equipment, could have significant impacts on these special-status raptor species in the form of stress, injury, or mortality to individuals where construction activities occur near active nests. To minimize potential impacts on golden eagles, Swainson's Hawks, Northern Harriers, and White-Tailed Kites, MM BIO-8 would be implemented. **With the implementation of these measures, impacts on these special-status raptor species would be less than significant.**

Other Migratory Birds and Raptors

Several species of migratory birds and raptors were observed during the April 2022 surveys. Construction activities may be scheduled during the avian breeding season (generally February 1 through August 31, depending on the species) and could disturb nesting birds in or adjacent to the Project area. Construction-related disturbance could result in the incidental loss of fertile eggs or nestlings or nest abandonment, which could potentially have significant impacts on local or regional populations of affected bird species. Impacts on nesting birds could result from:

- Tree and shrub removal, which may be necessary to accommodate modifications to canal infrastructure, that could decrease nesting sites for species such as the song sparrow and the loggerhead shrike.
- Ground-disturbing activities (e.g., grubbing and grading to facilitate construction access) that occur within annual grasslands, which could affect ground-nesting birds, such as the grasshopper sparrow and the short-eared owl.
- Noise from construction activities.

- Removal of bridges and other construction activities near the existing bridges that could disturb or remove active cliff swallow nests if they are present.

However, with the implementation of MM BIO-9, impacts on migratory birds and raptors would be less than significant.

California Tiger Salamander and California Red-legged Frog

Neither the California tiger salamander nor the California red-legged frog were observed during the April 2022 surveys. However, based on available information on the species' movement capabilities and known occurrence locations, both species may occur in the portion of the Project area from approximately Tracy northward. In addition to potential aquatic habitat (i.e., seasonal ponds, freshwater emergent or forested wetlands, or maintained agricultural ditches and drainage features that seasonally retain water), portions of the Project area and immediately adjacent areas provide suitable upland habitat for both species—consisting of contiguous areas of annual grassland with existing California ground squirrel burrows for the California tiger salamander and patches of riparian trees or forested shrub wetlands for the California red-legged frog. Therefore, both the California tiger salamander and the California red-legged frog have the potential to occur in the Project area north of Tracy, especially in areas where both suitable upland and aquatic breeding habitat are present. The Proposed Action could result in the temporary and/or permanent loss of aquatic breeding habitat and the displacement of individuals if the limits of work were to overlap suitable habitat for these species along the outer edge of the canal ROW. Direct disturbance from construction activities, such as the operation of vehicles and heavy equipment around upland and breeding habitat, could also result in significant impacts due to stress, injury, or mortality to individuals or destruction of upland refugia. **However, with the implementation of MM BIO-10, impacts on the California tiger salamander and California red-legged frog would be less than significant**.

Western Spadefoot Toad

Western spadefoot toads are largely fossorial and spend most of the year in underground burrows, which they may construct themselves or may inherit from small mammals. Breeding and egg laying occur almost exclusively in shallow, temporary pools formed by heavy winter rains. Although this species was not observed during the April 2022 surveys, annual grasslands featuring existing mammal burrows and friable soils providing habitat for the non-breeding season and ephemeral pools providing potential aquatic habitat occur intermittently throughout the Project area. As such, the implementation of the Proposed Action could result in the temporary and/or permanent loss of western spadefoot toad habitat and displacement of individual toads where Project activities affect potential aquatic breeding habitat and upland burrow sites. Direct disturbance from construction activities, such as operation of vehicles and heavy equipment and earth-moving operations, could result in significant impacts on individuals due to stress, injury, or mortality to individuals or destruction of their burrows. **However, with the implementation of MM BIO-11 impacts on the western spadefoot toad would be less than significant**.

Northern California Legless Lizard, California Glossy Snake, San Joaquin Coachwhip, and Coast Horned Lizard

Although these special-status reptile species were not observed during the April 2022 surveys, annual grassland, sandy intermittent channel, and dry wash habitats providing suitable foraging and/or burrowing habitat for these species occur intermittently throughout the Project area. The implementation of the Proposed Action could result in temporary and/or permanent habitat loss

and the displacement of individuals where construction footprints overlap suitable habitat for these species. Direct disturbance from construction activities, such as operation of vehicles and heavy equipment and earth-moving operations, could result in significant impacts due to stress, injury, or mortality to individuals or destruction of their burrows. **However, with the implementation of MM BIO-12 impacts on the Northern California legless lizard, California glossy snake, San Joaquin coachwhip, and coast horned lizard would be less than significant**.

Giant Garter Snake

Although the giant garter snake was not observed during the April 2022 surveys, portions of the Project area provide suitable aquatic resources with emergent vegetation. The potential for giant garter snake to occur within the Project area is highest near where the DMC flows into Mendota Pool because of the presence of suitable habitat and known occurrence of the species in the vicinity. Other suitable aquatic habitat, such as emergent wetlands and vegetated agricultural ditches occurs within the Project area north of Mendota Pool; however, the potential for giant garter snake to occur in these areas is extremely low, owing to the lack of nearby known occurrences. As such, any Project-related impacts on the species are expected to be limited to areas near the Mendota Pool where individuals may be harmed directly through interactions with construction equipment and personnel as well. In addition, indirect impacts could occur from noise and vibration associated with construction work that may displace individuals from protective cover leading to an increased risk of predation or injury from vehicular or foot traffic. **However, with the implementation of MM BIO-13, impacts on the giant garter snake would be less than significant**.

Western Pond Turtle

The western pond turtle was observed during the April 2022 surveys in an intermittent creek immediately south of Mountain House Road, near the northernmost extent of the Project area. Additionally, this species has the potential to occur throughout the Project area where ponds, ditches, and other watercourses that retain water and have suitable adjacent herbaceous vegetation for nest construction and egg laying are present. Similar to the giant garter snake, western pond turtles may be subject to direct harm through interactions with construction equipment and personnel where the limits of ground disturbance overlaps suitable habitat for the species as well as indirectly through noise and vibration associated with construction work that may displace individuals from preferred areas. **However, with the implementation of MM BIO-14, impacts on the western pond turtle would be less than significant**.

Longhorn Fairy Shrimp, Vernal Pool Fairy Shrimp, and Vernal Pool Tadpole Shrimp

No vernal pool branchiopods were observed during the April 2022 surveys. However, the Project area provides freshwater emergent wetland, alkaline emergent wetland and pond habitat that may be suitable for these species, depending on the depth and longevity of inundation. Therefore, these species have the potential to occur in the Project area and to be subject to Project-related impacts. Vernal pool branchiopods could be adversely affected if construction activities were to result in the fill or excavation of vernal pools or alterations to the hydrology of vernal pool habitats. To minimize or avoid any potential impacts on vernal pool branchiopods MM BIO-15 would be implemented. **With the implementation of these measures, impacts on vernal pool branchiopods would be less than significant**.

Crotch Bumble Bee

According to CNDDB records, three occurrences of the Crotch bumble bee have been documented in the vicinity (i.e., within 5 miles) of the Project area. However, these occurrences were all recorded prior to 1960. The nearest recent (documented within the last 20 years) occurrence of the species was recorded approximately 18 miles away from the Project area. Marginally suitable annual grassland habitats occur throughout the Project area. Habitat suitability for the Crotch bumble bee is dependent on the presence of suitable nesting sites, floral resources, and overwintering sites. Crotch bumble bees primarily nest from late February through late October in abandoned small mammal burrows but may also nest under perennial bunch grasses or thatched annual grasses, beneath brush piles, in old bird nests, and in dead trees or hollow logs (Williams et al. 2014). Crotch bumble bees are generalist foragers capable of collecting pollen and nectar from a wide variety of flowering plants (Williams et al. 2014). Little is known about the overwintering sites used by Crotch bumble bees; however, bumble bees generally overwinter in soft disturbed soil or under leaf litter.

Annual grassland habitats within the Project area are considered marginally suitable for the Crotch bumble bee because they are within the DMC ROW, which is subject to regular maintenance to control weedy vegetation (e.g., blading and discing, herbicide use). Blading and discing involves using a grader- or tractor-mounted blade or disc to scrape or shallowly till the soil. These activities disturb the upper soil horizons, which is not conducive to maintaining the types of underground cavities typically used by Crotch bumble bees for nesting. Blading and discing may also result in the removal of flowering plants providing potential pollen and nectar resources. Similarly, herbicides used to control weeds along the DMC ROW may reduce the availability of floral resources for Crotch bumble bees within the Project area.

Despite the marginal nature of existing annual grassland habitats, Crotch bumble bees have potential to occur within the Project area where such habitats are present. Therefore, ground disturbance associated with Project implementation has the potential to impact the Crotch bumble bee through direct mortality from being crushed in underground burrows or collisions with vehicles or equipment. Additionally, ground disturbance may result in the loss of foraging plants; changes in foraging behavior; nest abandonment; reduced nest success; and reduced health and vigor of eggs, young and/or queens. Based on the findings of the 2022 surveys, potential Crotch bumble bee nesting, foraging, and overwintering habitat is ubiquitous throughout the Project area. Therefore, the avoidance of areas that may provide suitable Crotch bumble bee habitat is infeasible. Similarly, avoidance of the Crotch bumble bee overwintering period is infeasible as construction work would be required year-round to achieve Project objectives. For these reasons, the Proposed Action has the potential to result in impacts due to direct disturbance and/or habitat loss. Given the marginal quality of the habitat present and the many decades throughout which no Crotch bumble bees have been observed within the Project area, however, no substantial adverse effect on this species, either directly or through habitat modifications, is anticipated. Nevertheless, in accordance with MM BIO-2, upon any detection of Crotch bumble bees prior to or during Project implementation, SLDMWA would coordinate with CDFW to identify applicable species-specific avoidance and minimization measures, determine whether compensatory mitigation would be required, and obtain take authorization, if necessary. **Therefore, with the implementation of MM BIO-2, impacts on the Crotch bumble bee would be less than significant**.

M.4.2.2 Impact BIO-2: Have a substantial adverse effect on any riparian habitat or other sensitive natural community or critical habitat identified in local or regional plans, policies, or regulations or by the CDFW, USFWS, or NMFS.

The Proposed Action could have potentially significant impacts on sensitive natural communities. Sensitive natural communities are found throughout the Project area, as described in Section M.1. Under the Proposed Action, up to approximately 7.2 acres of alkaline emergent wetland, approximately 21.2 acres of freshwater emergent wetland, approximately 2.1 acres of freshwater forested wetland, approximately 10.3 acres of intermittent channel, approximately 108.6 acres of maintained agriculture ditches and drainage features, approximately 1.4 acres of pond habitat, and approximately 1.4 acres of riparian woodland would be temporarily impacted. Temporary impacts could result from removing vegetation to allow for construction equipment access and materials staging and/or through the process of excavating material from existing borrow sites along the canal ROW.

The Proposed Action would also result in the temporary loss of up to approximately 54.5 acres of emergent wetlands—consisting of narrow bands of emergent vegetation—along the banks of the southernmost 18 miles of the earthen-lined portion of the DMC where in-channel work involving excavation and the lowering of canal water levels would be required to stabilize the existing banks. This habitat loss is considered temporary as it is anticipated that similar wetland habitats would become established along the canal banks subsequent to Project completion. Additionally, the Proposed Action would result in a permanent loss of up to approximately 0.7 acre of maintained agriculture ditches as a result of the expansion of the canal embankment footprint in some areas. However, with the implementation of MM BIO-16, sensitive natural communities will be identified on construction drawings and protected during construction. **Therefore, with the implementation of MM BIO-16, impacts on sensitive natural communities would be less than significant**.

The portion of critical habitat for the California red-legged frog that overlaps the Project area consists of annual grassland and ruderal/developed habitat, and as such likely functions solely as marginal upland and/or dispersal habitat—defined as physical and biological features 3 and 4 in the critical habitat designation (USFWS 2010). However, given the potential for impacts on California red-legged frog critical habitat from construction activities, it is anticipated that formal consultation with USFWS will be required. No activities will be initiated that would affect a federally listed species or designated critical habitat without first completing the appropriate consultation(s) with USFWS and receiving formal notice that the action would not jeopardize the continued existence of the species. **Compliance with measures expected to be determined by USFWS through consultation, and the expected implementation of MM BIO-10 as well as MM BIO-16, would result in the Proposed Action having a less than significant impact on critical habitat for the California red-legged frog.**

Delta smelt critical habitat overlaps portions of the Project area between Mountain House Road and the Tracy Fish Facility. However, the Project area is located downstream of the Tracy Fish Facility, which prevents Delta smelt from entering the canal via the San Joaquin River Delta. Therefore, the Project area does not support any of the biological or physical habitat attributes that are essential to the Delta smelt's conservation (i.e., primary constituent elements). Furthermore, the portion of Delta smelt critical habitat that overlaps the Project area does not maintain factors constituting habitat for the species in surrounding areas. **As such, the Proposed Action would have no impact on critical habitat for Delta smelt.**

M.4.2.3 Impact BIO-3: Have a substantial adverse effect on state or federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means.

According to the findings of the BSR, wetlands and other waters potentially under the jurisdiction of the U.S. Army Corps of Engineers (USACE) and the Regional Water Quality Control Board (RWQCB) occur at numerous locations along the length of the Project area, especially where the outer toe of the existing canal embankment meets the adjoining landscape. As previously noted, the Proposed Action would result in temporary impacts on up to approximately 7.2 acres of alkaline emergent wetland, approximately 21.2 acres of freshwater emergent wetland, approximately 2.1 acres of freshwater forested wetland, approximately 10.3 acres of intermittent channel, approximately 108.6 acres of maintained agriculture ditches and drainage features, approximately 1.4 acres of pond habitat and would result in permanent impacts on up to approximately 0.7 acre of maintained agriculture ditches and drainage features. However, these acreages are based on a reconnaissance-level mapping effort and the actual extent of jurisdictional waters of the U.S. can only be determined by USACE after completion and verification of a formal wetland delineation. Additional features including irrigation canals and the channel of the DMC itself contain some wetland characteristics and will need to be addressed during a formal wetland delineation. Given the nature of expected impacts to potential jurisdictional waters, any applicable permits/authorizations from RWQCB and USACE will be obtained prior to any temporary or permanent impacts on such resources, as described in MM BIO-17, and all terms and conditions of said permits/authorizations will be implemented. Further, where impacts on jurisdictional wetlands and other waters cannot be avoided, restoration and compensatory mitigation will be required to offset any temporary and permanent impacts as described in MM BIO-17. **Therefore, with the implementation of MM BIO-17, impacts on state or federally protected wetlands would be less than significant**.

M.4.2.4 Impact BIO-4: Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites.

Implementation of the Proposed Action would have temporary impacts on forested wetlands and intermittent channels that may be used by wildlife as migratory corridors, and therefore could result in potentially significant impacts on the movement of native or resident migratory species. **However, with the implementation of MMs BIO-16 and BIO-17, impacts would be less than significant**.

M.4.2.5 Impact BIO-5: Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance.

Each county within which the Project area is located has adopted a general plan which addresses protection of biological resources:

- The Fresno County General Plan addresses biological resources in the Natural Resources section, which includes subsections D through F where goals are identified to conserve wetland and riparian areas, fish and wildlife habitat, and valuable vegetation resources in Fresno County (Fresno County 2000).
- The Merced County General Plan – 2030 Update addresses biological resources in the Natural Resources Element, which identifies its primary goal (Goal NR-1) as being to preserve and protect, through coordination with the public and private sectors, the biological resources of the County (Merced County 2013).

- The Stanislaus County General Plan addresses biological resources in the Conservation/Open Space Element, which identifies the protection of wildlife and species of the County as a goal (Goal Ten) (Stanislaus County 2016).
- The San Joaquin County General Plan addresses biological resources in the Natural and Cultural Resources Element, which includes Goal NCR-2. The goal of NCR-2 is to preserve and protect wildlife habitat areas for the maintenance and enhancement of biological diversity and ecological integrity (San Joaquin County 2016).
- The Contra Costa County General Plan addresses biological resources in the Conservation Element, in which three goals are identified that include components related to vegetation and wildlife: to protect ecologically significant lands, wetlands, plant and wildlife habitat (Goal 8-D); to protect rare, threatened and endangered species of fish, wildlife and plants, significant plant communities, and other resources which stand out as unique because of their scarcity, scientific value, aesthetic quality or cultural significance (Goal 8-E); and to encourage the preservation and restoration of the natural characteristics of the San Francisco Bay/Delta estuary and adjacent lands (Goal 8-F) (Contra Costa County 2005).

With implementation of MMs BIO-1 through BIO-17 to avoid or minimize impacts on biological resources, the Proposed Action would not conflict with the goals of these plans. **This impact would be less than significant**.

M.4.3 Mitigation Measures

MM BIO-1: Measures to Minimize Impacts on Special Status Plants

A botanical survey shall be conducted prior to construction activities to determine the presence or absence of special-status plant species in the Project area. The surveys shall be conducted in general accordance with the *Protocols for Surveying and Evaluating Impacts to Special-Status Native Plant Populations and Natural Communities* (CDFW 2021) and shall be timed to appropriately coincide with the blooming period of special-status plant species with the potential to occur in the Project disturbance areas.

If more than five years lapse after the botanical survey is conducted prior to ground disturbance, two botanical surveys (early and late season) shall be conducted in all suitable habitat located within the Project disturbance areas to determine the presence or absence of special-status plants.

If special-status plant species are found during the botanical surveys, the locations of the special-status plants and a 50-foot buffer will be marked as avoidance areas both in the field using flagging, staking, fencing, or similar devices and on construction plans.

If non-listed, special-status plants are identified during botanical surveys and complete avoidance is not practicable, and the Project would directly or indirectly affect more than 25 percent of a local occurrence by either number of plants or square footage of occupied habitat, a qualified biologist will determine if implementation of a conservation plan is recommended. If federally listed plants are identified during botanical surveys and complete avoidance is not practicable, coordination with USFWS will be conducted as appropriate to develop the conservation plan. No take of federally listed species will occur without an Incidental Take Permit (ITP) from USFWS. If it is determined that the Project would be subject to compliance with the CESA and state-listed plant species are detected in areas where avoidance is impracticable, then CDFW will be consulted and any necessary permits will be obtained.

The special-status plant conservation plan may consist of, but would not necessarily be limited to, purchase of mitigation credits at a regional conservation bank; plant salvage and relocation; collection and subsequent planting of seed or incorporating seed from native nursery into seed mix used for revegetation efforts; stockpiling, storing, and replacing topsoil containing the local seed bank; or other measures determined practicable based on the species and site conditions. If on-site conservation measures are implemented, the objective is to restore the impacted special-status plant species community to pre-existing conditions by providing for the restoration of a self-sustaining population of special-status plants in the general area where the impact occurred at a minimum of a 1:1 ratio (e.g., number of plants, square footage occupied). For on-site conservation measures, the conservation plan will identify success criteria and provide for annual or other regular monitoring to evaluate whether the conservation effort has met the success criteria. The conservation plan will also include measures for remedial actions (e.g., additional plantings, supplemental irrigation, increased monitoring) if monitoring efforts indicate that success criteria are not being met.

For some species and site conditions, the biologist may determine that a conservation plan is not recommended. Some of these circumstances may include but are not limited to the following: (1) there are other nearby populations that will not be disturbed; (2) plant relocation, seeding, or revegetation would not have a reasonable probability of success; (3) implementation of measures could result in detrimental effects on existing special-status plant populations; or (4) incompatibility with required operations and maintenance activities. If the biologist determines, in coordination with USFWS (and/or CDFW if it is determined that the Project would be subject to compliance the CESA) that a conservation plan is not warranted, no additional measures are required.

MM BIO-2: General Measures to Minimize Impacts on Special-Status Animal Species

A Biological Resources Management and Monitoring Plan (BRMMP) shall be developed and implemented for the Project. The BRMMP shall provide for the following:

1. Overall implementation and monitoring of the MMs for biological resources and the terms and conditions of any agency permits/authorizations throughout the duration of Project construction and restoration/revegetation of riparian habitat per BIO-2c.
2. Designation of an overall Project biologist and the roles and responsibilities of the Project biologist and other monitoring biologists and the roles of Reclamation, San Luis & Delta-Mendota Water Authority (SLDMWA) and construction personnel in coordinating and implementing the BRMMP.
3. Adaptive management in scheduling worker environmental awareness training (WEAT) and conducting pre-construction surveys for special-status species. In some cases, additional biological surveys beyond those identified in the MMs may be warranted to proactively avoid biological constraints or conflicts with protective measures. For example, early monitoring for nesting birds or occupied mammal burrows may be needed to preserve opportunities for vegetation removal, removal of nesting starts before egg laying, and burrow monitoring and closure prior to the initiation of breeding or nesting activities.
4. The procedure and authorizations required to modify the MMs, if needed, to resolve conflicts with constructability requirements or other measures required by agency permits/authorizations or to provide for equivalent avoidance/minimization of adverse effects on sensitive biological resources under changing conditions over the life of Project construction. For example, nesting birds or other special-status species may

initiate nesting or denning activities in proximity to construction areas while active construction activities are ongoing, including within the 'no-disturbance buffers.' In these cases, it may be that the animals are acclimated to the level of construction disturbance, and continuance of construction activities would not be expected to adversely affect the animals or their nesting/breeding activities (assuming that increased levels of disturbance or closer proximity of construction activities is not planned). The BRMMP will include provisions for how these and similar circumstances will be addressed and how determinations regarding additional biological monitoring or agency coordination will be addressed.

5. The procedure to record and document implementation of the MMs and other measures including any pre-construction survey reports, WEAT sign-in forms, routine biological monitoring forms, photographs, and other materials related to implementation of the BRMMP.
6. The procedure to comply with the terms and conditions and notification and reporting requirements of any agency permits/authorizations required for the Project, and the procedure for coordination/consultation with resource or permitting agencies as necessary.
7. The procedure to inform, document, and monitor restoration and revegetation activities associated with restoring temporary impacts on terrestrial and aquatic habitats and vegetation communities. This includes any post-construction monitoring/reporting and remedial measures that may be required.

Prior to the initiation of ground disturbance, a qualified biologist(s) will conduct a WEAT for all construction personnel. Training sessions will be repeated for all new personnel before they access the Project site. Sign-in sheets identifying attendees and the contractor/company they represent will be prepared for each training session, and records of attendance will be maintained by the Project. At a minimum, the WEAT will include a description of the protected species and biological resources that may occur in the Project area and their physical description, habitats, and natural history, as well as the measures that are being implemented to avoid or minimize Project-related impacts, penalties for non-compliance, and the boundaries of the work area. As appropriate, training will be conducted in languages other than English to ensure that employees and contractors understand their roles and responsibilities. A written summary of the training will be provided to all attendees, and an electronic copy will be provided so that the Project can make and distribute future copies. The WEAT will be conducted annually, at a minimum, for all construction personnel.

A litter control program will be instituted at each Project site. All workers will place their food scraps, paper wrappers, food containers, cans, bottles, and other trash in covered or closed trash containers. The trash containers shall be removed from the Project area at the end of each working day.

No firearms (except as possessed by federal, state, or local law enforcement officers) or pets will be permitted on construction sites.

To prevent inadvertent entrapment of wildlife during construction, all excavated steep-walled holes or trenches greater than 2 feet deep shall be covered or filled at the end of each working day or provided with one or more escape ramps no greater than 200 feet apart. Before such trenches or holes are filled, they must be thoroughly inspected for trapped animals. If protected species are found in any of the holes or trenches, work shall cease until an escape ramp is provided and the

animal leaves on its own volition, or until the animal has been relocated by a USFWS-approved biologist, and/or in coordination with USFWS as appropriate.

All construction activity will be confined within the Project site, which may include temporary access roads, haul roads, and staging areas specifically designated and marked for these purposes.

Restoration and re-vegetation work associated with temporary impacts shall be done using California native plant material from on-site or local sources (i.e., local ecotype). Plant materials from non-local sources shall be allowed only with written authorization from USFWS. To the maximum extent practical (i.e., presence of natural lands), topsoil shall be removed, cached, and returned to the site according to successful restoration protocols. Loss of soil from run-off or erosion shall be prevented with straw bales, straw wattles, or similar means provided they do not entangle, block escape or dispersal routes of listed animal species.

The Project construction area shall be delineated with high visibility temporary fencing, flagging, or other barrier to prevent encroachment of construction personnel and equipment onto any sensitive areas during Project work activities. Such fencing shall be inspected and maintained daily until completion of the Project. The fencing will be removed only when all construction equipment is removed from the site. No Project activities will occur outside the delineated Project construction area.

Only USFWS-approved personnel holding valid permits issued pursuant to section 10(a)(l)(A) of the ESA will be allowed to trap or capture listed species. Any relocation plan will be approved by USFWS prior to release of any listed species.

Tightly woven fiber netting or similar material (no monofilament material) will be used for erosion control or other purposes at the Project site to ensure that animals do not become trapped.

Prior to Project implementation, Reclamation will consult with USFWS to ensure its actions do not jeopardize the continued existence of any federally listed species or destroy/adversely modify critical habitat pursuant to Section 7(a)(2) of the ESA. If consultation with USFWS results in the issuance of a biological opinion, the Proposed Action will be conducted in compliance with all reasonable and prudent measures and terms and conditions set forth in the biological opinion.

To inform discussions between SLDMWA and CDFW regarding the potential for the Proposed Action to impact species currently protected under the CESA, and out of an abundance of caution, a qualified biologist familiar with the behavior and life history of the Crotch bumble bee will conduct surveys to determine the presence/absence of the species within the project area within 1 year prior to the initiation of construction. These surveys will be conducted during the Crotch bumble bee flying season (i.e., March 1 to September 1) when the species is most likely to be detected above ground. Survey results, including negative findings, will be submitted to CDFW prior to the initiation of project-related ground-disturbing activities. At a minimum, the survey report will provide the following:

a. A description and map of the survey area, focusing on areas that could provide suitable habitat for the Crotch bumble bee.

b. Field survey conditions that include the name(s) of qualified biologist(s) and their qualifications, date and time of the survey, survey duration, general weather conditions, and survey goals.

c. A map(s) showing the location of Crotch bumble bee nests/colonies identified during the surveys.

d. A description of the physical (e.g., soil, moisture, slope) and biological (e.g., plant composition) conditions where each Crotch bumble bee nest/colony was found. A sufficient description of biological conditions, primarily impacted habitat, including native plant composition (e.g., density, cover, and abundance) within the impacted habitat (e.g., species list separated by vegetation class, density, cover, and abundance of each plant species).

Prior to Project implementation, SLDMWA will consult with CDFW if any species protected under CESA are confirmed present within the project area and it is determined that take of one or more of these species cannot be avoided during project implementation. Should it be determined that the Proposed Action would result in take of one or more species protected under CESA, SLDMWA would obtain take authorization through the acquisition of an ITP from CDFW, pursuant to Fish and Game Code Section 2081 subdivision (b).

MM BIO-3: Measures to Minimize Impacts on Bats

To the extent practicable, the removal of large trees with cavities or the modification of canal infrastructure with the potential to provide bat roosts will occur before maternity colonies form (i.e., prior to March 1) or after young are volant (able to fly) (i.e., after August 15).

If construction (including the removal of large trees and/or the modification of canal infrastructure) occurs during the non-volant season (March 1 to August 15), a qualified biologist will conduct a pre-construction survey of the Project area for maternity colonies. The pre-construction survey will be performed no more than 14 days prior to the implementation of construction activities (including staging and equipment access). If a lapse in construction activities for 14 days or longer occurs between those dates, another pre-construction survey will be performed. If any maternity colonies are detected, appropriate conservation measures (as determined by a qualified biologist) will be implemented. These measures may include but are not limited to establishing a construction-free buffer zone around the maternity colony site, biological monitoring of the maternity colony, and delaying construction activities in the vicinity of the maternity site.

MM BIO-4: Measures to Minimize Impacts on the American Badger

Any American badger detected within the Project area during Project-related activities will be allowed to move out of the work area of its own volition.

Concurrent with other required surveys, during winter and spring months before new Project activities, and concurrent with other pre-construction surveys (e.g., San Joaquin kit fox (SJKF) and Burrowing Owl), a qualified biologist will perform a survey to identify the presence of active or inactive American badger dens. If this species is not found, no further mitigation will be required. If badger dens are identified within the construction footprint during the surveys or afterward, they will be inspected and closed using the following methodology:

- When unoccupied dens are encountered outside of work areas but within 100 feet of proposed activities, vacated dens will be inspected to ensure they are empty and temporarily covered using plywood sheets or similar materials.
- If badger occupancy is determined at a given site within the work area, work activities at that site shall be halted. Depending on the den type, reasonable and prudent measures to avoid harming badgers will be implemented and will include seasonal limitations on Project construction near the site (e.g., restricting the construction period to avoid spring-summer pupping season) or establishing a construction exclusion zone around the identified site or resurveying the den at a later time to determine species presence or absence.

- Badgers will be passively relocated using burrow exclusion (e.g., installing one-way doors on burrows) or similar CDFW-approved exclusion methods. In unique situations, it may be necessary to actively relocate badgers (using live traps) to protect individuals from potentially harmful situations. If necessary, such relocation would be performed with advance CDFW coordination and concurrence.

MM BIO-5: Measures to Minimize Impacts on San Joaquin Kit Fox

Determine the presence of SJKF dens:

a) Pre-construction monitoring will be performed no less than 14 days and no more than 30 days prior to construction to identify kit fox habitat features within the Project Area.

b) Areas within which pre-construction monitoring have been completed more than 30 days prior to construction will be re-inventoried not more than 30 days prior to construction.

c) Pre-construction monitoring for dens will be conducted by qualified biologists familiar with SJKF biology, natural history, and potential dens.

d) Pipes and culverts will be searched for SJKF immediately prior to being moved or sealed to ensure that an animal has not been trapped. If SJKF is observed, it will be gently encouraged to leave the area by a USFWS-approved biologist. (i.e., without using loud noise, physical force, or physical movement of the pipe or culvert such that the animal could be injured or startled while it is leaving the area).

Identify and document locations of potential or occupied dens (natal or non-natal) and their status (occupied or unoccupied). Definitions:

a) Known den: any existing natural den or manmade structure that is used or has been used at any time in the past by SJKF. Evidence of use may include historical records, past or current radiotelemetry or spotlighting data, kit fox sign such as tracks, scat, and/or prey remains, or other reasonable proof that a given den is being or has been used by a kit fox. USFWS discourages use of the terms "active" and "inactive" when referring to any kit fox den because a great percentage of occupied dens show no evidence of use, and because kit foxes change dens often, with the result that the status of a given den may change frequently and abruptly.

b) Potential den: any subterranean hole within the species' range that has entrances of appropriate dimensions (five to eight inches in diameter) for which available evidence is insufficient to conclude that it is being used or has been used by a kit fox. Potential dens shall include the following: (1) any suitable subterranean hole five to eight inches in diameter within the species' range; or (2) any den or burrow of another species (e.g., coyote, badger, red fox, or ground squirrel) that otherwise has appropriate characteristics for kit fox use.

c) Natal/pupping den: any den used by kit foxes to whelp and/or rear their pups. Natal/pupping dens may be larger with more numerous entrances than dens occupied exclusively by adults. These dens typically have more kit fox tracks, scat, and prey remains in the vicinity of the den, and may have a broader apron of matted dirt and/or vegetation at one or more entrances. A natal den, defined as a den in which kit fox pups are actually whelped but not necessarily reared, is a more restrictive version of the pupping den. In practice, however, it is difficult to distinguish between the two, therefore, for purposes of this definition either term applies.

d) Atypical den: any manmade structure which has been or is being occupied by SJKF. Atypical dens may include pipes, culverts, and diggings beneath concrete slabs and buildings.

Identify and execute appropriate action(s) regarding notification, buffers, excavation and fill, or seal off:

a) Occupied natal den: if an occupied natal den is visible or encountered within the Project limits or on publicly accessible land sufficiently close to the Project construction area such that it would be disturbed (based on qualified biologist opinion and monitoring), USFWS (and CDFW if it is determined that the Project would be subject to compliance with the CESA) will be contacted immediately and before any Project action occurs to determine permissible actions to permit resumption of work.

b) Unless determined necessary for safety or constructability by Reclamation, SLDMWA, or the Project contractor, the Project site will not be lighted between sunset and sunrise.

c) Pipes or culverts with a diameter greater than four inches will be capped or taped closed when it is ascertained that no SJKF are present. Any SJKF found in a pipe or culvert will be allowed to escape unimpeded.

If a natural den or burrow is determined to meet size criteria (i.e., greater than 4-inches in diameter) and cannot be avoided per the no-disturbance buffers recommended in the USFWS *Standardized Recommendations for Protection of the SJKF Prior to or During Ground Disturbance* (USFWS 2011) or must be destroyed, the following guidelines will be followed:

a) Prior to den destruction, areas scheduled for construction within the vicinity of potential kit fox dens shall be monitored by a qualified biologist to determine their status. Monitoring will begin with pedestrian surveys to identify locations of potential kit fox dens and observe for suitable surrounding habitat. Because it is logistically impractical to monitor all dens using remote cameras and tracking medium (or to hand excavate to confirm vacancy), baited camera traps may be used to assess presence or absence of SJKF activity. Prior to ground-disturbing activities in Project segments that require excavation, baited camera traps will be deployed in approximate 0.25-mile increments for four consecutive nights. Baited camera traps may be placed farther than 0.25-mile apart depending on the suitability of surrounding habitat and land uses that are observed during pedestrian surveys and in areas with lower densities of potential kit fox dens. If no kit foxes are detected by the camera traps during this time period, it can be assumed that kit foxes are not currently using the area, and ground-disturbing activities may commence in that area. If a kit fox is detected by a camera trap, then further investigation will be required as described below.

b) If a kit fox is detected by a baited camera trap or otherwise observed in an area, further pre-construction monitoring will be conducted to determine which den(s) are being used. Baited camera traps will be deployed in the area, and tracking medium will be placed at the entrances of suspected dens to monitor the area for four consecutive nights. If no SJKF activity is observed during this period, the den will be deemed unoccupied and destroyed immediately under the supervision of a USFWS-approved biologist to preclude subsequent use. If SJKF activity is observed at the den during this period, the den will be monitored for at least five consecutive days from the time of observation to allow any resident animal to move to another den during its normal activities. Use of the den can be discouraged during this period by partially plugging the entrance(s) with soil in such a manner that any resident animal can escape easily. Destruction of the den may begin when, in the judgment of a

USFWS-approved biologist, the animal has vacated. The biologist will be trained and familiar with SJKF biology. If the animal is still present after five or more consecutive days of plugging and monitoring, the den may be excavated when, in the judgment of a USFWS-approved biologist, it is temporarily vacant, for example during the animal's normal foraging activities. All den destruction shall be conducted under the supervision of a USFWS-approved biologist.

c) All dens requiring excavation will be excavated under the supervision of a USFWS-approved biologist. In no event will an excavation that meets the definition of a confined space (i.e., a space large enough and so configured that a person can bodily enter but has limited or restricted means for entry or exit) be initiated. In this circumstance, discouragement (as described above) would be used.

d) The den will be fully excavated and then filled with dirt and compacted so that SJKF cannot reenter or use the den during the construction period. If at any point during excavation, an SJKF is discovered inside the den, the excavation activity will cease immediately, and monitoring of the den will be resumed. Destruction of the den may be resumed when in the judgment of a USFWS-approved biologist, the animal has escaped from the partially destroyed den.

Before and during construction:

- Project-related vehicles shall observe a daytime speed limit of 20-mph throughout the site in all Project areas, except on county roads and State and Federal highways; this is particularly important at night when kit foxes are most active. Night-time construction shall be minimized to the extent possible. However, if it does occur, then the speed limit shall be reduced to 10-mph. Off-road traffic outside of designated Project areas shall be prohibited.
- Kit foxes are attracted to den-like structures such as pipes and may enter stored pipes and become trapped or injured. All construction pipes, culverts, or similar structures with a diameter of 4-inches or greater that are stored at a construction site for one or more overnight periods shall be thoroughly inspected for kit foxes before the pipe is subsequently buried, capped, or otherwise used or moved in any way. If a kit fox is discovered inside a pipe, that section of pipe shall not be moved until USFWS has been consulted. If necessary, and under the direct supervision of the biologist, the pipe may be moved only once to remove it from the path of construction activity, until the fox has escaped.
- A representative shall be appointed by the Project proponent who will be the contact source for any employee or contractor who might inadvertently kill or injure a kit fox or who finds a dead, injured or entrapped kit fox. The representative will be identified during the employee education program and their name and telephone number shall be provided to USFWS.
- In the case of trapped animals, escape ramps or structures shall be installed immediately to allow the animal(s) to escape, or USFWS shall be contacted for guidance. If at any time a trapped or injured kit fox is discovered, USFWS and CDFW shall be contacted as noted below.
- Any contractor, employee, or military or agency personnel who are responsible for inadvertently killing or injuring a SJKF shall immediately report the incident to their

representative. This representative shall contact USFWS immediately in the case of a dead, injured or entrapped kit fox.

- The Sacramento Fish and Wildlife Office (and CDFW if it is determined that the Project would be subject to compliance with the CESA) shall be notified in writing within three working days of the accidental death or injury to a SJKF during Project related activities. Notification must include the date, time, and location of the incident or of the finding of a dead or injured animal and any other pertinent information.
- New sightings of kit fox shall be reported to the CNDDB. A copy of the reporting form and a topographic map clearly marked with the location of where the kit fox was observed shall also be provided to USFWS.
- Because dusk and dawn are often the times when this species is most actively foraging, to the extent practicable, all construction activities will cease one half hour before sunset and will not begin prior to one half hour before sunrise. Except when necessary for driver or pedestrian safety, lighting of a Project site by artificial lighting during nighttime hours is prohibited.

MM BIO-6: Measures to Minimize Impacts on the Tricolored Blackbird and the Yellow-Headed Blackbird

Prior to construction, appropriately timed surveys for Tricolored Blackbirds and Yellow-Headed Blackbirds will be conducted in areas supporting potentially suitable habitat within 0.25-mile of construction areas. Habitat within 0.25-mile of Tricolored Blackbird or Yellow-Headed Blackbird colonies will be avoided during nesting season, which can begin as early as mid-March and extend through August. If it is determined that the Project would be subject to compliance with the CESA, CDFW will be consulted in cases where colonies cannot be avoided to potentially reduce buffer distances with active monitoring during construction by a qualified biologist.

MM BIO-7: Measures to Minimize Impacts on the Burrowing Owl

A minimum of one pre-construction survey for Burrowing Owls within a minimum of 500 feet of the Project area (where accessible) will be conducted by a qualified biologist within 15 days prior to the initiation of construction activities in a given area, regardless of the timing of construction. Pre-construction surveys each year of construction during the nonbreeding season (September 1 to January 31) will take place in order to determine the presence of Burrowing Owls before breeding activities begin. If any occupied burrows are identified, appropriate conservation measures (as determined by a qualified biologist) will be implemented. No disturbance will occur within 150 feet of occupied burrows during the nonbreeding season (September 1 to January 31) or within 250 feet during the breeding season (February 1 to August 31). These measures may also include establishing a construction-free buffer zone around the active nest site in coordination with the CDFW, biological monitoring of the active nest site, and delaying construction activities in the vicinity of the active nest site until the young have fledged.

If necessary, in situations where Burrowing Owls are detected within the Project area during the nonbreeding season and maintaining a 150-foot, no-disturbance buffer is not practicable, a qualified biologist will submit an exclusion and passive relocation plan to CDFW. The exclusion and passive relocation plan will generally follow the guidelines outlined in Appendix E of the *Staff Report on Burrowing Owl Mitigation* (CDFW 2012). The exclusion and passive relocation plan will consist of installing one-way doors in potential burrows, daily monitoring, and collapsing burrows once it is

determined that the burrows are unoccupied. Exclusion may only take place during the nonbreeding season (September 1 to January 31) and may be an ongoing effort during this time period. This will allow the owls to exit burrows if they are present, but not return. The exclusion and passive relocation plan will also detail plans to replace collapsed burrows with artificial burrows at a minimum 1:1 ratio or describe why artificial burrows are not needed (e.g., numerous available natural burrows are available in nearby areas that will not be disturbed). Monitoring of collapsed burrows will be conducted as needed so that burrowing owls do not recolonize the area prior to construction disturbance.

If necessary, in situations where occupied burrows are detected during the breeding season and maintaining a 250-foot no-disturbance buffer is not practicable, CDFW will be consulted to determine alternative measures to minimize the potential for disturbance to occupied burrows and nesting activities. Measures may include but are not limited to continuous biological monitoring by a qualified biologist until it has been determined that the young have fledged and are no longer reliant on the nest or parental care for survival or construction is complete. No direct disturbance of burrows with eggs or young can be conducted without written authorization from the CDFW and USFWS.

MM BIO-8: Measures to Minimize Impacts on the Golden Eagle, Swainson's Hawk, Northern Harrier, or White-Tailed Kite

For construction activities that occur between February 1 and August 31, a qualified biologist will conduct pre-construction surveys for Golden Eagles, Swainson's Hawks, Northern Harriers, and White-Tailed Kites. The pre-construction surveys will include the Project footprint and a minimum of a 0.5-mile radius where access is permitted around the construction area in suitable nesting habitat (i.e., large trees for Swainson's Hawk and White-Tailed Kite, cliff faces for Golden Eagle, and grasslands for Northern Harrier). The pre-construction surveys will be conducted no more than 10 days before ground disturbance in a given area and will be phased based on the construction schedule.

If nesting Golden Eagles, Swainson's Hawks, Northern Harriers, or White-Tailed Kites are detected, an appropriate no-disturbance buffer (minimum of 500 feet for Northern Harrier, 0.5 mile for Golden Eagle, Swainson's Hawk, and White-Tailed Kite) will be established and monitored daily by a qualified biologist. Buffers will be maintained until a qualified biologist has determined that the young have fledged and are no longer reliant on the nest or parental care for survival. A 0.5-mile no-disturbance buffer will also be maintained from any overwintering eagles if they are detected in the Project area or surrounding areas; the buffer will be maintained for the duration that the bird(s) are present. If any Bald Eagles or Golden Eagles are detected, Reclamation will coordinate with USFWS as necessary to comply with the Bald and Golden Eagle Protection Act.

If maintaining the minimum no-disturbance buffer around an active Golden Eagle or any overwintering eagles is not practicable, USFWS will be consulted to determine whether reduced minimum no-disturbance buffers are appropriate based on site-specific circumstances (e.g., visual barriers between nest and construction area, existing level of disturbance) or to identify alternative measures to minimize the potential for Project-related disturbance to the nest site that could result in nest abandonment or other forms of take. Similarly, if necessary, CDFW would be consulted to determine whether reduced minimum no-disturbance buffers could be implemented around active Swainson's Hawk, Northern Harrier, or White-Tailed Kite nests or to identify alternative measures to minimize the potential for Project-related disturbance to existing nest sites. Measures may include, but are not limited to, continuous biological monitoring by a qualified biologist until it has been

determined that the young have fledged and are no longer reliant on the nest or parental care for survival or construction is complete. If the nesting pair shows signs of distress (i.e., adults leaving the nest when eggs or young chicks are present) as a result of Project-related activities, the monitoring biologist will have authority to stop work until it is determined that the adults have returned and are no longer showing signs of distress.

If trees suitable for nesting by Swainson's Hawk are scheduled to be removed during the non-nesting season, a qualified biologist will conduct a pre-construction survey during the nesting season prior to tree removal to determine whether Swainson's Hawks are using the trees for nesting. If the trees proposed for removal are being used by nesting Swainson's Hawk, and it is determined that the Project would be subject to compliance with the CESA, consultation with CDFW will take place prior to tree removal.

If CESA compliance is required, and consultation with CDFW results in a determination that take of an active Swainson's Hawk nest cannot be avoided, then take authorization pursuant to CESA will be obtained from CDFW prior to initiation of any activities that are likely to result in take.

If an active Golden Eagle or White-Tailed Kite nest may not be avoidable, then all activities that are likely to result in take will be delayed until a qualified biologist has determined that the young have fledged and are no longer reliant on the nest or parental care for survival.

MM BIO-9: Measures to Minimize Impacts on Nesting Migratory Birds

To the extent practicable, vegetation removal will be scheduled to avoid the breeding season for nesting raptors and other special-status birds (generally February 1 through August 31, depending on the species). Removal of vegetation outside of the nesting season is intended to minimize the potential for delays in vegetation removal due to active nests.

Regardless of when vegetation removal is scheduled, a qualified biologist will conduct a minimum of one pre-construction survey for nesting migratory birds and raptors within the Project area and a buffer (250 feet for migratory birds, 500 feet for raptors) around the Project area (where accessible) for all construction-related activities that will occur during the nesting season. The pre-construction survey will be conducted no more than 15 days prior to the initiation of construction in a given area and will be phased based on the construction schedule. Due to the ongoing, phased approach to construction, multiple pre-construction surveys per year may be required. If an active nest is found, a construction-free buffer zone (250 feet for migratory birds, 500 feet for raptors) will be established around the active nest site. If establishment of the construction-free buffer zone is not practicable, appropriate conservation measures (as determined by a qualified biologist) will be implemented. These measures may include, but are not limited to, consultation with CDFW to establish a different construction-free buffer zone around the active nest site, daily biological monitoring of the active nest site, and delaying construction activities in the vicinity of the active nest site until the young have fledged.

If removal of bridges or other bridge work is scheduled to occur during the swallow nesting season, exclusionary devices (e.g., netting) will be installed around the bridges prior to the initiation of the avian breeding season (before February 15) during the same year as the bridges are scheduled for removal and after a qualified biologist has determined no active nests (i.e., nests with eggs or young) are present. The exclusionary devices will remain in place until August 15 or until the bridge removal or other bridge work is completed. The exclusionary devices will be anchored such that swallows cannot attach their nests to the structure through gaps. Exclusionary devices will be regularly inspected as necessary to confirm that they are adequately preventing initiation of nest building. If

swallows have breached the exclusionary devices and began building nests on the structure, nesting material (i.e., partially built nests) can be removed only if a qualified biologist has determined that eggs or young are not present. No removal of nests with eggs or young can be conducted without written authorization from CDFW and USFWS, or until a qualified biologist has determined that the nest is no longer active (e.g., the nest has failed, the young have fledged and are no longer dependent on the nest).

MM BIO-10: Measures to Minimize Impacts on the California Tiger Salamander (CTS) and the California Red-legged Frog (CRLF)

Before and during construction:

- Protocol presence/absence surveys shall be conducted by a USFWS-approved biologist in suitable habitat prior to construction. As the Project is multi-year, protocol presence/absence surveys can be conducted in portions of the Project area that have work scheduled the following year. Alternatively, presence can be assumed in suitable habitat and the measures below implemented.
- To the maximum extent practicable, the Project design and construction implementation will avoid impacts to suitable breeding habitat. Areas of avoidance shall be indicated on Project plan sets and shall be clearly delineated in the field. Signage indicating "Environmentally Sensitive Area: Keep Out" shall be posted.
- Protocol aquatic surveys shall be conducted by a USFWS-approved biologist in suitable breeding habitat within areas that will be disturbed by construction in the following year, and within 1.3 miles of those areas to detect occupied breeding resources (1 survey in March, April, and May each). Any occupied breeding resources will be prioritized for avoidance.
- Resources documented to support breeding populations of CTS/CRLF shall be avoided during construction with a buffer sufficient to ensure the continued functioning of that breeding resource. If adherence to this buffer is not feasible, USFWS shall be contacted to determine whether moving individuals prior to construction is authorized.
- A USFWS approved biologist shall survey the work sites where suitable habitat has been identified no more than 30 days before the onset of construction. Adult individuals detected during the surveys shall be relocated out of the area of disturbance by a USFWS-approved biologist.
- Work in occupied habitat shall only occur during the dry season.
- Areas beneath construction equipment and vehicles shall be inspected daily, prior to operation, for presence of CTS/CRLF under tracks/tires and within machinery by a USFWS approved biologist until the biologists determines a designated contractor is sufficiently trained to monitor. A USFWS approved biologist will ensure that this individual receives training consistent with USFWS requirements. A USFWS approved biologist will be on-call to come to the site if CTS/CRLF are found.
- CTS/CRLF one-way, exclusion fencing shall be installed between construction areas and occupied habitat. This fencing shall extend 1.3 miles from the boundary of the occupied habitat along the alignment of the Project area.
- Overnight staging of vehicles or equipment shall be prohibited within 100 feet of occupied or assumed-occupied breeding resources.

- Work in occupied breeding habitat shall only occur during the dry season.

After construction:

- Temporary disturbance of occupied habitat shall be mitigated by restoring the area to pre-Project contours and revegetation.

MM BIO-11: Measures to Minimize Impacts on the Western Spadefoot Toad

If a western spadefoot toad is encountered during construction activities, it will be allowed to move out of harm's way of its own volition, or a qualified biologist will relocate it to the nearest suitable habitat that is at least 100 feet outside of the construction impact area.

Prior to moving equipment or materials each day, construction personnel will inspect underneath and around equipment and other Project materials (e.g., stored pipes greater than two inches in diameter) where located within 200 feet of aquatic habitat for western spadefoot toads. If western spadefoot toads are found, they will be allowed to move out of the construction area under their own volition, or a qualified biologist will relocate individuals to the nearest suitable habitat that is at least 100 feet outside of the construction impact area.

MM BIO-12: Measures to Minimize Impacts on the Northern California Legless Lizard, California Glossy Snake, San Joaquin Coachwhip, and Coast Horned Lizard

Prior to moving equipment or materials each day, construction personnel will inspect underneath and around equipment for northern California legless lizard, California glossy snake, San Joaquin coachwhip, and coast horned lizard. If these species are encountered during construction activities, they will be allowed to move out of harm's way of their own volition or a qualified biologist will relocate the organism(s) the nearest suitable habitat that is at least 100 feet outside of the construction impact area.

MM BIO-13: Measures to Minimize Impacts on the Giant Garter Snake

Before and during construction:

- Protocol presence/absence surveys shall be conducted by a USFWS approved biologist in suitable habitat prior to construction. As the project is multi-year, protocol presence/absence surveys can be conducted in portions of the Project Area that have work scheduled the following year. Alternatively, presence can be assumed in suitable habitat and the measures below implemented.
- Avoid construction activities within 200 feet from the banks of occupied giant garter snake aquatic habitat. Confine movement of heavy equipment to existing roadways to minimize habitat disturbance.
- Construction activity within suitable habitat shall be conducted between May 1 and October 1. This is the active period for giant garter snakes and direct mortality is lessened, because snakes are expected to actively move and avoid danger. Impacts to winter hibernacula shall be avoided during the period of October 2 and April 30.
- The Project area shall be surveyed for giant garter snakes 24-hours prior to construction activities. Survey of the Project area shall be repeated if a lapse in construction activity of two weeks or greater has occurred. If a snake is encountered during construction, activities shall cease until appropriate corrective measures have been completed or it has been determined that the snake will not be harmed.

- Any dewatered habitat shall remain dry for at least 15 consecutive days after April 15 and prior to excavating or filling of the dewatered habitat.

MM BIO-14: Measures to Minimize Impacts on the Western Pond Turtle

Before construction activities begin, a qualified biologist will conduct western pond turtle surveys within creeks and in other ponded areas affected by the Project. Adjacent upland areas will be examined for evidence of nests and individual turtles. The Project biologist will be responsible for the survey and for the relocation of pond turtles, if found. Construction will not proceed until reasonable effort has been made to capture and relocate as many western pond turtles as possible to minimize take. However, some individuals may remain undetected or enter sites after surveys and could be subject to injury or mortality. If a nest is observed, a biologist with the appropriate permits and prior approval from CDFW will move eggs to a suitable location or facility for incubation and release hatchlings into the creek system the following autumn.

MM BIO-15: Measures to Minimize Impacts on the Longhorn Fairy Shrimp, Vernal Pool Fairy Shrimp, and Vernal Pool Tadpole Shrimp

Before and during construction:

- Protocol presence/absence surveys shall be conducted by a USFWS approved biologist in suitable habitat prior to construction. As the Project is multi-year, protocol presence/absence surveys can be conducted in portions of the Project area that have work scheduled the following year. Alternatively, presence can be assumed in suitable habitat.
- Work in occupied listed vernal pool branchiopod habitat shall only occur during the dry season.
- The authorized limits of branchiopod habitat (i.e., 250 feet from the pool edge) will be clearly staked in the field, to prevent construction personnel from causing impacts to areas outside of work limits.
- Where temporary impacts will occur to occupied or assumed-occupied listed vernal pool branchiopod habitat, the top 1 to 3 inches of soil shall be salvaged to preserve the cyst bank. Saved topsoil shall be covered to avoid erosion. Topsoil shall be replaced as soon as possible upon completion of work in the impacted habitat.
- Overnight staging of vehicles or equipment shall be prohibited within 100 feet of occupied or assumed-occupied fairy shrimp.

After construction:

- Temporary impacts to listed branchiopod habitat shall mitigated for by restoring the affected area to pre-Project contours, compaction levels, and revegetation.

MM BIO-16: Measures to Minimize Impacts on Sensitive Natural Communities

Temporary and permanent impacts on sensitive natural communities known to occur within the Project area will be minimized to the greatest extent practicable. Trees and other vegetation will not be removed if it can otherwise be reasonably avoided. In determining areas where vegetation must be removed to provide adequate access for construction or staging, consideration will be given to selecting areas that require the least amount of removal of mature trees and canopy cover in coordination with a qualified biologist.

Prior to the initiation of construction activities, exclusionary fencing will be installed along the boundaries of all environmentally sensitive areas to be avoided, which will include sensitive natural communities and aquatic resources adjacent to the areas of Project-related impacts, so that impacts on environmentally sensitive areas outside of the construction area are minimized. Locations of environmentally sensitive areas and exclusionary fencing will be identified on construction plans. The exclusionary fencing will be inspected and maintained on a regular basis throughout Project construction in the areas where the fencing is needed to avoid unintended disturbance.

A Post-Construction Revegetation and Monitoring Plan will be developed and implemented to provide for the restoration of temporarily impacted riparian habitats to pre-existing conditions. The plan will include provisions for the planting of native woody vegetation and native seed mix or otherwise provide for the reestablishment of self-sustaining native riparian vegetation similar to the existing native riparian vegetation community. Planting of native riparian vegetation will include but is not limited to replacement of any trees removed by the Project at a 3:1 ratio (replaced to removed) with appropriate native tree species. For the purposes of this requirement, a tree is defined as a native woody plant (i.e., tree or mature shrub) with at least one stem measuring two inches or greater diameter at breast height. The plan will also identify success criteria and provide for annual or other regular monitoring to evaluate whether the revegetation effort has met the success criteria. The plan will include measures for remedial actions (e.g., additional plantings, supplemental irrigation, increased monitoring) if monitoring efforts indicate that success criteria are not being met.

MM BIO-17: Measures to Minimize Impacts on Wetlands

Prior to any temporary or permanent impacts on aquatic resources, any required permits/authorizations from RWQCB and USACE will be obtained. All terms and conditions of the required permits/authorizations will be implemented.

Where jurisdictional wetlands and other waters cannot be avoided, to offset temporary and permanent impacts that would occur as a result of the Project, restoration and compensatory mitigation to ensure no net loss will be provided as described below.

A wetland mitigation and monitoring plan will be developed in coordination with CDFW, USACE, or RWQCB to detail mitigation and monitoring obligations for temporary and permanent impacts to wetlands and other waters due to construction activities and for other CDFW jurisdictional areas. The plan will quantify the total acreage affected; provide for mitigation, as described below, to wetland or riparian habitat; specify annual success criteria for mitigation sites; specify monitoring and reporting requirements; and prescribe site-specific plans to compensate for wetland losses resulting from the Project consistent with the USACE's no net loss policy.

Prior to construction, the aquatic structure of wetland and riparian areas to be disturbed will be photo-documented and measurements of width, length, and depth will be recorded. Recontouring and revegetation of the disturbed portions of jurisdictional areas in areas temporarily affected by construction prior to demobilization by the construction contractor will be completed at the end of Project construction. Creek banks will be recontoured to a more stable condition if necessary.

Revegetation will include a palette of species native to the watershed area according to a revegetation plan to be developed by Reclamation and submitted to USACE, CDFW, and RWQCB for approval. Following removal, woody trees habitat acreage would be replanted at a minimum 1:1 ratio, or as determined and agreed upon by the permitting agencies. Interim vegetation or other measures will be implemented as necessary to control erosion in disturbed areas prior to final revegetation.

Wetland and other waters impact in the construction and inundation area will be compensated at a ratio of 2:1 or at a ratio agreed upon by the wetland permitting agencies. Compensatory mitigation will be conducted by creating or restoring wetland and aquatic habitat at an agency-approved location on nearby lands or through purchasing mitigation credits at a USACE- or CDFW-approved mitigation bank (depending on the resource). If mitigation is conducted on- or off-site, a five-year wetland mitigation and monitoring program for on- and off-site mitigation will be developed. Appropriate performance standards may include a 75-percent survival rate of restoration plantings; absence of invasive plant species; and a viable, self-sustaining creek or wetland system at the end of five years.

A weed control plan for the Project to limit the spread of noxious or invasive weeds will be developed. This plan would be consistent with current integrated pest management plans already in practice on lands surrounding the reservoir. Noxious or invasive weeds include those rated as 'high' in invasiveness by the California Invasive Plant Council. The plan will include a baseline survey to identify the location and extent of invasive weeds in the Project area prior to ground-disturbing activity, a plan to destroy existing invasive weeds in the construction area prior to initiation of ground-disturbing activity, weed-containment measures while the Project is in progress, and monitoring and control of weeds following completion of construction.

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Delta-Mendota Canal Subsidence Correction Project
Draft Environmental Assessment/Initial Study

Appendix N: Archaeological Survey and Evaluation Report

ARCHAEOLOGICAL SURVEY AND EVALUATION REPORT FOR THE DELTA-MENDOTA CANAL SUBSIDENCE CORRECTION PROJECT, CALIFORNIA (REDACTED VERSION)



Signage for the Delta-Mendota Canal

Prepared for

US Bureau of Reclamation
Region 10
2800 Cottage Way
Sacramento, CA 95825

and

San Luis & Delta-Mendota Water Authority
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With assistance from
JRP Historical Consulting LLC

February 2023

ARCHAEOLOGICAL SURVEY REPORT FOR THE DELTA-MENDOTA CANAL SUBSIDENCE CORRECTION PROJECT, CALIFORNIA (REDACTED VERSION)

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February 2023

Confidential Information

Archaeological and other heritage resources can be damaged or destroyed through uncontrolled public disclosure of information regarding their location. This document contains sensitive information regarding the nature and location of archaeological sites that should not be disclosed to unauthorized persons.

Information regarding the location, character or ownership of a historic resource is exempt from the Freedom of Information Act pursuant to 54 USC Section 307103 (National Historic Preservation Act) and 16 USC Section 470hh (Archaeological Resources Protection Act) and California State Government Code, Section 6254.10.

If any information in this document is to be released for public review, all locational information associated with archaeological resources must be redacted before distribution.

SUMMARY OF FINDINGS

The U.S. Bureau of Reclamation and San Luis & Delta-Mendota Water Authority are proposing to correct issues associated with subsidence on the Delta-Mendota Canal (DMC) in order to restore the canal to its original design capacity. Two alternatives are under consideration. Alternative 1 is the No Project (under the California Environmental Quality Act)/No Action (under the National Historic Preservation Act) Alternative that describes the future without the project. Alternative 2 proposes to raise deficient concrete lining and embankment (berm) segments of the canal and to raise impacted structures.

The Area of Potential Effects (APE) is approximately 114 miles long and is located on multiple U.S. Geological Survey topographic quadrangle maps and within various Townships, Ranges, and Sections. It is located within Alameda, Contra Costa, Fresno, Merced, San Joaquin, and Stanislaus counties. Due to the need for operational flexibility for field staff, Reclamation's entire DMC ROW and some areas adjacent to the ROW are included in the APE. All access and staging will occur via existing operations and maintenance access roads along the DMC and would be contained within the ROW. The maximum vertical disturbance for the project will extend 100 feet for cone penetration tests and soil borings. The APE for the proposed activities amounts to 5,899 acres in total.

This Archaeological Survey Report documents the results of the Class III inventory and National Register of Historic Places (NRHP)/California Register of Historical Resources (CRHR) eligibility evaluations for archaeological resources. Built environment resources are briefly discussed within this report. The Historic Resources Inventory and Effects Analysis Report prepared by JRP Historical Resources LLC (JRP) addresses the built environment resources in full and is presented in Appendix F. Pacific Legacy, Inc. was subcontracted by CDM Smith to conduct the inventory of the Project area of potential effect (APE) to assist the Authority and Reclamation in complying with their obligations under Section 106 of the National Historic Preservation Act (NHPA) and the California Environmental Quality Act (CEQA). Prior to fieldwork, Pacific Legacy requested an archival and records search of the APE from the California Historic Resources Information System (CHRIS) information centers to identify previous cultural studies and resources. Pacific Legacy also requested that the Native American Heritage Commission conduct a Sacred Lands File search of the APE and was responsible for consultation with Native American Tribes as detailed in Assembly Bill 52. Section 106 consultation was conducted directly between the Bureau of Reclamation and Tribes.

Pacific Legacy completed an intensive pedestrian survey of 5,735 acres of the APE in May and June, 2022. Two newly identified archaeological sites and two archaeological isolates were located during the survey. The two newly identified archaeological sites, DMC-CRP-001 and DMC-CRP-002, were evaluated for eligibility for the NRHP and the CRHR and were recommended ineligible for inclusion in either list. Five built environment resources were recorded within the APE that are considered eligible for the NRHP and CRHR. The JRP report identified three linear historic properties that cross over or under Delta-Mendota Canal and have been previously determined eligible for listing in the National Register of Historic Places: San Joaquin Pipelines/Hetch Hetchy Aqueduct, Santa Fe Grade, and Outside Canal. This report and concludes that two additional properties – Delta-Mendota Canal and San Luis Drain – meet the significance criteria for listing.

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Appendix A. Project Figures (Redacted)
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Appendix D. Archaeological Site Records (Redacted)
Appendix E. Archaeological Photographic Documentation (Redacted)
Appendix F. Historic Resources Inventory and Effects Analysis Report

1.0 INTRODUCTION

This Archaeological Survey Report (ASR) documents the results of an archaeological inventory study conducted by Pacific Legacy, Inc. on behalf of the U.S. Bureau of Reclamation (Reclamation) and San Luis & Delta-Mendota Water Authority (Authority) for the proposed Delta-Mendota Canal Subsidence Correction Project (Project) in Alameda, Contra Costa, Fresno, Merced, San Joaquin, and Stanislaus Counties, California (see Appendix A, Figure 1). Pacific Legacy, Inc. was subcontracted by CDM Smith to conduct a Class III intensive survey of the Project area of potential effect (APE) to assist the Authority and Reclamation in complying with their obligations under Section 106 of the National Historic Preservation Act (NHPA) and the California Environmental Quality Act (CEQA).

Background research conducted for the Project included archival and record searches (Appendix B) as well as consultation with the Native American Heritage Commission (NAHC), Native American tribal representatives, and members of the public (Appendix C). The pedestrian field inventory of the survey area was conducted in May and June, 2022. Pacific Legacy conducted archaeological site recording during the field inventory.

1.1 DESCRIPTION OF THE UNDERTAKING

The purpose of the Project is correct issues associated with subsidence on the Delta-Mendota Canal (DMC) in order to restore the canal to its original design capacity and to protect the canal from stormwater that could either enter the canal or flow across the canal. Two alternatives are under consideration. Alternative 1 is the No Project (under the California Environmental Quality Act)/No Action (under the National Historic Preservation Act) Alternative that describes the future without the project. Alternative 2 proposes to raise deficient concrete lining and embankment (berm) segments of the canal and to raise impacted structures.

1.1.1 Alternative 1 – No Project/No Action

The No Project Alternative (under CEQA) describes the future without the project and may include some reasonably foreseeable changes in existing conditions and changes that would reasonably be expected to occur in the foreseeable future if the project were not approved. The No Action Alternative (under NEPA) also describes future circumstances without the Proposed Action and includes predictable actions by persons or entities, other than the federal agency involved in a project action, acting in accordance with current management direction or level of management intensity.

Under the No Project/No Action Alternative, the existing conditions of the DMC would remain unchanged, and the flow rates would be reduced from design capacity during operation to meet Reclamation Design Standards No. 3 (Reclamation 2014). Currently, 30 out of the existing 115 bridges along the DMC are considered deficient because they do not have 1 foot of clearance above the Maximum Water Surface Elevation when the canal is operated at design flow (MWSEL). However, the number of deficient bridges is expected to reach 45 when taking into consideration future subsidence conditions. Deficient bridges would be partially submerged when the canal is operated at the design flow, resulting in safety risks. To operate the canal safely and in accordance with Reclamation safety standards under the No Project/No Action, the maximum flow reduction in the DMC is estimated to be 1,457 cfs (44 percent reduction) from design capacity (Reclamation 2021a).

The No Project/ No Action Alternative includes current conditions in the project area and will be analyzed consistently with the Reinitiation of Consultation on the Coordinated Long-term Operations of CVP and SWP (ROC on LTO) and the 2018 Addendum to the Coordinated Operation Agreement Central Valley Project/State Water Project ROD that are assumed to also reasonably portray future anticipated operational conditions.

Design flows, reduction in flow, and actual flow capacities in the DMC for current and future (with future subsidence) conditions.

1.1.2 Alternative 2

Under Alternative 2, Raise Deficient Structures, the deficient lining, embankment, and impacted structures of the canal would be raised to restore the canal capacity to its original design flow capacity. Specific actions would include raising deficient concrete lining segments and bank segments to meet the minimum freeboard requirements, installing riprap for erosion protection to stabilize the banks along the earthen segment, replacing bridges and pipeline crossings that do not have enough clearance above water surface elevation to meet minimum required clearings, raising the gates of check structures and wasteways to design level and modify impacted structures, and evaluating existing drainage structures to modify them for safe passage of stormwater.

The proposed modifications of the canal and related structures would be in accordance with current federal, state, and local design guidelines and standards. Under this alternative, the canal would be modified to satisfy current Reclamation safety standards including freeboard requirements for the canal lining and embankment. Construction requirements for this alternative include:

- **Raising deficient canal concrete lining**. To achieve this, new concrete lining would be placed above the existing concrete lining, with seals installed between the old and new concrete linings to eliminate seepage. At locations with ladders installed in the concrete lining (every 750 feet), additional risers would be added in the new lining.
- **Raising the earth embankment at deficient bank segments of the canal**. This would be achieved by adding fill material from an existing borrow sites along the canal right-of-way (ROW). The added fill material would be rolled and smooth to match adjacent road elevations, and an asphalt chip seal will be installed on the left service road along the length of the canal.
- **Stabilizing the canal banks along the earthen-lined segment of the canal.** This would require lowering the water depth in the canal by up to six feet during construction, which would allow construction to extend about 6 feet below the Maximum Water Surface Elevation when the canal is operated at design flow (MWSEL). Two-foot-deep sections of earthen materials would be excavated from the sides of the canal, and a one-foot-thick strip of filter material would be installed above the excavated surface followed by a one-foot riprap that would be placed above the filter material.
- **Repairing distressed concrete lining above and below the water's surface.** Lining distresses were found to be either in the upper parts of the canal prism or more extensive, extending to the bottom of the canal prism. Distressed lining at locations above MP 50 (between station 1890+25 and 1905+00.00) include MPs 8.2 (between station 422+01 and 433+00), 17.8 (between stations 982+00 and 996+51), 18.1 (between stations 997+50 and 1019+48), 23.2 (between stations 1260+50 and 1268+37.31), 30 (between stations 841+88 and 862+00), 34 (between stations 1054+75 and 1060+00), 42.3 (between stations 1483+20 and 1505+00), and 42.6 (between stations 1506+19.5 and 1514+00). The

distresses at these locations are local and do not extend to the bottom of the canal, so to fix these the water depth would be lowered about 6 feet below the design level during construction. Damaged lining would be removed, and the embankment would be excavated for at least 2 feet below the lining where all materials would be removed and replaced with selected and acceptable earth fill material. At locations downstream of MP 50 (between station 1890+25 and 1905+00.00), the lining distresses extend under the water surface, and sections are distorted at these locations. Damaged concrete lining and material distorting the canal would be removed with underwater operations, and grouted mattress would be installed and grouted with cement underwater at applicable locations.

- **Replacing impacted vehicle bridges**. Forty-five bridges have been identified as impacted under Alternative 2. Identified bridges would be replaced by single span bridges with deep foundations at two abutments of the bridges in the concrete-lined segment. Along the earthen segment, intermediate piers would be constructed to support the replaced bridges within the canal prism. The low chord elevation of replaced bridges would be at least 3 feet above the MWSEL, including predicted subsidence. Asphalt pavement would be installed for the modified road segments. All affected utilities would be replaced and attached to newly constructed bridges. Earthwork would extend on both sides of the bridge to smoothly merge the profile of the bridge deck with the approach roads. Pipes carrying natural gas would be relocated under the canal utilizing horizontal directional drilling, whereas pipes carrying any other liquids would be replaced by pipes of equal diameter. New pipes would be epoxy coated and attached to bridges with hangers.

- **Replacing impacted pipeline crossings.** Thirty-six pipeline crossings have been identified as impacted under Alternative 2. The new pipelines would be carried by truss bridges, and pipes adjacent to each other would be carried by single bridges.

- **Modifying check structures and wasteways.** Although gates on check structures and wasteways were designed to have heights that exceeded the MWSEL at their locations, subsidence has caused an increase in water surface elevations which has resulted in some of these gates having heights lower than the MWSEL. To avoid overtopping, seventeen gates would require raising. Raising the heights of the gates could require changes to the drums, hoists, and cables to confirm that the gates will open to levels above the new MWSEL. The smaller (20 x 17 foot) gates are not likely to require hoist system replacements while the larger (18 x 15 foot) gates, located at check structures 14, 15, 16, 17, 19, and 20, are likely to require hoist system replacements.

- **Modifying turnouts.** Eighty-two turnouts on the left side of the canal would require raising. The walls requiring raise would be raised with concrete, the existing galvanized steel would be removed, and metal guards would be installed around each stilling pit for all gravitational turnouts.

- **Modifying drainage structures**. Work on drainage structures would include installing trash racks for drain inlets; installing flared inlets for pipe culverts without inlets; replacing drain inlets that require relocation during replacement of deficient bridges; installing additional drain inlets at MP 18.06 (station 997+25), 20.71 (station 1133+75), 41.08 (between stations 1427+00 and 1433+50), 49.83 (between stations 1889+00 and 1890+25)and 60.44 (station 2497+50); replacing existing headwalls and wing walls with new ones that are higher at MP 5.77 (station 303+15), 21.91 (station 1197+00), 25.62 (station 613+36), 30.63 (station 877+92), 41.93 (station 1474+40), 45.75 (station

1673+80), and 64.28 (station 2709+35); replacing the clogged side culvert at MP 5.77 (station 303+15) with a new box culvert, raising the headwalls for drain inlets, culverts, and overchutes at some locations; and installing or replacing riprap at inlets, outlets, culverts, and overchutes to protect embankment from erosion.

1.2 PROJECT AREA OF POTENTIAL EFFECT

The APE is approximately 114 miles long and is located on multiple U.S. Geological Survey topographic quadrangle maps and within various Townships, Ranges, and Sections. The APE is depicted on these maps in Appendix A, Figure 1. The APE is located within Alameda, Contra Costa, Fresno, Merced, San Joaquin, and Stanislaus counties. Due to the need for operational flexibility for field staff, Reclamation's entire DMC ROW and some areas adjacent to the ROW are included in the APE. All access and staging will occur via existing operations and maintenance access roads along the DMC and would be contained within the ROW. The maximum vertical disturbance for the project will extend 100 feet for cone penetration tests and soil borings. The APE for the proposed activities amounts to 5,899 acres in total. Appendix A contains project location, vicinity, and APE maps.

1.3 REGULATORY CONTEXT

Reclamation is the lead Federal Agency for the Project under NEPA, and the Authority is the lead State Agency under CEQA. As a federal undertaking, the Project is subject to Section 106 of the NHPA[1] (54 USC 300108), which states:

> The head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking in any State and the head of any Federal department or independent agency having authority to license any undertaking, prior to the approval of the expenditure of any Federal funds on the undertaking or prior to the issuance of any license, shall take into account the effect of the undertaking on any historic property. The head of the Federal agency shall afford the [Advisory] Council [on Historic Preservation] a reasonable opportunity to comment with regard to the undertaking.

The implementing regulations of Section 106 of the NHPA are found in 36 CFR Part 800, which identifies the steps and consultation requirements that must be taken to comply with Section 106 of the NHPA. Pursuant to 36 CFR 800.16(l)(1), a historic property is defined as:

> any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria.

The criteria for determining NRHP eligibility are found in 36 CFR Part 60.

[1] Following ACHP guidelines, "Section 106" is referred to as that section of the original public law that enacted the NHPA as opposed to its current legal citation (54 USC 306108). It is a reference that has been in constant use for almost 50 years. The provisions of the newly codified NHPA may be found under 54 USC 300101 et seq.

In the event that historic properties within the APE for an undertaking will be subject to adverse effects, the lead federal agency is required to consider ways to avoid, minimize, or mitigate ("resolve") such effects, in consultation with the Advisory Council on Historic Preservation (ACHP), the State Historic Preservation Officer (SHPO), and other Section 106 consulting parties. This often requires the development and execution of a Memorandum of Agreement or Programmatic Agreement among the consulting parties (36 CFR 800.6).

Section 106 regulations allow federal agencies to conduct "nondestructive project planning activities before completing compliance with Section 106" (36 CFR 800.1[c]), provided any subsequent consideration of alternatives to avoid, minimize, or mitigate adverse effects is not restricted during the planning process. At this time, Reclamation does not have an undertaking with the potential to affect historic properties as the feasibility and environmental studies are planning activities. Should Congress authorize an identified Project alternative or other Project that addresses the stated aims of the Project, and the lead Federal Agency has an undertaking as defined in 36 CFR 800.14(y) and 800.3(a)(1), that federal action will then be subject to NHPA Section 106 compliance and other federal cultural resources laws as applicable.

Because the Project construction alternative includes lands owned and administered by Reclamation, additional cultural resource policies and procedures also are relevant. Among these is the Native American Graves Protection and Repatriation Act (NAGPRA) (Public Law 101-601; 25 USC 3001-3013), which describes the rights of Native American lineal descendants, Indian tribes, and Native Hawaiian organizations with respect to the treatment, repatriation, and disposition of Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony, referred to collectively in the statute as "cultural items," with which they can show a relationship of lineal descent or cultural affiliation. NAGPRA also establishes procedures for the inadvertent discovery or planned excavation of Native American cultural items on federal or tribal lands.

Additional mandates applicable to Reclamation administered lands are outlined in the manuals "Policy for Cultural Resources Management" (LND P01; Reclamation 2012a), "Directives and Standards for Cultural Resource Management" (LND 02-01; Reclamation 2012b), and "Administration of the Archaeological Resources Protection Act (ARPA) on Bureau of Reclamation Land" (LND 02-04; Reclamation 2014). Reclamation is also guided by the "Policy for Museum Property Management" (LND P05; Reclamation 2012c) and "Directives and Standards for Museum Property Management" (LND 02-02; Reclamation 2012d).

1.3.1 National Register of Historic Places

The NRHP is "an authoritative guide to be used by federal, state, and local governments, private groups, and citizens to identify the Nation's cultural resources and to indicate what properties should be considered for protection from destruction or impairment" (36 CFR 60.2). Eligibility for inclusion in the NRHP is determined by applying the following criteria, which were developed by the National Park Service in accordance with the NHPA and outlined in 36 CFR 60.4:

> The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and
>
> A. That are associated with events that have made a significant contribution to the broad patterns of our history; or
>
> B. That are associated with the lives of persons significant in our past; or

C. That embody distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. That have yielded, or may be likely to yield, information important in prehistory or history.

Any prehistoric or historic period district, site, building, structure, or object that meets one or more of the criteria above and possesses sufficient integrity may be eligible for inclusion in the NRHP as a historic property.

Typically, cemeteries, birthplaces, or graves of historic period figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, commemorative properties, and properties that have achieved significance within the past 50 years are not considered eligible for listing in the NRHP. Such properties may qualify, however, if they are integral parts of districts that do meet the criteria or if they fall within the following categories:

- A religious property deriving primary significance from architectural or artistic distinction or historical importance; or

- A building or structure removed from its original location, but which is significant primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event; or

- A birthplace or grave of a historical figure of outstanding importance if there is no appropriate site or building directly associated with his productive life.

- A cemetery which derives its primary significance from graves of persons of transcendent importance, from age, from distinctive design features, or from association with historic events; or

- A reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived; or

- A property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own exceptional significance; or

- A property achieving significance within the past 50 years if it is of exceptional importance (36 CFR 60.4).

1.3.2 California Environmental Quality Act

State historic preservation regulations affecting the Project include the statutes and guidelines contained in CEQA. CEQA requires the lead State Agency to consider carefully the potential impacts of a project on historical resources. A "historical resource" includes, but is not limited to, any object, building, structure, site, area, place, record, or manuscript that is considered historically

or archaeologically significant (PRC 5020.1). Section 15064.5 of state CEQA *Guidelines* specifies criteria for evaluating the significance or importance of cultural resources as follows:

- The resource is associated with events that have made a contribution to the broad patterns of California history;
- The resource is associated with the lives of persons important in our past;
- The resource embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important individual or possesses high artistic values; or
- The resource has yielded, or may be likely to yield, important information in prehistory or history.

The technical advice series produced by the California Governor's Office of Planning and Research offers guidance on procedures to identify historical resources, evaluate their importance and potential for listing in the CRHR, and estimate potential impacts on historical resources. The advice series strongly recommends that Native American concerns and the concerns of other interested persons and corporate entities including, but not limited to, museums, historical commissions, associates, and societies be solicited as part of the process of cultural resources inventory. In addition, California law protects Native American burials, skeletal remains, and associated grave goods regardless of their antiquity and provides for the sensitive treatment and disposition of those remains.

1.3.3 California Register of Historical Resources

The CRHR, which is similar to the NRHP, is an authoritative guide that was created to identify the state's historical resources and to indicate what properties are subject to protection, to the extent prudent and feasible, from substantial adverse change. The criteria for CRHR eligibility are based upon NRHP criteria. Certain resources are determined by the statute to be automatically included in the CRHR, including California properties formally determined eligible for or listed in the NRHP, California Historical Landmarks (CHL) numbers 770 and above, and California Points of Historical Interest.

Per the CRHR, historical resources may consist of buildings, structures, objects, or archaeological sites. Each of these entities is assessed for its historical, architectural, archaeological, cultural, or scientific importance. Per CEQA *Guidelines*, (Section 15064.5[b]), project activities may have a significant impact on the environment if they would cause a substantial adverse change in the significance of a historical resource. Activities that could result in a substantial adverse change include demolition, replacement, substantial alteration, and/or relocation of the resource. Steps that must be implemented in order to comply with state CEQA *Guidelines* include the following:

- Identify cultural resources;
- Evaluate the significance of the cultural resources based on established thresholds of historical, architectural, archaeological, cultural, or scientific importance;
- Evaluate the effects of a project on all cultural resources; and

- Develop and implement measures to mitigate the effects of the project on significant cultural resources.

The state Office of Historic Preservation has broad authority under federal and state law for the implementation of historic preservation programs in California. The SHPO comments on effect determinations and the eligibility of cultural resources for listing in the NRHP and the CRHR.

1.4 PERSONNEL

John Holson, MA, RPA, and Anmarie Medin, MA, RPA, served as co-principal investigators for this Project. Christopher Peske, BA, served as field director with Ashley Schmutzler, MA, serving as assistant field director. Archaeologists who participated in fieldwork included Griffen Bragagnolo, BA, Gloria Brown, MA, Jack Flynn, BA, Myra Jamison, Bridget Parry, BA, and Walter Tovar Saldana, MA. Graham Dalldorf, MA, served as the geoarchaeologist for the Project. Mr. Peske was the lead author of this report under the supervision of Mr. Holson. Ms. Medin, Ms. Holm, Elena Reese, MA, Mr. Dalldorf, and Ms. Jamison provided contributions to the report. All key personnel involved in the Project meet the professional qualification standards described in *Archaeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines*.

2.0 SETTING SUMMARY

2.1 PHYSICAL CONTEXT AND SETTING

The DMC runs through several physiographic provinces and biotic communities which are briefly described here because they have bearing on human occupation of the landscape and thus cultural resources that might be affected by the project. The locations and characteristics of California Native American temporary and permanent habitations, procurement areas, and travel routes were influenced by local physiography, flora, and fauna, as were later historic period settlements, infrastructural developments, and commercial enterprises.

The DMC APE lies along the western side of the San Joaquin Valley at the ecological interface with the eastern Diablo Range foothills, where the peaks and mountains to the west give way to the low-lying Central Valley alluvial plain to the east. Excellent treatments of Central Valley physiography, flora, and fauna may be found in Schoenherr (1992), Lightfoot and Parrish (2009), Munz (1963), Bartow (1991), and Rosenthal and Meyer (2004a). The following discussion draws heavily on these sources.

The Diablo Range is marked by a number of seismic faults that have helped to contribute to its varied topography of variable peaks, valleys, and plateaus. Jurassic to Cretaceous metamorphic rock (Franciscan Complex) underly the Range. Soils within the eastern Diablo Range foothills include Carbona-Calla and Wisflat-Badland Arburua series soils in the north and O'Neil-Apollo and Wisflat-Badland Arburua series soils to the south (USDA-NRCS 2007). The A-horizon (surface or near surface) texture of most of these soils may be characterized as loam or clay-loam with 0-30% gravel inclusions. Colors range from brown or dark brown to grayish brown or dark gray. Today, many of these soils support annual forbs and grasses as well as livestock grazing.

The eastern margins of the Diablo Range are characterized by Valley Grassland, which once dominated all well-drained areas within the Central Valley and the larger valleys of the Coast Ranges (Schoenherr 1992). This grassland was largely characterized by perennial bunchgrasses such as needle-grass (*Stipa* spp.), triple-awned grass (*Aristida* spp.), bluegrass (*Poa* spp.), and rye grass (*Elymus* spp.), though annual grasses and herbs also were prevalent along the western edges of the San Joaquin Valley (Schoenherr 1992). Shrubs such as saltbush (*Atriplex polycarpa*) dotted the alluvial fans of the eastern Diablo Range, providing forage for herds of pronghorn. With the arrival of Europeans and the spread of agriculture, many cultivated species were introduced in addition to many Old World weed species such as wild oats (*Avena fatua*), brome grass (*Bromus* spp.), filaree (*Erodium cicutarium*), and star-thistle (*Centaurea melitensis)*, among others.

Until the late 1800s when Euro-American settlement increased dramatically, tule elk (*Cervus canadensis nannodes*), pronghorn (*Antilocapra americana*), and black-tailed deer (*Odocoileus hemionus*) were widespread within the Diablo Range foothills and the San Joaquin Valley. Herds of these animals would have been found throughout Valley Grassland habitats and would have ranged in response to seasonal conditions between the riparian forests and marshes of the lowlands to the lower limits of the foothill woodlands. Pronghorn and tule elk were thought to have been extirpated from the Central Valley by 1870, though a single pair of tule elk was discovered near Buena Vista Lake in 1874, and conservation measures were ultimately undertaken to protect the species in the 1970s (Linse 1998). Pronghorn, once found throughout California, were reintroduced in certain parts of the state, though their numbers remain vastly reduced (Schoenherr 1992:550).

Other mammals once common within the foothills included the grizzly bear (*Ursus arctos* ssp.), black bear (*Ursus americana*), gray wolf (*Canis lupus*), coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), bobcat (*Lynx rufus)*, mountain lion (*Puma concolor),* spotted skunk (*Spilogale putorius*), stripped skunk (*Mephitis mephitis*), badger (*Taxidea taxus*), and raccoon (*Procyon lotor*). Smaller mammals such as the cottontail (*Sylvilagus audoboni*), brush rabbit (*Sylvilagus bachmani*), gray squirrel (*Sciurus griseus*), ground squirrel (*Spermophilus beecheyi*), and gopher (*Thomomys bottae)* were also prevalent.

Bird species including the California quail (*Callipepla californica*), dusky grouse (*Dendragapus obscures),* Stellar's jay (*Cyanocitta stelleri),* red-tailed hawk (*Buteo jamaicensis*), black-shouldered kite (*Elanus leucurus*), American kestrel (*Falco sparverius*), California condor (*Gymnogyps californianus*), and raven (*Corvus corax*) were common. Although some of these species such as the kite and kestrel have benefitted from human activities, others such as the condor have suffered from habitat destruction, poaching, and lead poisoning (Schoenherr 1992). Within the shallow streams of the foothills, steelhead trout (*Oncorhynchus mykiss*), Chinook salmon (*Oncorhynchus tshawytscha)*, Sacramento sucker (*Catostomus occidentali*), and Sacramento pike-minnow (*Ptychocheilus grandis*) may have been encountered.

Historic period settlement of the eastern Diablo Range foothills resulted in dramatic changes to the biotic communities that once characterized the region. As Schoenherr (1992:520) has pointed out, "only about 1% of the grassland today could be considered pristine." Many animal species that were once widespread and integral to California Native American lifeways were extirpated within the DMC vicinity or, as in the case of the California grizzly, driven to extinction. Other species, such as rodents, skunks, and certain birds of prey, have thrived and remained abundant.

2.2 ARCHAEOLOGICAL CONTEXT

2.2.1 Central California Archaeology and the Development of Cultural Sequences

The archaeological record within the Central Valley encompasses the full range of prehistoric hunter-gatherer adaptations. Native Californians within the Central Valley developed a sophisticated material culture, became central figures within an extensive trade system incorporating distant and neighboring regions, and achieved population densities equaled only by agricultural societies in the American Southwest and Southeast (Rosenthal et al. 2007). Despite its centrality to California prehistory, however, archaeological research within the Central Valley has progressed relatively little within the three decades since Moratto's (1984) synthesis of California archaeology.

The eastern Diablo Range foothills and the lower Delta and San Joaquin Valley areas that make up the Study Area are characterized by quaternary landscapes with low-elevation alluvial fans, stream channels, sloughs, marshes, and hilly grasslands. Dramatic environmental changes occurred during prehistory within the San Joaquin Valley, including faunal extinctions, the emergence of wetlands, flooding and siltation of bottom lands, the cyclical advent and disappearance of shallow lakes, and numerous climatic fluctuations (Moratto 1984). No single cultural historical framework has been established that accommodates the entire prehistoric record of the Central Valley, though detailed cultural chronologies have been derived for certain sub-regions such as the lower Delta. In discussing the cultural history of the Study Area, it is therefore appropriate to use the broad period and stage classification system developed by Fredrickson (1974) and refined by Rosenthal et al. (2007:150) while referencing more localized cultural historical sequences put forth by Olsen and Payen (1969) and Groza (2002). Broad cultural periods identified for the Central Valley include the Paleo-Indian (13,500-10,500 BP), Lower Archaic (8,500-7,500 BP), Middle Archaic (7,500-2,500 BP), Upper Archaic (2,500-850 BP), and Emergent (850-150 BP) periods. More localized sequences relevant to the Study Area, which were defined largely through distinctive artifact types and

mortuary practices, include the Positas (ca. 5,250-4,550 BP), Pacheco (4,550-1,650 BP), Gonzaga (1,650-950 BP), and Panoche (450-100 BP) complexes.

Key temporal phases are outlined in Table 2-1. Organized by geologic time sequence, a chronological synthesis for the Central Valley by Rosenthal et al. (2007) is presented in addition Olsen and Payen's (1969) Diablo Range Foothills sequence and Groza's (2002) San Francisco Bay-Delta Region Scheme D1. All three temporal schemes may be useful in examining the prehistory of the Delta Mendota general area, though the synthetic sequence offered by Rosenthal et al. (2007) and the more localized sequence offered by Olsen and Payen (1969) will be most relevant to the eastern foothills of the Diablo Range and the western margins of the San Joaquin Valley.

The chronological sequence developed by Rosenthal et al. (2007) is based on the Central California Taxonomic System (CCTS), the first cultural chronological scheme developed to describe the prehistory of Central California. The tripartite CCTS sequence was consistent with other archaeological frameworks developed contemporaneously throughout much of North America. The archaeological sites used to develop the framework were centered on the rivers and tributaries that flowed into the Sacramento-San Joaquin Delta area as reported in various publications (Lillard et al. 1939). Key among them was CA-SAC- scheme was 107 (the Windmiller Site), located on the Cosumnes River. CA-SAC-107, unlike other sites on which the scheme was based, appeared to contain three distinct and stratified prehistoric components (i.e., Early, Middle, and Late) as well as a later post-contact period component. Subsequent revisions to the CCTS included those by Beardsley (1948), Fredrickson (1974), and Milliken et al. (2007), though most archaeologists now recognize three basic time periods with two transitional periods (Rosenthal et al. 2007). According to Groza's (2002) San Francisco Bay-Delta Region sequence, these are referred to as the Early Period, Early-Middle Period Transition, Middle Period, Middle-Late Period Transition, and Late Period (see Table 2-1).

Unlike Groza's scheme, the chronological sequence developed by Olsen and Payen (1969) is more specific to the eastern Diablo Range. During the 1960s, in anticipation of the construction of the nearby San Luis, Los Banos, and Little Panoche reservoirs, numerous early Native Californian sites were investigated. The more substantial sites found in these areas were the focus of intensive subsurface investigations (Nissley 1975; Olsen and Payen 1968, 1969, 1983; Pritchard 1970, 1983; Romoli and Ruby 1963). Based on the findings from some of these investigations, Olsen and Payen (1969) and Moratto (1984) proposed estimated dates for the prehistoric cultural sequence of the area that included the Positas, Pacheco, Gonzaga, and Panoche complexes. An older, ephemeral Paleo-Indian period dating to the Terminal Pleistocene has also been recognized in the San Joaquin Valley (Rondeau et al. 2007). Varying occurrences of typologically and technologically distinct artifacts have provided archaeologists with a general sequence of cultural change over time. The causes of these changes tend to be varied, complex, and intricately interrelated, and include factors such as climatic changes and shifts in cultural contact and movement.

Table 2-1 Concordance of Pertinent Chronological Sequences.

<table>
<tr><th>Years BP</th><th>Geologic Time Sequence</th><th>Central Valley Sequence (Rosenthal et al. 2007)</th><th>Diablo Range Foothills (Olsen and Payen 1969)</th><th>San Francisco-Bay Delta Sequence (Groza 2002)</th></tr>
<tr><td>Present</td><td rowspan="5">Late Holocene</td><td>Emergent Period (850-150 BP)</td><td rowspan="2">Panoche Complex (450-100 BP)</td><td>Late Period (675-250 BP)</td></tr>
<tr><td>1,000</td><td rowspan="3">Upper Archaic Period (2,500-850 BP)</td><td>Middle-Late Period Transition (950-675 BP)</td></tr>
<tr><td></td><td>Gonzaga Complex (1,650-950 BP)</td><td>Middle Period (2,150-950 BP)</td></tr>
<tr><td>2,000</td><td rowspan="6">Pacheco Complex (4,550-1,650 BP)</td><td>Early Middle Period Transition (2,450-2,150 BP)</td></tr>
<tr><td>3,000</td><td rowspan="5">Middle Archaic Period (7,500-2,500 BP)</td><td rowspan="3">Early Period (3,800-2,450 BP)</td></tr>
<tr><td>4,000</td><td rowspan="4">Middle Holocene</td></tr>
<tr><td>5,000</td><td rowspan="2">Positas Complex (5,250-4,550 BP)</td></tr>
<tr><td>6,000</td><td rowspan="5"></td></tr>
<tr><td>7,000</td><td rowspan="5">Early Holocene</td><td rowspan="3">Lower Archaic Period (10,500-7,500 BP)</td></tr>
<tr><td>8,000</td></tr>
<tr><td>9,000</td></tr>
<tr><td>10,000</td><td rowspan="2">Paleo-Indian Period (13,500-10,500 BP)</td></tr>
<tr><td>11,000</td></tr>
</table>

2.2.2 The Paleo-Indian Period (13,500-10,500 BP)

Although humans may have been present in North America well before the Paleo-Indian Period, the best available archaeological evidence indicates that the earliest inhabitants of North America arrived sometime around 13,500 years ago (Rosenthal et al. 2007:151). Evidence for Paleo-Indian occupation of the San Joaquin Valley comes primarily from isolated finds of fluted projectile points recovered from remnant Pleistocene landforms (Rondeau et al. 2007), including one point collected from CA-MER-215 (the Wolfsen Mound) near Newman, California (Peak and Weber 1978 in Dillon 2002) and from two sites located near Tracy Lake and the Tulare Lake Basin (Rosenthal et al. 2007:151). These points have often been compared to Clovis Series projectile points, which have been securely dated elsewhere in North American to the period between 13,500-11,500 BP. To date, the most extensive evidence for the Paleo-Indian Period occupation of the San Joaquin Valley comes from CA-KIN-32 (the Witt site), which is located in Kings County along the ancient shoreline of Tulare Lake (Moratto 1984:81-82). CA-KIN-32 revealed hundreds of early concave base points, and the uranium series dating of human bone from the site produced uncalibrated dates of 11,379, 11,380, and 15,802 BP. Although they could not be clearly linked either to the human bone or projectile points, bones from extinct fauna recovered from CA-KIN-32 also produced dates of 10,788, 15,696, and 17,745 BP (Rosenthal et al. 2007: 151). Evidence for early human occupation within the San Joaquin Valley remains sparse, though recent geoarchaeological studies (Rosenthal and Meyer 2004a; White 2003) have highlighted the potential to encounter Paleo-Indian sites in buried Late Pleistocene deposits that have been subject to repeated episodes of deposition and erosion.

2.2.3 Lower Archaic (10,500-7,500 BP)

Climatic changes at the end of the Pleistocene brought about a significant period of deposition along the alluvial fans and floodplains of the Central Valley beginning around 11,000 BP. Many Late Pleistocene landforms were subsumed, resulting in the formation of a geologic boundary between Late Pleistocene and Early Holocene sediments (Rosenthal and Meyer 2004b). Further climatic changes around 7,500 BP during the Middle Holocene resulted in an additional cycle of deposition, which likely buried or obscured many Lower Archaic Period archaeological deposits within the Central Valley (Meyer and Rosenthal 1997). Due in part to these factors, evidence for the Lower Archaic Period occupation of the Central Valley is relatively sparse and is mostly represented by isolated finds such as the stemmed projectile points, flaked stone crescents, and steep-edged, flaked stone tools that have been noted along the shores of Tulare Lake (Wallace and Riddell 1991). To date, only one significant Lower Archaic Period archaeological deposit has been reported within the San Joaquin Valley basin. CA-KER-116, situated along the ancient Buena Vista Lake shoreline, was found to contain a subsurface component comprised of flaked stone crescents, a carved stone atlatl spur, a few flaked stone tools, human remains, and a small but varied faunal assemblage made up of fish, shell, bird, and artiodactyl remains. Researchers did not report on the presence of milling implements or plant remains at CA-KER-116, though radiocarbon dates associated with the site ranged from 9,125-8,400 BP (Fredrickson and Grossman 1977; Hartzell 1992). No large mammal remains were noted at CA-KER-116, but the occurrence of large, heavily worked projectile points led some to argue that deer, pronghorn, and elk must have been an important part of the Lower Archaic Period diet (Rosenthal et al. 2007:152).

Although little evidence for milling implements or plant processing has been recovered from Lower Archaic Period valley basin assemblages, investigations in the eastern Diablo Range foothills have revealed extensive signs of early plant processing. Lower Archaic Period sites that appear to have been seasonally occupied have been recorded containing abundant groundstone implements such as handstones and milling slabs (Meyer and Rosenthal 1997). Based on the presence of these

implements and the predominance of acorn and pine nutshell at sites such as CA-CAL-629/630 (the Skyrocket Site) and at CA-COL-696 (the Los Vaqueros Site), some researchers have argued that nut crops associated with the foothill woodlands were a main dietary focus (Moratto 2002; Rosenthal et al. 2007), rather than small seeds as others have argued (Basgall 1987; McGuire and Hildebrandt 1994). Rosenthal et al. (2007:152) posited that the distinct foothill and valley basin cultural traditions and adaptations that became apparent in Middle Archaic Period sites emerged during the Lower Archaic Period, though the relative scarcity of Lower Archaic Period sites along the valley floor renders that difficult to confirm.

2.2.4 Middle Archaic (7,500-2,500 BP)

The Middle Holocene was characterized by warmer, dryer climatic conditions, and many of the pluvial lakes that hunter-gatherers relied on gradually receded or disappeared. At the same time, alluvial fans and floodplains stabilized, and the extensive wetland habitat of the Sacramento-San Joaquin River Delta formed as rising sea levels pushed inland. Many of the most extensive archaeological deposits in the Central Valley have been found in association with deeply buried, stabilized Middle Holocene alluvial landforms (Rosenthal et al. 2007:152). Excavations at CA-COL-247 for instance revealed Middle Archaic Period cultural materials dating to 5,970 BP associated with Middle Holocene soils buried at a depth of 3-3.5 meters below the ground surface (Rosenthal et al. 2007:153).

Evidence from a number of sites has indicated that distinctions between foothill and valley floor settlement and subsistence practices became pronounced within the Middle Archaic Period (Fredrickson 1994; Rosenthal and Meyer 2004b). Deposits within the eastern Diablo Range foothills dating to between 6,000-4,000 BP have been recorded, many in buried contexts (Rosenthal et al. 2007; Rosenthal and Meyer 2004a). Assemblages from these deposits have typically included abundant groundstone tools for chopping, scraping, and pounding along with macrofloral remains dominated by acorns and pine nuts (McGuire 1995; Rosenthal and McGuire 2004; Wohlgemuth 2004). Similar assemblages dating to the Middle Archaic Period have been noted as far north as Sacramento and as far south as Kings River in the southern San Joaquin Valley. Within the eastern Diablo Range foothills, sites such as CA-SOL-315 and CA-GLE-217 have been associated with the Mendocino Pattern, a more localized adaptive expression characterized by high residential mobility (Fredrickson 1974). In general, foothill assemblages were dominated by flaked and groundstone tools used for food procurement and processing with few bone or shell artifacts, beads, or ornaments, though tabular pendants have been broadly if infrequently noted (Basgall and Hildebrandt 1989; Rosenthal and McGuire 2004). Projectile points included notched, stemmed, thick-leaf, and narrow concave base darts with a high degree of local and regional variability. Raw material for flaked stone tools varied widely among eastern Diablo Range foothill sites, due largely to a reliance on local raw materials, though imported obsidian from quarries in the North Coast Ranges, Cascade Mountains, and eastern Sierra Nevada Mountains has been reported (White and Weigel 2006).

In contrast to the eastern foothills of the Diablo Range, comparatively few Middle Archaic Period sites within the San Joaquin Valley basin have been discovered. This is largely attributable to the geomorphic processes noted above and to the urban and agricultural development that has altered so much of the valley floor. Some stratigraphically intact deposits have been recovered, however, notably CA-SJO-68 in San Joaquin County, which was dated to at least 5,000 BP. Sites associated with the later Middle Archaic Period (ca. 4,500 BP) are better represented, particularly in the lower Delta and northern San Joaquin Valley region. Sites such as CA-CCO-637, CA-SJO-068, CA-SJO-112, CA-SJO-142, and CA-SJO-145 have yielded elaborate and diverse assemblages that reflect

complex socio-political strategies focused on riverine and marsh resources (Heizer 1949; Moratto 1984; Ragir 1972; Wohlgemuth 2004). Those assemblages included dart points (large, square-stemmed, and contracting-stemmed forms); mortars and pestles indicating a continued reliance on acorns and pine nuts; elaborate fishing technologies (e.g., gorges, composite bone hooks, and spears); basketry and cordage; ceramic items; stone, bone, and shell objects (*Olivella* beads and *Haliotis* ornaments); large burial areas; and non-local materials such as obsidian from the North Coast Ranges (e.g., Napa Valley and Borax Lake sources) and eastern Sierra Nevada Mountains (e.g., Bodie Hills, Casa Diablo, and Coso). These assemblages have been interpreted as a reflection of increasing residential stability and more intensive and logistically organized subsistence practices (Rosenthal et al. 2007: 153-155).

The archetypal expression of the Middle Archaic Period was identified as the Windmiller Pattern by Fredrickson (1973) and Moratto (1984) and was recognized at several sites along freshwater marshes and riparian corridors. Those sites were marked by western-oriented ventrally and dorsally extended burials with extensive grave offerings. Recent investigations have suggested that Windmiller sites were widespread throughout the San Joaquin Valley during the Middle Archaic Period and did not necessarily spread from the Delta region as previously supposed (Heizer 1958; Beardsley 1954). In fact, this tradition of extended burials has been recognized throughout the San Joaquin Valley from Buena Vista Lake northward, persisting into the Upper Archaic Period.

Positas Complex and Pacheco Complex

Localized expressions of the Middle Archaic Period within the Delta Mendota Study Area included the Positas Complex (5,250-4,550 BP) and the Pacheco Complex (4,550-1,650 BP), both of which were represented at CA-MER-094. The Positas Complex, closely associated with the Early Period of Groza's (2002) San Francisco Bay-Delta Region scheme, was distinguished by small, shaped mortars; short, cylindrical pestles; millngstones; perforated flat cobbles; and spire-lopped Olivella beads (Moratto 1984:191; Olsen & Payen 1969:41). The Pacheco Complex was marked by two distinctive phases that were associated with the late Early Period and Upper Middle Period of the San Francisco Bay-Delta Region scheme (Groza 2002). These phases included Pacheco B, which pre-dated 3,550 BP, and Pacheco A, which post-dated 3,550 BP. Pacheco B was marked by foliate bifaces, rectangular *Haliotis* ornaments, and thick Olivella beads; Pacheco A was distinguished by a proliferation of Olivella bead types; perforated canine teeth; bone awls, whistles, and saws; stemmed and side-notched projectile points; and abundant millingstones, mortars, and pestles (Moratto 1984:192; Olsen and Payen 1969).

2.2.5 Upper Archaic (2,500-850 BP)

The early Upper Archaic Period roughly coincided with the onset of cooler, wetter, and more stable Late Holocene climatic conditions (Rosenthal et al. 2007:155). The lakes that had receded during the Middle Archaic Period returned to their former levels during the Upper Archaic Period, which was also marked by increased freshwater flows into the Sacramento-San Joaquin Delta. Increased soil deposition and formation also occurred during the Late Holocene, capping many earlier Middle Holocene soils and land surfaces (Rosenthal and Meyer 2004a).

Rosenthal et al. (2007:156) noted that "a geographically complex mosaic of distinct sociopolitical entities marked by contrasting burial positions, artifact styles, and other elements of material culture" proliferated during the Upper Archaic Period. These elements of material culture included bone tool types (e.g., tubes, ornaments, and wands), the widespread manufacture and distribution of *Olivella* beads and *Haliotis* ornaments, obsidian biface blanks produced from eastern Sierra Nevada Mountain obsidian sources, ceremonial blades, and charmstones (Rosenthal et al. 2007). In the Delta and portions of the Sacramento and San Joaquin valleys, mortars and pestles became increasingly

prevalent in the archaeological record, indicating a heavier reliance on acorns (Moratto 1984, Wohlgemuth 2004), while along the valley margins handstones and milling slabs dominated Upper Archaic Period assemblages along with macrofloral evidence of acorns and pine nuts (Jackson and Ballard 1999). Faunal assemblages reflected regional subsistence strategies that focused on bulk processing of salmon, shellfish, rabbits, and deer or elk.

In the eastern Delta, the Windmiller tradition was replaced by the Berkeley Pattern (Fredrickson 1973), signaled by extensive habitation features and debris reflecting long-term residence, though the Windmiller tradition persisted within the San Joaquin Valley along the western and southern edges of the Delta and along the streams and marshes of Merced County at CA-MER-3, CA-MER-215, and CA-MER-323, (Dougherty and Werner 1993; Peak and Weber 1978; Pritchard 1970). The western margins of the San Joaquin Valley appear to have marked a transitional area, featuring discrete cemeteries with flexed (e.g., CA-MER-94 and CA-CCO-696) or extended burials (e.g., CA-MER-3 and CA-CCO-696), and it has been suggested that the area was alternatively occupied by groups originating in the valley and from the adjacent eastern Diablo Range (Rosenthal et al. 2007:156). Upper Archaic Period acquisition of obsidian in the San Joaquin Valley from sources in the eastern Sierra Nevada Mountains persisted, and in the lower Delta area obsidian from western sources in Napa Valley and the North Coast Ranges also continued to be significant.

Gonzaga Complex

The localized Upper Archaic Period sequence documented within the Delta Mendota Study Area vicinity was termed the Gonzaga Complex (1,650-950 BP), which straddled the Upper Middle Period and initial Late Period according to the San Francisco Bay-Delta Region scheme (Groza 2002). It has been noted in deposits throughout the western side of the San Joaquin Valley (Moratto 1984:192), specifically at sites such as CA-MER-3, CA-MER-14, and CA-MER-94. The Gonzaga Complex was marked by a mix of extended and flexed human burials; bowl mortars; squared and tapered-stem projectile points; grass saws; characteristic Haliotis ornaments; and thin rectangular, split-punched, and oval Olivella beads (Moratto 1984:192; Olsen and Payen 1969). Much remains unknown about the Gonzaga Complex, as excavated occurrences have consisted almost exclusively of funerary sites, and the majority of the artifacts have been comprised of grave goods (Breschini et al. 1983:79).

2.2.6 The Emergent Period (850-150 BP)

Late Holocene climatic conditions continued into the Emergent Period, but episodes of flooding, deposition, and drought have also been documented (Rosenthal and Meyer 2004a). By the Emergent Period, Native Californians living within the San Joaquin Valley had developed the cultural traditions that would be noted at the time of European contact. These traditions included technological adaptations such as the bow and arrow and the fish weir. Native trade networks also appear to have changed during the Emergent Period, as shell beads assumed the role of currency throughout much of the region. Population densities, which had been growing steadily in the Central Valley since the Middle Archaic period, continued to increase during the Emergent Period; this growth correlated with an intensification of hunting, gathering, and fishing as well as increased socio-political complexity (Rosenthal et al. 2007:159). Large, populous villages developed at strategic locations along river courses for accessing seasonally abundant salmon runs (White 2003), and villages and smaller residential communities continued to grow along the many side streams of the foothills and along the river channels and sloughs of the San Joaquin Valley floor (Olsen and Payen 1968; Pritchard 1970).

Panoche Complex

Within the Central Valley, the Emergent Period is most often associated with the Panoche Complex (450-100 BP) (Olsen and Payen 1968, 1969, 1983; Pritchard 1970), which was associated with the terminal Late Period of the San Francisco Bay-Delta scheme (Groza 2002). It has been distinguished at many western San Joaquin Valley sites by the remains of large, circular structures; flexed burials as well as primary and secondary cremations; millingstones; varied mortar and pestle types; bone awls, saws, whistles, and tubes; side-notched projectile points; clamshell disk beads; Haliotis disk beads; and Olivella lipped, side-ground, and rough disk beads (Moratto 1984:193). Although the Panoche and Gonzaga complexes have been documented through a number of sites, there appears to have been a hiatus of approximately 500 years between them both. That lapse may be due to a period of unfavorable climatic conditions—conditions that could not support oaks and a subsistence system focused on the gathering and processing of acorns. Direct archaeological evidence for a dramatic decrease in acorn-bearing oaks during this period has yet to be documented, though additional research may shed some light on the apparent abandonment of the region between approximately 950 and 450 BP (Olsen and Payen 1969; Moratto 1984:191-193).

While a 500-year occupation hiatus between the Gonzaga and Panoche complexes may be apparent based on the excavations of sites in the Pacheco Pass area, according to Breschini and Haversat (1987), this apparent abandonment may have been somewhat limited and fairly localized in nature. Based in part on excavations conducted at CA-FRE-1333, Breschini and Haversat have suggested that the Gonzaga complex dates should probably be extended several hundred years, considerably narrowing the gap between the Gonzaga and Panoche complexes. Evidence for a period of abandonment in the late Panoche to early Gonzaga complexes could still be discerned at CA-FRE-1333, however, as could a dramatic change in site function from a small village to a sporadically utilized camp or shelter (Breschini and Haversat 1987:39).

Although Pritchard (1970) noted some Emergent Period and early historic period materials at CA-MER-3, early accounts suggest that Pacheco Pass and the area around San Luis Reservoir had been largely abandoned by local Native Californians by the early 19th century (Latta 1949; Olsen and Payen 1968). Much of this was likely due to the increased Spanish, Mexican, and American use of the pass as an important transportation route. Bands of cattle and horse thieves reportedly made frequent use of Pacheco Pass, and military expeditions also made incursions into the area in search of runaway coastal mission neophytes or in search of new workers. Collectively, these pressures proved too much for the local Native inhabitants who had largely fled the vicinity by the 1840s and early 1850s (Shumate 1977:22).

2.3 ETHNOGRAPHIC CONTEXT

The DMC APE falls within the traditional territory of the Northern Valley Yokuts (Kroeber 1925; Latta 1949, 1977; Olsen and Payen 1968; Wallace 1978), one of three ethnographically and linguistically defined groups that occupied the San Joaquin Valley at the time of European contact. Generally speaking, the Northern Valley Yokuts inhabited the territory extending from the crest of the Diablo Range in the west to the foothills of the Sierra Nevada Mountains in the east and from where the San Joaquin River makes its turn northward in the south to the area midway between the Calaveras and Mokelumne rivers in the north (Wallace 1978:462). The other two groups that occupied the San Joaquin Valley included the Southern Valley Yokuts, who inhabited the region around Tulare Lake, and the Foothill Yokuts, who inhabited the lower reaches of the Sierra Nevada Mountains (Kroeber 1925, Wallace 1978). Collectively, these three Yokuts groups comprised a population of roughly 41,000 individuals at the time of European contact.

The Yokuts were hunter-gatherers who divided themselves into kin and language-based tribelets, resulting in a mosaic of smaller territories and discrete settlements (Kroeber 1925:474). The Yokuts' Penutian language was spoken by some 40 groups using distinctive but closely related dialects. Those groups clustered primarily along narrow strips of land bordering the San Joaquin River and its tributaries, as well as lands east of the river along the Sierra Nevada foothills. Fewer Yokuts are believed to have inhabited the western margins of the San Joaquin Valley, where villages were typically located along watercourses such as Los Banos and Panoche creeks (Wallace 1978:463). Mission birth, baptismal, and death records have been used to reconstruct information on many Native Californian tribelets, and several have been identified within Northern Valley Yokuts territory (Milliken 1995, 2008: Figure 2). These tribelets included *Jalalon*, *Tauquimne*, and *Tamcan* groups in the delta region; *Laquisemne* (*Tonul*) on the Stanislaus River between the San Joaquin River and Sierra Nevada Mountain foothills; *Apelamam* (*Huocon*) on the Merced River between the San Joaquin River and Sierra Nevada Mountain foothills; *Mayem* (*Tejey*) from roughly opposite the mouth of the Merced River south to Mendota; and other tribelets inhabiting the banks of the Chowchilla, Fresno, and San Joaquin rivers within the Sierra Nevada Mountain foothills (Wallace 1978:466).

Tribelet territories were generally defined by physiographic features such as sloughs and rivers. Lightfoot and Parrish (2009:80) have posited that these territories would have been sufficiently large and diverse so as to provide a range of biotic and environmental resources, but sufficiently manageable so as to remain accessible from just a few settlement locations. While tribelets comprised geographic or physiographic units, they functioned foremost as sociopolitical units. Within the tribelet, there would have been a central village or principal settlement that was occupied by a headman or chief along with most members of the tribe (Wallace 1978:466). This central village would have been surrounded by smaller satellite settlements, perhaps comprising as few as two or three households (Kroeber 1962).

Settlements consisted of large, semi-subterranean round or oval dwellings with hard-packed floors (Olsen and Payen 1968:38; Wallace 1978:464-465). Within the San Joaquin Valley basin, tule stalks were readily available and could be woven into mats and stretched over frames of light poles to form dwelling walls. Because of seasonal flooding and the wetland conditions that prevailed within the tule marshes on the valley floor, settlements were typically established on high ground or on piled earthen mounds constructed along water courses. Ceremonial sweat houses and assembly chambers also were frequently constructed within larger, more substantial settlements. A large central village might include as many as 200 inhabitants who lived a primarily sedentary existence, with collecting trips taking place during particular times of the year for the acquisition of seasonally available resources (Wallace 1978).

Accounts of Northern Valley Yokuts subsistence practices suggest that they relied on local plant and animal communities typically found along watercourses (Cook 1955, 1960; Gayton 1936; Wallace 1978). Owing to the many rivers, creeks, sloughs, tule marshes, and ponds within Yokuts territory, several important fish species were taken, including seasonal runs of anadromous fishes (e.g., salmon, sturgeon, and lamprey) and other freshwater fishes (e.g., Sacramento Sucker, Sacramento perch, and Thicktail Chub) (Lightfoot et al. 2009:325-329). Turtles and reptiles were also hunted. Nets with sinkers, baskets, bone- and antler-tipped harpoons, and tule watercraft were all employed (Cook 1960; Wallace 1978). Located on the Pacific Flyway, migratory waterfowl such as geese and ducks were taken for food, bone (for tools), and feathers. Terrestrial mammals (e.g., elk, deer, rabbits, and ground squirrels) were also likely hunted, though the brevity of hunting accounts that appeared in historic period documents led Wallace (1978:464) to conclude that big-game hunting probably represented a marginal activity. In addition to acorns, which could be collected from oak

stands on both sides of the San Joaquin Valley, an array of seeds, roots, and corms were collected, processed, and consumed or stored (Lightfoot et al. 2009:307-323). Yokuts landscapes were systematically tended through routine pruning, brush clearance, and prescribed burns that improved the quality and quantity of plant yields (Cook 1960:260).

Riparian habitat along the San Joaquin Valley floor supported numerous fish species and reptiles and, in turn, the birds and carnivorous mammals that preyed on them. Herds of pronghorn, deer, and tule elk passed through the valley, and the seasonal wetlands attracted masses of migratory birds. Once-extensive grasslands bordering the sloughs and marshes supplied nutritious seeds, while the foothills were home to acorn-laden oaks. The Diablo Range foothills and Sierra Nevada Mountain foothills—transitional zones between oak savanna and grassland environments—offered a diverse range of natural resources. These varied ecosystems provided a wide array of floral species, such as acorns, oats, and other seeds that served as staple foods, as well as various grasses used for basketry. Faunal resources found in the area included numerous fish species, shellfish, turtles, waterfowl, deer, tule elk, pronghorn antelopes, lagomorphs, rodents, reptiles, birds, and insect species that would have provided sustenance and sources of various materials such as hide, bone, feathers, and ligaments.

Yokuts material culture and technological systems were as varied as the environments in which they resided, and those systems tended to reflect the availability of environmental resources. Mortars and pestles, handstones and milling slabs, and bedrock mortar outcrops were used for processing acorn nuts, seeds, berries, and other small game for consumption or storage. Flaked stone arrow points, knives, and scraping implements made from imported obsidian and locally available chert, jasper, and chalcedony were used to hunt or process game animals (Wallace 1978:465). Bone tools, particularly awls, were prevalent and were widely used in basketry production. Baskets were produced from grasses such as sedge into a wide variety of sizes and shapes, each suited to a particular task (e.g., cooking containers, winnowing trays, water bottles, seed beaters, etc.) and adorned with patterns characteristic of Yokut artistic expression.

Although the Northern Valley Yokuts were the predominant group in the region, evidence also suggests that there was interaction with neighboring hunter-gatherer groups. Northern Valley Yokuts living along Los Banos Creek probably interacted with Mutsun Ohlone speakers whose territory stretched from the Monterey Bay east to the Diablo Range and to the west end of Pacheco Pass (Golla 2007; Levy 1978; Milliken 1995:257; Milliken 2007). Contact between coastal and interior tribal groups would have been facilitated by the pass, a natural thoroughfare that encouraged the exchange of goods and traditions during the prehistoric and early historic periods (Piling 1950). The influence of Ohlone and Ohlone-descendent groups could be seen in the San Luis area and throughout the Central Valley in the form of exotic materials not found in the region. Archaeological materials uncovered by Treganza (1960), Riddell and Olsen (1964), Olsen and Payen (1969), Pritchard (1966, 1970, 1983), and Riddell (1970), though analyzed and interpreted according to Central Valley cultural and temporal schemes, may have had much in common with manifestations from the western side of the Diablo Range. Abalone shell has been recovered at many archaeological sites, and historic period accounts have indicated that salt, mussels, and dried abalone were frequently traded between the Ohlone and interior groups (Davis 1961:23). Linguistic evidence of extensive contact between the coastal Ohlone and San Joaquin Valley tribelets has been noted as well. For example, some Miwok terms are the same as those among Ohlone groups, which suggests that exchange networks involved not only material goods but other cultural traits as well (Whistler and Golla 1986).

Within the Sacramento-San Joaquin River Delta region, Northern Valley Yokuts would have interacted with Miwok speakers. The San Joaquin River corridor offered an exchange route for rafts laden with food and raw materials, and the Yokuts reportedly traded dogs to their northern Miwok neighbors in exchange for baskets and blankets (Barrett and Gifford 1933:270). Obsidian from Napa Glass Mountain, located in present day Napa County, has been recovered archaeologically from sites in the San Joaquin Valley, and likely reflected trade partnerships with Miwok and Ohlone speakers occupying Suisun Bay (Sutton and Des Lauriers 2002). Obsidian from sources within the Sierra Nevada Mountains (e.g., Bodie Hills and Casa Diablo) has also been recovered, and would have entered the San Joaquin Valley via trans-Sierran networks (Hughes and Milliken 2007). Marine shell, ocean fish, and shellfish from the Pacific Coast were also traded. Piñon nuts found their way to coastal tribes from inland sources (Davis 1961:23), and clam shell beads were traded from coastal areas to regions far inland. Yokuts traders were not only active in pre-contact times but also played an important role in the introduction of European trade goods (e.g., glass beads, metal items, etc.) among other groups inhabiting the Central California interior and Sierra Nevada region (Arkush 1993).

During the Mission Period (ca. 1776-1830s), large numbers of Northern Valley Yokuts were removed from their homes to Spanish missions in the San Francisco Bay Area. Mission San José received many members of Northern Valley Yokuts tribes between 1806 and the late 1820s (Milliken 2008:9), and their language was among the most widely spoken at Mission San José, Mission Santa Clara, and Mission San Juan Bautista (Milliken 2008:9). Most frequently represented during that time period were the *Jalalons* and *Nototomnes* from the Delta, *Yatchicumnes* and *Passasimis* from the main channel of the San Joaquin River, and *Lacquisemnes* from the lower Stanislaus River (Milliken 2008:61). Large numbers of clamshell disk beads likely associated with Yokuts groups from the Central Valley have been found in later Mission Period deposits at Mission Santa Clara, mirroring shifting recruitment practices by missionaries proselytizing further east (Allen et al. 2010:171), as well as enduring exchange practices. In addition to participating in missions, Northern Valley Yokuts also actively resisted them, at times fleeing to the impenetrable tule marshes and at other times participating in raids that resulted in the theft or destruction of mission property (Cook 1960, Milliken 1995, 2008; Phillips 1993). In that sense, Pacheco Pass and other canyon passes would have doubled as routes of exchange and as avenues of cultural escape or survival for Yokuts speakers and other groups entangled with the missions.

Introduced diseases, irreparable damage to Native Californian ecosystems, and the displacement of indigenous communities from missionization was compounded in subsequent years by Mexican and American settlement. Like most Native Californian communities, Northern Valley Yokuts populations declined dramatically as Native people were decimated by epidemic diseases in the early-19th century and then by the tremendous influx of American settlers participating in mining, timbering, farming, and ranching from the mid-19th to 20th centuries (Wallace 1978). Today, however, several Yokuts communities persist, and several have been federally recognized as extant, sovereign tribes.

2.4 HISTORIC PERIOD CONTEXT

Spain's missionization and colonization of California was focused on the coastal areas and is discussed abundantly in the historical literature and need not be repeated here. The western edge of the San Joaquin Valley, including those lands encompassed by the DMC APE, would have been used mainly as grazing land during the Spanish Period. Spaniards explored interior regions of California from the 1800s, however permanent settlement by non-native people did not occur until

the 1830s and 1840s during the Mexican era. Mission lands were secularized in 1834, and large tracts of land were granted to citizens of Alta California as a reward for loyal service and to increase the Mexican population against American forays and territorial unrest. In San Joaquin, Stanislaus, and Merced counties, there were fourteen ranchos granted by Mexican governors to prominent families and individuals (Beck and Haase 1974: Maps 28 and 32). Table 2-2 provides basic information about the Mexican Period ranchos that intersected or were situated near the DMC APE.

Table 2-2 Mexican Land Grants near the Class I and Class III Inventory Study Areas.

Rancho Name and Number	Date Granted/ Land Patent Date	Grantee(s)/Patentee(s)	County
105: Orestimba Rancho	1844/1863	Sebastián Nuñez	Stanislaus/ Merced
*106: Rancho del Puerto	1844/1864	Mariano and Pedro Hernandez /Samuel Reed and Rubin Wade	Stanislaus
*107: El Pescador	1843/1858	Valentin Higuera and Rafael Felix /Henry Grimes	San Joaquin/ Stanislaus
*108: El Pescador	1843/1865	Pio and Naglee	Alameda/ San Joaquin
*198 Sanjon de Santa Rita	1841/1862	Francisco Soberanes	Merced/ Fresno

*Grant numbers provided by Beck and Haase (1974).

Secularization brought an influx of Mexican settlers to California and allowed for the emergence of a new class of wealthy landowners known as "*los rancheros*." The new economy focused on livestock ranching rather than irrigated farming. The Mexican settlers received large land grants and appropriated existing mission irrigated fields, livestock, fences, corrals, irrigation ditches, outbuildings, and other improvements (Bocek and Reese 1992:49). Large-scale water system features were neglected, which resulted in the decline of irrigated farming after the missions were secularized (Caltrans and JRP 2000:11). Agricultural methods continued to rely on California Native American labor for shallow plowing, sowing, and harvesting of crops (Bocek and Reese 1992:49).

During the 1840s, relations between the Mexican and U.S. governments became increasingly strained as the U.S. Government continued to expand its territory westward. These political stresses erupted in the Mexican-American War, which lasted from 1846-1848. The war ended with the 1848 signing of the Treaty of Guadalupe Hidalgo, which called for the U.S. Government to pay $15 million to the Mexican Government. In exchange, lands that would eventually encompass part or all of ten states, including California, were made a part of U.S. territory. Mexican citizens within annexed areas were given the choice between relocating to Mexico and receiving American citizenship with full civil rights. Over 90% chose to remain.

At the close of the Mexican-American War in 1848, James Marshall discovered gold on the American River. Marshall's discovery ushered in the California Gold Rush and shaped American Period settlement and agricultural development in California. Not only did the Gold Rush create a demand for a wide variety of agricultural foodstuffs, but it also set in motion a wave of homesteading and settlement aimed at producing food commercially. Intensive settlement occurred first in San Francisco and Sacramento and then extended into the hinterlands as miners explored the gold fields. Many of these early '49ers turned to agriculture, not simply as a way to subsist, but as a way to profit due to the high demand for fresh foods. Beyond the production of goods, land ownership itself often led to the creation of wealth, self-sufficiency, political power, and independence.

Agricultural activity during the American Period within the San Joaquin Valley was characterized by three types of pursuits: cattle and sheep ranching; grain farming; and irrigated agriculture. Cattle and sheep ranching remained dominant following the Spanish and Mexican periods until the 1880s.

During the 1850s-1870s, free-ranging Spanish cattle were replaced by American breeds of livestock and dairy cows; sheep breeds were also improved during the same period (Burcham 1982). The Homestead Act of 1862 had a profound impact on the expansion of settlement within the western U.S. and played a key role in the development of California's agricultural economy. Although initially focused on agriculture, homesteading eventually shifted to include ranching. The Homestead Act and its amendments had such a huge impact on settlement within the western U.S. that by 1958 some 38,784,000 acres of federal land had been granted in California alone (Caltrans 2007:42).

In addition to the Homestead Act, other key developments spurred the growth of agriculture within the San Joaquin Valley during the late 19th century. These developments included improved transportation, the increased use of irrigation, the greater availability of agricultural labor, and increased mechanization. With the completion of the Transcontinental Railroad in 1869, farmers were able to ship fresh produce to markets in the East, which encouraged a shift in the 1870s towards irrigated crops such as fruits, nuts, and vegetables. The transformation in the late 19th century from expansive grain fields and grazing lands to irrigated crops occurred relatively quickly. The drive to irrigate much of California, and in particular the San Joaquin Valley, played an important role in the expansion of mechanized farming and the establishment of small farming communities. The influx of settlers into the state during and after the California Gold Rush also meant that there was a ready supply of agricultural laborers available as well as an increased demand for agricultural products.

Stock raising or ranching in the San Joaquin Valley also was essential to the regional economy. Hogs, sheep, and cattle, which were raised for meat, wool, and other products, made up the bulk of the stock that roamed across the region (Caltrans 2007:82). Cattle and sheep ranching predominated, while hog production was generally less important (Caltrans 2007:85-86). Throughout the 19th century, ranches of all sizes proliferated. The need for grazing land necessitated larger landholdings than for farmsteads. These needs varied by the type of stock, with sheep requiring wider ranges for herding. Homestead laws were further amended to accommodate these needs, and larger acreage claims were granted that allowed ranching to further expand.

Late 19th century range wars between sheep and cattle ranchers resulted in the dominance of cattle in the California ranching industry. Ultimately, three levels of cattle ranching evolved. These included large corporate or company ranches of more than 160 acres, mid-sized ranches of 40 to 160 acres, and small ranches of 40 acres or less. The overgrazing of natural fodder, combined with late 19th century droughts, led to the ascent of many smaller ranching operations that also grew hay in irrigated fields). Corporate operations with access to water, however, also fared well. Miller and Lux for instance controlled large tracts of land, were well capitalized, and monopolized the market. Unlike farmers who concentrated their land development, cattle and sheep ranchers spread their improvements over large areas (Caltrans 2007:85). The ranchers would move their operations from location to location, as necessary. For larger ranches, this type of land use required a substantial and knowledgeable labor force.

Corporate ranches typically featured multiple barns, feed lots, elaborate water systems, loading chutes, slaughterhouses, and bunkhouses for workers (Caltrans 2007:84). Mid-sized ranches often comprised multiple contiguous or discontinuous homesteads that provided a larger area for grazing (Caltrans 2007:84). Small ranches were generally established by individual homesteaders and would include a main ranch house, a barn, windmills, a slaughterhouse, corrals, and pastures (Caltrans 2007:84). These small ranches, also called ranchettes, became popular after the turn of the century (Caltrans 2007:84).

During the 20th century, livestock production in California and the San Joaquin Valley declined while irrigated crop farming intensified. The exception to this was dairy farming and poultry production, which began to thrive. During 1950s and 1960s, cattle ranching revived somewhat with the innovation of large-scale commercial feedlots (Olmstead and Rhode 2011). With the dominance of irrigated crops in the 20th century, cattle ranching was relegated to the margins of the San Joaquin Valley in the un-irrigated foothills and in high-density feed lots (Parsons 1987). The confinement of ranches to these un-irrigated areas required the use of livestock watering locales that drew water from wells using a windmill and pump, stored the water in tanks or cisterns, and made water available to livestock in troughs. These livestock watering locales were ubiquitous features within the ranching landscape and essential to the success of ranching operations.

2.4.1 The Development of Water Conveyance Systems

The aridity of the western San Joaquin Valley began to pose problems for American Period agriculture during the late 19th century as land was developed further away from water sources. Canal projects were undertaken to move water from the rivers flowing into the San Joaquin Valley from the Sierra Nevada. The Merced Irrigation District was established during the 1870s and 1880s for the eastern side of Merced County and developed many miles of canals (Merced Irrigation District 2014). Henry Miller also was involved in early attempts to develop irrigation within the western Central Valley. He organized the San Joaquin & Kings River Canal and Irrigation Company and built a canal in 1871 from the San Joaquin River to the town of Los Banos (Outcalt 1925:221). In 1870s, Miller extended the canal to Los Banos Creek and Newman, and began developing the Buena Vista Slough area at the downstream end of the Kern River (Outcalt 1925:222). The canals provided much of the irrigation for Miller's properties in the San Joaquin River watershed and for local agriculture. Upon Miller's death in 1916, his daughter and son-in-law inherited the bulk of his vast landholdings along with his water rights (Outcalt 1925:402).

In 1887, the state legislature passed the Wright Act, which permitted the formation of irrigation districts across California (Stene 2011:3). The Wright Act was amended in 1897 to ensure sufficient bond funding for irrigation projects (Stene 2011:4). A report on the "Sacramento Project" produced in 1904 was the first to link the U.S. Reclamation Service to water issues in the Central Valley. It was not until 1911, however, that the state legislature created the State Reclamation Board, which was authorized to spend up to $33 million on Central Valley flood control projects. Both the U.S. Reclamation Service and the California State Engineer reported on the possibility of storing Sacramento River water at Iron Canyon in Tehama County. In 1919, Colonel Robert Marshall, Chief Geographer for the U.S. Geological Survey, further proposed the construction of several storage reservoirs along the Sacramento River system and the transfer of water between the Sacramento Valley and the San Joaquin Valley via two large canals positioned to either side of the Sacramento River; these canals were meant to convey water over the Tehachapi Mountains to Southern California (Stene 2011:2).

In 1921, the state legislature directed the State Engineer to formulate a comprehensive water plan for California to accomplish conservation, flood control, storage, distribution, and water use and appropriated $200,000 to investigate and develop the plan. Over the course of the next decade, fourteen reports were produced detailing water flow, drought conditions, flood control, and irrigation issues in California. State Engineer Edward Hyatt used those reports to draft the California State Water Plan. Salinity control within the Sacramento-San Joaquin Delta was of particular concern to northern California water users. Unless a minimum of 3,300 second-feet of water flowed past Antioch, salt water from the San Francisco Bay would move into Suisun Bay and the Delta during high tide, making the water unusable for crops and industry (Stene 2011:2). The State Water

Plan, among other measures, called for the construction of a 420-foot dam at Kennett to maintain regular water flow to Antioch.

In 1933, the state legislature authorized the Central Valley Project (CVP) as a state project and approved the sale of revenue bonds to fund it. Despite the authorization of revenue bonds, however, the state of California was unable to finance the project. President Franklin D. Roosevelt issued an executive allocation of $20 million under the Emergency Relief Appropriation Act for construction of the CVP in 1935, which was later reduced to $4.2 million. Roosevelt approved the CVP, including the Kennett, Friant, and Contra Costa divisions, on December 2, 1935, and the Rivers and Harbors Act of 1937 re-authorized $12 million for the project. Navigational improvements, regulation, and flood control of the Sacramento and San Joaquin rivers were listed as priorities of the CVP under the Rivers and Harbors Act, with power generation cited as the lowest priority.

Construction of the CVP began in the late 1930s. In 1939, Henry Miller's heirs agreed to exchange riparian rights on their landholdings for substitute water. They did not abandon their riparian water rights but agreed not to exercise them as long as the government could provide substitute water. These contracts are still in effect, and some of Miller and Lux's original canals continue to convey irrigation water today (San Joaquin River Exchange Contractors 2014). During the early 1940s, America's entry into World War II increased demand for agricultural products and further depleted groundwater in the western Central Valley (U.S. Bureau of Reclamation 2011). Controversy surrounding the CVP increased and, following World War II, advocates of small farmers formed the Central Valley Project Conference (CVPC) to contest state versus federal operation and control, public versus private distribution of power, U.S. Army Corps of Engineers versus Reclamation construction of multi-use projects, and acreage limitations outlined in the Reclamation Act of 1902. Despite contention over these issues, construction of the CVP continued through the late 1940s and 1950s.

By the 1950s, the western side of the Central Valley had become the focus of both the CVP and the newly formed State Water Project (SWP) (Stene 2011:10). A 1954 federal investigation identified the area along Pacheco Pass in the Diablo Mountains as the ideal site for the San Luis Reservoir (U.S. Bureau of Reclamation 2011). Despite opposition from a variety of regional factions, a state bond measure to fund irrigation in the western Central Valley was narrowly passed in 1960. To avoid the unnecessary expense of parallel aqueducts, the State of California agreed to partner with the federal government in the creation of the San Luis Unit in 1961 (Stene 2011:13-14). The San Luis Reservoir in the Diablo Mountains west of Los Banos would be filled with water supplied by the federal Delta-Mendota Canal and the state's California Aqueduct (Stene 2011:14). A ground-breaking ceremony officiated by President John F. Kennedy marked the start of construction in 1962, and all construction was completed for the project by 1967. Typically, water from the Delta is pumped into the reservoir in winter and early spring and released in summer when water supplies are low (DWR 1974:276).

The Delta-Mendota Canal, a key feature of the CVP, was completed in 1952. Friant Dam stored San Joaquin River flow and diverted it into the Madera and Friant-Kern canal systems. Reclamation built Delta-Mendota Canal to provide Sacramento River water to irrigators and other water users who lost San Joaquin River water downstream of Friant Dam. The canal transports water from the C.W. Bill Jones Pumping Station (formerly Tracy Pumping Station) along the western side of the San Joaquin Valley for irrigation, for use at the San Luis Reservoir, and for recharging the San Joaquin River where water has been diverted at Friant Dam for the Friant-Kern system. The canal spans roughly 113 miles in length and ends at the Mendota Pool (Stene 1994:13-14).

The California SWP was first envisioned in 1919 by Colonel Robert Marshall who proposed conveying water from the Sacramento River watershed to the San Joaquin Valley and then over the Tehachapi Mountains to Southern California. A State Water Plan was introduced in 1931, however funding remained unavailable during the Great Depression. After World War II, the California Water Plan was reintroduced and finally passed in 1960. In 1963, construction was begun on the California Aqueduct, a series of canals, tunnels, and pipelines that implemented Marshall's early 20th century vision. The main line of the canal was completed in 1971, with subsequent branches or extensions completed as late as 1997 (DWR 2014). The aqueduct begins at the San Joaquin-Sacramento River Delta at the Banks Pumping Plant, which pumps from the Clifton Court Forebay. Water is pumped by the Banks Pumping Plant to the Bethany Reservoir, which serves as a forebay for the South Bay Aqueduct via the South Bay Pumping Plant. From the Bethany Reservoir, the aqueduct flows by gravity to the O'Neill Forebay at San Luis Reservoir. From the O'Neill Forebay, it flows to the Dos Amigos Pumping Plant and then on for roughly 95 miles before it diverges in Kings County into a main line and a Coastal Branch. In southern Kern County, the main line splits into a West Branch and an East Branch, which together serve Los Angeles, San Bernardino, and Riverside counties. The California Aqueduct weaves in and out of the DMC APE in San Joaquin, Stanislaus, and Merced counties.

2.4.2 Transportation Development

While the development of water conveyance systems was critical to settlement and agricultural expansion within the San Joaquin Valley, so too was the development of transportation. Several transportation corridors formed within the DMC vicinity over time, driven largely by local topography. The earliest was the Spanish Period El Camino Viejo that was later paralleled in the 19th century by the Southern Pacific Railroad and in the 20th century by the American Period Interstate-5 corridor. Two east-west trending transportation corridors also cross the DMC vicinity and pass through the Diablo Range, which separates the San Joaquin Valley from the coast. These include Livermore Pass (now Altamont Pass) as well as Pacheco Pass. These transportation corridors were used prehistorically by California Native Americans travelling between the coast and the Central Valley interior, and later used during the Spanish, Mexican, and American periods.

In Alameda and San Joaquin counties, several attempts were made to establish a stage line bridging Stockton and Oakland by way of Livermore Pass to compete with the steamships that crossed San Francisco Bay and navigated up the San Joaquin River to Stockton. The steamers, specifically those controlled by the California Navigation Company, reduced their fees to undercut stage fares and the stage routes were short-lived (Tinkham 1923:103-104).

Pacheco Pass, which intersects the DMC vicinity near the San Luis Reservoir in Merced County, also served as a main transportation corridor connecting the southern San Francisco Bay Area with the San Joaquin Valley. Although the trail was used prehistorically long before the Mexican Period, it eventually took its name from Juan Pérez Pacheco in the 1840s when he and José María Mejía received a land grant that included the Pacheco Pass area. In 1857, Andrew Firebaugh built a toll road across the pass from San José. By 1858, the San Luis Ranch house was acting as a stage station along Firebaugh's toll road (Outcalt 1925:217-218). Pacheco Pass also served as a part of the route used by the Butterfield Overland Mail Company, which ran stage lines from San Francisco to St. Louis beginning in 1858 (Hoover et al. 1990). Stage stations in Merced County included the San Luis Ranch and Lone Willow Stage Station near Los Banos (Hoover et al. 1990:200-201).

Although early pedestrian, stock, and stage routes were critical to the settlement of the DMC vicinity during the Spanish, Mexican, and early American periods, it was the development of railroads that transformed transportation in the San Joaquin Valley. Railroad routes in the San Joaquin Valley

followed roughly the same transportation corridors that were established during the Spanish and Mexican periods. The two main railroads that competed within the region were the Southern Pacific Company and the Western Pacific Railroad. By 1884, Southern Pacific emerged as the name of all the main railroads in California, including the Central Pacific and the Western Pacific railroads (Rawls and Bean 1997:175-176). By 1900, the Southern Pacific Company had become a major railroad with a system that spanned the western US from Los Angeles to Portland and east into Arizona, Utah, and Texas. It was ultimately absorbed in the late 1980s by Rio Grande Industries and again in the late 1990s by the Union Pacific Railroad (Sullivan 2010).

The original Western Pacific Railroad was established in 1862 to construct the westernmost portion of the Transcontinental Railroad between the present-day cities of Oakland and Sacramento. Construction was begun in 1865, and the route crossed Niles Canyon to Livermore Pass before proceeding on to the state capital. In 1869, the Western Pacific Railroad was absorbed by the Central Pacific Railroad, which purchased the bankrupt company and completed the rail line that year (Fickewirth 1992:164; Luna 2005:7). In 1903, a second company was founded under the name Western Pacific Railroad. It was established by the Denver and Rio Grande Western Railroad, a competitor of Southern Pacific Railroad. The Western Pacific Railroad acquired the Alameda and San Joaquin Railroad and constructed a route from present day Oakland through the Feather River Canyon. By 1930, this route spanned Oakland to Niles Canyon and then turned north via Carbona, Stockton, Sacramento, and Marysville where it turned east through the Feather River region. A 1930 Denver and Rio Grande Western route map also depicted a Tesla branch line extending south from Carbona (Denver & Rio Grande Western Railroad 1930). In 1982, the Western Pacific Railroad was acquired by the Union Pacific Railroad (Brehm 2014).

Twentieth century road and highway improvements during the 1910s and 1920s turned wagon roads into higher speed auto roads. Prior to that time, the interstate and transcontinental transportation of people and goods relied on railroads, with roads used mainly for local travel (Weingroff 2011). The development of improved roads in the region was part of a national "Good Roads Movement" that arose in the 1880s as a response to the increasing popularity of bicycles and then automobiles in the early 1900s (Roland et al. 2011:E4). A number of interest groups began pressuring the federal and state governments to take control of road building and maintenance (Hugill 1992). Among the goals of these movements was the construction of improved or hard-surface roads of macadam, bituminous macadam, or concrete (Roland et al. 2011:E5). Despite these efforts, in the early 20th century only a small percentage of the roads in California and nationwide were improved (Roland et al. 2011:E5).

The Lincoln Highway Association (LHA) was established in 1913 by automobile enthusiasts and industry officials with the goal of creating a continuous, improved road between New York to San Francisco by the shortest route possible (LHA 2014). The Lincoln Highway was the first transcontinental highway and played a significant role in the development of highways and the founding of Eisenhower's System of Interstate and Defense Highways (Weingroff 2011). The original Lincoln Highway route was identified in 1913 and used existing improved and unimproved roads. It crossed the Sierra Nevada via two routes that are today known as Interstate-80 and US-50. It followed what is now Highway 99 south to Stockton. Interstate-205 and Interstate-580 now parallel much the same route the Lincoln Highway took into Oakland. Through the DMC vicinity, the route followed Old Grant Line Road, north of what has become Interstate-205. In 1927, the Lincoln Highway was realigned to a route that parallels present-day Interstate-80 between Davis and Berkeley (LHA 2014). The portion of the highway that crossed the DMC vicinity has thus reverted to local roads.

3.0 SOURCES CONSULTED

3.1 ARCHIVAL AND RECORDS SEARCH

An archival and records search of the APE and a surrounding 0.25-mile radius was requested by Pacific Legacy on behalf of Reclamation and the Authority on March 10, 2022. Requests were submitted to the Northwest Information Center (NWIC), the Southern San Joaquin Valley Information Center (SSJVIC), and the Central California Information Center (CCIC) of the California Historical Resources Information System (CHRIS). The NWIC, which holds historical resource and study information for Alameda and Contra Costa counties, conducted a records search under file number 21-1476 on April 11, 2022. The SSJVIC conducted a records search of the search area within Fresno and Madera counties on March 21, 2022, under file number 22-107. The CCIC, which covers Merced, San Joaquin, and Stanislaus counties, conducted a search on March 14, 2022, under file number 12106ILN. All searches included a review of the following:

- *Built Environment Resources Directory,* Sonoma County (California Office of Historic Preservation 2022);
- NRHP Directory of Determinations of Eligibility, California Office of Historic Preservation, Volumes I and II, 1990 and updates (California Office of Historic Preservation 1990 and updates);
- *California Inventory of Historic Resources* (State of California 1976);
- *California Historical Landmarks (*State of California 1990); and,
- Historical maps, ethnographic information, historical literature, local inventories, and documents concerning the general area.

The archival and records search was conducted to determine whether cultural resources and built environment resources have been previously discovered within and adjacent to the APE and a 0.25-mile buffer area around the APE. A detailed list of previous cultural resource studies was obtained within the records search area. Full copies of previous cultural resource studies were obtained for those conduced within the APE. Cultural resource records for archaeological sites, isolated finds, and historic period built-environment resources were collected in full. This document details previous archaeological studies and resources within the search area. Documentation pertaining to exclusively historic period built-environment studies and resources is discussed in Appendix F. The results of the archival and records search are depicted on United States Geological Survey (USGS) 7.5-minute series topographic quadrangles in Appendix A, Figure 2.

3.2 PREVIOUS CULTURAL RESOURCE STUDIES

A total of 200 cultural resource studies that deal with archaeological resources have been conducted within 0.25-miles of the APE. These studies were reviewed to determine if they documented adequate survey coverage. For the purposes of this report, adequate survey coverage is defined as a survey that has been conducted within the past ten years (2012 or later) and was conducted using a minimum of 15-meter spaced pedestrian transects. A total of 24 studies met these qualifications or

included archaeological excavation and are documented in Table 3-1 and discussed below. Approximately 0.9% of the APE has been subject to adequate archaeological study. A complete list of previous cultural studies is presented in Appendix B.

Table 3-1 Previous Archaeological Studies with Adequate Survey Coverage or Excavation.

Study Number	Title	Author	Year	Type
ME-07812	MP-153 Cultural Resources Post Field Sumary Record, 13-SCAO-083; PG&E Newman Canal Gas Line License	Way, M.	2013	Archaeological, Field study
ME-07979	Cultural Resources Inventory Report, Line 331B MP 0.79-1.31 and Valve Lot Extension Reinforcement Project, Santa Nella, Merced County, California.	Ludwig, Brian	2013	Archaeological, Architectural/Historical, Field study
ME-08202	Los Banos Creek Diversion Project, Mreced County, California; Bureau of Reclamation 14-SCAO-241	Carper, M.	2014	Archaeological, Architectural/Historical, Field study
ME-08264	Cultural Resources Post Field Report for the San Luis Water Distrcit New Pump Station on the Delta Mendota Canal	Barnes, A.J.	2015	Archaeological, Field study
ME-08746	Historic Property Survey Report for the Proposed State Route 140 Merced Guardrail Upgrade Project, Merced County, California [plus one western extension in to Stanislaus County]; 10-MER-140 P.M. 0.0/42.1 EA 10-0Y110; EFIS: 1013000108	Delsescaux, J.	2016	Archaeological, Architectural/Historical, Evaluation, Field study
ME-08959	Historic Property Survey Report and Archaeological Survey Report for the Proposed D10 Bridge Substructure Repair Project, Merced, Mariposa, San Joaquin and Stanislaus Counties, California; 10-VAR-VAR P.M. Various E.A. 10-1C810; EFIS: 1015000038	Delsescaux, J.	2018	Archaeological, Architectural/Historical, Field study
ME-09169	Cultural Resources Survey Report and Evaluation for the Installation of a Water Meter via Pipeline from the Delta-Mendota Canal at Turn Out 84.38L, Merced County, California	Kile, M. C.	2020	Archaeological, Architectural/Historical, Field study
ME-09301	Historic Property Survey Report/Finding of Effect, Newman Community Conservation Area, 78 and 24-acre Parcels, Merced County, California	Basin Research Associates	2021	Archaeological, Architectural/Historical, Field study

Study Number	Title	Author	Year	Type
SJ-07782	Cultural Resources Survey of the Fabian Tract Spoils Reuse Project, San Joaquin County, CA	Soule, W.	2012	Archaeological, Field study, Other research
SJ-08299	Cultural Resources Assessment of the City of Tracy Public Utility Corral Hollow Road Utility Improvements Project, San Joaquin County, California	Fergusson, A. and A. Farber	2014	Archaeological, Architectural/Historical, Field study
SJ-09239	Cultural Resources Inventory and Evaluation Report, International Park of Commerce Arroyo Project, San Joaquin County, California	Ludwig, B. and J. A. Coleman	2020	Archaeological, Architectural/Historical, Evaluation, Field study
ST-07826	Cultural Resources Inventory for License to Del Puerto Water District for New Discharge Point near Milepost 52.40L on the Delta-Mendota Canal, Stanislaus County, California; 13-SCA)-030	Carper, M.	2013	Archaeological, Field study
ST-07968	MP-153 Cultural Resources Post Field Summary Record, Tracking Number: 14-SCAO-076, Project: Cultural Resources Post Field Report for the Del Puerto Water District New Well Discharge System on the Delta-Mendota Canal.	Barnes, Amy J.	2014	Archaeological, Field study
ST-08341	Historic Property Survey Report North Valley Regional Recycled Water Program (NVRRWP) Vicinity of Patterson, Stanislaus County	Basin Research Associates	2014	Archaeological, Architectural/Historical, Field study
ST-09248	Archaeological Survey Report, Sperry Avenue at Interstate 5 Interchange Project, Stanislaus County, California; 10-STA-005, PM 15.8/15/9, Caltrans District 10, EA 10-0G420/E-FIS 1014000038	Falke, M. and K. Vallaire	2018	Archaeological, Field study
FR-02536	Archaeological Survey Report Seismic Retrofit of the Sierra Avenue Bridge Over the Delta-Mendota Canal (42C0281), Fresno County, California	Armstrong, Matthew D.	2012	Archaeological, Field study
FR-02591	Cultural Resources Inventory and Evaluation for the First Lift Canal Project, Fresno County, California	Baloian, Randy and Jay B. Lloyd	2013	Archaeological, Evaluation, Field study

Study Number	Title	Author	Year	Type
FR-02646	Cultural Resources Post Field Summary Record for the San Luis Pipe at DMC Milepost 98.60	Carper, Mark A.	2013	Archaeological, Field study
FR-02706	Post Field Summary Report for the Delta-Mendota Canal Interceptor Sumps Re-plumb Project, Fresno County, California	Carper, Mark A.	2014	Archaeological, Field study
FR-02710	Cultural Resources Inventory and Evaluation for the Second Lift Canal Project, Fresno County, California	Baloian, Randy, Matthew Armstrong, and Jay B. Lloyd	2014	Archaeological, Evaluation, Field study
FR-02729	Historic Property Survey Report for the Replacement of Bridge 42C0074 over the Delta-Mendota Canal on West Nees Avenue, Fresno County, California	Morlet, Aubrie and Randy Baloian	2015	Archaeological, Architectural/Historical, Evaluation, Field study
FR-02970	Cultural Resources Investigation for the Widren Water District Water Quality, Supply, and Drainage Enhancement Project.	Barns, Amy J.	2017	Archaeological, Evaluation, Field study
FR-03031	Cultural Resource Inventory and Evaluation Report for the Mowry Bridge Replacement Project, City of Mendota, Fresno County, California	Dyste, Diana T., M. Colleen Hamilton, Amber Long, Annie McCausland, Randy Ottenhoff, and Carlos van Onna	2020	Archaeological, Architectural/historical, Evaluation, Field study
S-46401	PG&E Tracy District Electrolysis Test Station Program (letter report)	Patrick, Melinda P.	2012	Archaeological, Field study

3.3 PREVIOUSLY DOCUMENTED ARCHAEOLOGICAL SITES

No previously recorded archaeological sites were documented within the APE. Two archaeological sites and a single isolate were identified within the 0.25-mile records search area around the APE. The two archaeological sites within the records search area are associated with Native American habitation or activities. The isolate is associated with the historic period. Table 3-2 provides a list of archaeological sites found during the archival and records searches.

Table 3-2 Previous Archaeological Sites within the Records Search Area.

Resource Designation(s)	Type	Author	Date Recorded	Description	NRHP/ CRHR Status*
P-24-000172 CA-MER-72	Site	F. F. Latta	1950	Native American occupation site that was not relocated in 1993.	Not Evaluated
		Albert Knight and Leonard Manuel, Jr.	1993		
P-39-000066 CA-SJO-262	Site	John W. Foster	1995	Cache of milling equipment	Not Evaluated
PEP 12-ISO-7	Isolate	D. Anderson, J. Panichelle, and T. Langheim	1992	Three fragments of sun-colored amethyst glass	Not Evaluated

3.4 NATIVE AMERICAN CONSULTATION

Pacific Legacy submitted a Sacred Lands File search request for the APE to the Native American Heritage Commission (NAHC) on April 5, 2022. A response was received on April 20, 2022, from Pricilla Torres-Fuentes, Cultural Resources Analyst with the NAHC, indicating that the Sacred Lands File search was positive within the APE. Ms. Torres-Fuentes provided a list of Native American tribal representatives who may have knowledge of or interest in cultural resources in the Project vicinity. These individuals and a record of correspondences are listed in Appendix C. As a part of the environmental review process, Reclamation is consulting with Native American tribal representatives and other potential stakeholders regarding the Project consistent with Section 106 of the NHPA.

Pacific Legacy is responsible for consulting with Native American tribal representatives regarding the Project in accordance with CEQA and Assembly Bill 52. On June 14, 2020, the Authority sent certified letters to Native American tribal representatives identified by the NAHC to inform them about the Project and request consultation. Five responses were received. Corrina Gould of the Confederated Villages of Lisjan Nation requested to be updated on the results of the Sacred Lands File Search in Alameda, Contra Costa, and San Joaquin counties. Paige Berggren of the Santa Rosa Rancheria Tachi-Yokut Tribe stated that the tribe has serious concerns regarding the Project and requested Native American monitoring during any ground disturbing activity. Anna Cheng of the United Auburn Indian Community indicated that the Project was outside of their geographic area of traditional and cultural affiliations. Katherine Perez of the Northern Valley Yokuts Tribe and the Nototome Cultural Preservation requested Native American monitoring of all cultural resource surveys and ground disturbing activities in tribal cultural resource areas. Venesa Kremer of the Wilton Rancheria requested copies of any cultural resource studies conducted within the APE. Follow letters updating the progress of cultural resource studies were sent out by the Authority on August 18, 2022. The complete responses as well as sample letters and the Native American contact log are presented in Appendix C.

4.0 SURVEY AND RECORDING METHODOLOGY

Inventory methods to identify cultural resources in the Project APE involved documentary research, archival and record searches, and a pedestrian field inventory of the Project survey area. The results of the record searches, as described in Section 2.0, were used during the field inventory to assist in relocating previously recorded archaeological resources. The methods used to document built environment resources are briefly discussed here and are developed more fully in in Appendix F.

4.1 ARCHAEOLOGICAL SURVEY AND RECORDING METHODS

4.1.1 Field Survey Methods

Fieldwork was conducted over the course of three rotations between May 17th and 26th, June 6th and 10th, and June 13th through the 17th, 2022, by Pacific Legacy archaeologists. Christopher Peske, BA, served as field director with Ashley Schmutzler, MA, serving as assistant field director. Archaeologists who participated in fieldwork included Griffen Bragagnolo, BA, Gloria Brown, MA, Jack Flynn, BA, Myra Jamison, Bridget Parry, BA, and Walter Tovar Saldana, MA. The intensive pedestrian field inventory of the survey area involved the use of 15-meter transects, which were narrowed to 1-meter transects when potential archaeological resources were identified. Areas within the APE that appeared to be private property were not surveyed. These locations and the surveyed areas are depicted in Appendix A, Figure 3. Site Records are included in Appendix D. Photographs were taken of the survey area and all cultural resources encountered and documented in a photographic log. Photographs from the field inventory are provided in Appendix E.

4.1.2 Site Recording

All cultural resources encountered during the inventory surveys were documented on DPR Forms 523 and on supplemental records in keeping with procedures identified in the *Instructions for Recording Historical Resources* (California Office of Historic Preservation 1995). At a minimum, resource documentation was completed on DPR Form 523(a) (a Primary form) and DPR Form 523(j) (a 1:24,000-scale map depicting the cultural resource location). Archaeological sites were defined as three or more artifacts discovered within 30 meters of each other. Isolated finds were defined as a single artifact, two artifacts located less than 30 meters apart, or as isolated, discrete features within the landscape (e.g., a historic period well head or trough, two prehistoric lithic flakes, etc.).

Isolated finds were recorded positionally recorded with a GNSS receiver, photographed, and briefly described. Prehistoric sites and historic period resources were recorded with a GNSS receiver, photographed, described, documented on a sketch map at an appropriate scale, and supplemented with additional forms, as necessary. Sketch maps were prepared that depicted the resource boundary, its major elements, and its relationship to other resources or natural features in the vicinity. No cultural materials were collected during the field inventory. Site mapping was conducted using ESRI Field Maps software paired with a Trimble R1 GNSS receiver in conjunction with hand-drawn maps prepared using a tape and compass. GNSS points were taken in the UTM Zone 10N projection, NAD 83 datum. Site maps were generated using ArcGIS Pro software and were plotted onto aerial photographs and topographic maps. Resource and isolate locations are depicted in Appendix A, Figure 3. Archaeological site and isolate records are presented in Appendix D.

In addition to the standard DPR Forms 523, additional data sheets were included as necessary to document each cultural resource. Diagnostic and unusual, rare, or unique artifacts were assigned artifact numbers and recorded with a GNSS receiver and on-site sketch maps. The potential for buried cultural deposits was noted through the inspection of natural or artificial exposures of soil

stratigraphy (e.g., vertical soil exposures, areas of bioturbation, etc.). Daily field notes documenting inventory survey efforts were kept on standardized forms and archived at the Berkeley office of Pacific Legacy.

4.2 GEOARCHAEOLOGICAL TESTING METHODS

[Placeholder for Geoarchaeological Testing Write-up]

4.3 BUILT ENVIRONMENT SURVEY AND RECORDING METHODS

JRP staff recorded and evaluated five built environment resources in the APE: Delta-Mendota Canal, two rural residential properties, and two drainage canals. JRP staff recorded Delta-Mendota Canal by visually observing the entire 116-mile canal from its headworks at the inlet canal upstream from C.W. Bill Jones Pumping Station to its outlet at Mendota Pool. JRP recorded the canal with digital photography and field notes. In order to photographically capture the characteristics of the canal, JRP took photographs of all major structures – check structures, siphon inlets and outlets, overchutes, turnouts, and bridges – and photographed representative examples of common and ubiquitous minor structures like inlet drains, culverts, road drains, and ladders. JRP photographed representative examples of the canal prism at regular intervals no greater than one-half mile for the entire length of the canal. JRP recorded Delta-Mendota Canal on a set of DPR 523 forms that consists of a Primary Record, a Building, Structures and Object Record, 22 DPR 523 Linear Feature Records, and a Site Map (Appendix F). The DPR 523 Forms for the canal do not include photographs of each of the approximately 750 appurtenant structures on the canal but do include photographs of representative examples. JRP recorded two rural residential properties and two drainage ditches on DPR 523 forms sets that provide descriptions of the resources and NRHP and CRHR evaluations.

5.0 INVENTORY RESULTS

5.1 ARCHAEOLOGICAL SURVEY AND INVENTORY RESULTS

Pacific Legacy completed an intensive pedestrian survey of 5,736 acres of the APE. The remaining portions of the APE were not surveyed due to total development with no ground visibility (2.0 acres), or a lack of access permission to private lands (161 acres). Ground surface visibility was generally excellent throughout the APE. Limits to surface visibility included vegetation outside of the canal access roads and sections of pavement on the access roads. When surface visibility was limited, survey transect spacing was reduced to ensure adequate survey coverage. Two newly identified archaeological sites and two archaeological isolates were located during the survey. Appendix D contains the site and isolate records for all cultural resources encountered in the survey area.

The two newly identified archaeological sites, temporarily designated as DMC-CRP-001 and DMC-CRP-002, both date to the historic period. DMC-CRP-001 is a ditch complex that was partially obliterated by the construction of the Delta-Mendota Canal and Interstate 5. It comprises an earthen ditch that has portions carved into rock, an earthen linear berm, the ruins of a flood gate, and a patch of green grass that was anomalous to the surrounding survey corridor that may suggest a buried feature. Ground surface visibility at the site was low due to dense brush and grasses. DMC-CRP-002 is a trash scatter comprising 15 glass bottle fragments, some of which feature maker's marks and finishes that date to the 1950s. Ground surface visibility at the site was 100% as the grasses had been mowed recently.

Two new archaeological isolates were identified within the APE. DMC-CRP-ISO-001 comprised two crypto-crystalline silicate (CCS) flakes located near the old San Luis Creek bank. Ground surface visibility at the isolate was 100%. DMC-AAS-ISO-001 is the remains of a historic period plow located in a field along the Delta-Mendota Canal. The surface visibility around this isolate was extremely low due to tall grasses.

5.2 BUILT ENVIRONMENT INVENTORY RESULTS

Information Center search results identified three linear historic properties that cross under or over Delta-Mendota Canal and have been previously determined eligible for listing in the NRHP, as well as nine additional linear built environment resources that cross under or over the DMC and have been previously determined not eligible for listing in the NRHP. See Table 2 in Appendix F and APE maps for these previously evaluated historic linear resources. These resources were not rerecorded during this inventory. Newly recorded resources include the Delta-Mendota Canal, San Luis Drain, two rural residential properties on Lammers Road (APN 251-050-120 and 240-140-260) in San Joaquin County and a drainage canal that is part of Firebaugh Canal Water District in Fresno County.

6.0 SITE EVALUATIONS

Criteria for formally evaluating cultural resources under the NRHP and the CRHR were introduced in Sections 1.3.1 and 1.3.3. In addition, the JRP document in Appendix F addresses the historic context and results of the built environment survey. Using those criteria, evaluations are based on an approach that assesses the integrity or condition of cultural resources and their significance in relation to the four criteria outlined under 36 CFR Part 60.4 and under Section 15064.5 of state CEQA *Guidelines*.

Assessments of integrity are based upon the integrity of location, design, setting, materials, workmanship, feeling, and association for each resource examined. Integrity of location refers to whether a resource has been displaced from its original position. It may apply to standing structures or infrastructural elements, or it may apply to archaeological sites or cultural resource deposits that have been moved or displaced from where they originated. Cultural resources that lack integrity of location will generally have lost their depositional or historic context and would be expected to provide little significant information important to the study of prehistory or history. Integrity of setting, feeling, and association are particularly relevant when assessing historic period buildings, structures, objects, and sites for which the physical setting and its degree of preservation are important (e.g., a historic period irrigation ditch that is part of a larger intact site or district, a canal or aqueduct that remains in use and has not been substantially altered, or a historic period farmstead that retains its rural agricultural setting). In contrast, archaeological sites, particularly cultural deposits associated with Native American activities, can be significant if undisturbed even if they are encountered in a developed setting incongruent with the context of their original deposition. Integrity of design, materials, and workmanship may be pertinent to archaeological resources, though integrity of design and workmanship are most often examined with reference to built environment resources.

In order to evaluate cultural resources for their potential eligibility for listing in the NRHP and CRHR, it is necessary examine them with reference to a historic context. Information regarding the natural environment and cultural history of the Project APE was included in Section 2.0. Research themes and questions relevant to the specific resource types that are known to occur in the Project Area are offered below in Sections 5.1 and 5.2. Contextual information specific to individual cultural resources is presented in Section 5.3. A variety of sources, many available online, were consulted. These included previous site records; historic period topographic maps; federal land patents; GLO survey plats and mineral survey plats; federal manuscript and agricultural census records; mining bulletins and journals; historical newspapers and photographs; and local county histories, tax documents, and voter registers.

The aim in constructing resource-specific contexts was to identify potential associations with events that made a significant contribution to the broad patterns of our history (NRHP Criterion A/CRHR Criterion 1) and to identify potential associations with one or more individuals who were significant to our past (NRHP Criterion B/CRHR Criterion 2). The distinctive physical characteristics—the construction, style, or artistic values (NRHP Criterion C/CRHR Criterion 3) of cultural resources—were most evident through their material aspects but were also considered in light of their historic context. Finally, resource-specific contexts were used to evaluate the potential of sites or structures to yield information important to the study of prehistory or history (NRHP Criterion D/CRHR Criterion 4).

6.1 POTENTIAL ARCHAEOLOGICAL RESEARCH THEMES AND QUESTIONS FOR EVALUATING CULTURAL RESOURCES

A series of research themes and questions that might be addressed during the evaluation of cultural resources within the APE are presented below. Most of these themes and questions are relevant to both Native American associated resources and historic period resources, though the manner in which they are addressed will vary greatly based on the type of resource under assessment.

- *Chronology* is a fundamental research theme central to the study of cultural resources. A focus on chronology allows researchers to examine sites and/or structures as representative of (or anomalous within) a particular time and place, relate sites and/or structures to one another and to broader regional landscapes or patterns in prehistory or history, and better understand change through time as expressed through a given resource. Questions relating to chronology might include the following:
    - Does the resource contain dateable or temporally sensitive materials such as charcoal, other organic remains, obsidian, diagnostic projectile point types, or dateable historic period glass, metal, or ceramic artifacts?
    - Does the historic period structure exhibit details in its fabrication or construction that would render it dateable?
    - What do dateable materials or structures reveal about when the site was used, how it was related to other sites in the vicinity, and how use or occupation of the resource may have changed through time?
- *Economy* comprises another key research theme that is relevant to the study of cultural resources. For historic period resources, the theme of economy has much to do with how products or materials were produced, sold, purchased, and consumed. For prehistoric sites, the theme of economy is closely related to subsistence, though it also may relate to how raw materials or finished goods were obtained or traded. The theme of economy is closely aligned to other research themes such as settlement or community organization, technology, trade and exchange, and cultural identity. Questions relating to economy or economic subsistence might include the following:
    - Does the resource contain evidence of the subsistence economy such as macrofloral or faunal remains? Do those materials represent seasonally or more permanently available foods? If seasonal materials are represented, what might they reveal about when or how a given site was used (e.g., temporary versus long-term habitation)? Is there evidence of food storage present?
    - Are non-local resources represented, perhaps indicating trade or exchange?
    - What do the floral or faunal remains reveal about the use of technology at the site?

- Within historic period resources, is there evidence that food was grown for household consumption and/or grown as an economic commodity? Is there evidence for the consumption of non-local or mass-produced goods?

- *Settlement or Community Organization* refers to how people occupied the landscape—how they moved through space, where they established their settlements or communities, how those settlements or communities were structured and organized, and how they related to others within the same region or territory. Questions associated with settlement or community organization might include the following:

    - How is space structured within the boundaries of the resource? Is there evidence for different activity areas? What might that reveal about aspects of cultural identity such as gender, race, or ethnicity?

    - How does a particular resource relate to the larger settlement landscape or community? What cultural or environmental factors might have influenced the choice of one locale versus another?

    - Was a given resource area used temporarily or permanently? On a seasonal or year-round basis?

    - What might the resource reveal about social or economic structures at the local or regional level?

- *Technology* refers to the tools or methods that are used during the course of daily activities such as procuring or processing foods, building dwellings or other structures, and manufacturing utilitarian or non-utilitarian items. Questions relating to technology might include the following:

    - What kinds of tools were being used or manufactured by the people accessing or inhabiting the resource area?

    - Do they shed light on how the resource area was used or what activities may have been carried out there?

    - Do the artifacts present represent finished or unfinished items and what might that reveal about trade, exchange, and/or commerce?

    - What does the technology represented at a given resource location reveal about cultural chronology, the economy, and/or trade and exchange?

- *Trade and Economic Exchange* relate to how raw materials and finished goods were obtained through direct or indirect interactions between social groups. At Native American associated sites, it is possible to discover marine shell from the coast at sites within the San Joaquin Valley interior or non-local lithic materials procured from other regions. At historic period sites, it is even more common to find goods or materials of non-local manufacture that were acquired through commercial activity. Questions relating to trade and exchange might include the following:

- Does the site contain non-local materials or goods? How and from whom were those materials obtained?

- What do those items reveal about the spatial extent and stability of trade networks? What might those items reveal about technology, community organization, cultural identity, or the priorities and values of a given site's occupants?

- How do non-local materials at a resource location relate to the broader cultural landscape and environmental region?

- *Cultural History and Identity* pertain to the ways in which groups developed and formed shared identities based on social organization, political affiliation, religious practices, and/or gender, race, and ethnicity. Questions relating to cultural history and identity might include the following:

    - Does the resource area contain materials that can be linked to a particular social group that may shed light on the cultural history or identity of its inhabitants?

    - What do those materials or the ways in which they were structured, used, or organized reveal about gender, race, or ethnic identity?

    - Are particular ethnographic, linguistic, or ethnic groups represented?

    - For late Native American or historic period resources, how do the materials or remains within a given site support or refute other lines of evidence such as oral history or documentary records?

The research themes and questions above are not exhaustive but provide a basic framework for examining cultural resources within the Project APE and for evaluating the potential NRHP and CRHR eligibility of those resources.

6.2 SITE TYPES AND ATTRIBUTES

An integral part of conducting cultural resource evaluations includes defining and documenting the site types represented by a given group of cultural resources. This was noted in Section 6.0 when discussing the types of cultural resources that were encountered during Project inventory surveys. Defining and documenting general site types is useful because it can guide the construction of contexts for historic period sites and structures or suggest fruitful research themes and questions for prehistoric sites. A brief outline of site types and attributes representative of those typically found within the Project vicinity is presented below.

6.2.1 Native American Associated Site Types and Attributes

Typical sites associated with Native American activities might include permanent or temporary habitation sites or activity-specific sites such as lithic scatters or food processing areas.

- *Permanent habitation sites* comprise residential sites that were occupied on a permanent or nearly permanent basis. Such sites are often distinguished by their size and by evidence for long-term occupation and material deposition. Permanent habitation sites frequently contain stratified midden deposits or mounds. Midden deposits consist of black or very

dark, organic-rich soils that accumulate through intensive or long-term and repeated deposition. Permanent habitation sites might also be expected to feature evidence of house-pit depressions or the remains of other habitation structures. House-pit depressions are typically round, measure between 2-20 meters in diameter, and feature a low berm around their periphery. Given the effects of environmental forces and modern development, house-pit depressions are rarely encountered in the archaeological record but can provide valuable information about daily activities and the use of space in prehistory. The presence of bedrock milling features may also be indicative of long-term habitation. Frequently encountered in the foothills and in areas with bedrock outcrops, bedrock milling features contain mortars or slicks—rounded, cup-like depressions or shallower, elongated depressions that were formed by and used for grinding hard seeds such as acorns and other materials. Although many bedrock milling features have been associated with long-term habitation, they also frequently occur in isolation or independent of other archaeological deposits. The evaluation of a site's physical setting or context is critical in examining such features. In addition to midden soils, house-pit depressions, and bedrock milling features, the archaeological assemblage at permanent habitation sites might be expected to include an array of groundstone and lithic tools as well as floral and faunal remains.

- *Temporary or seasonal habitation sites* include those that were occupied for a short duration or those that were occupied repeatedly, though on a seasonal or short-term basis. Typically smaller than permanent habitation sites, temporary or seasonal habitation sites usually lack accumulated midden deposits or formal house-pit depressions. An array of activities may be evident at temporary or seasonal habitation sites, though materials would be expected to be less diverse than encountered at permanent habitation sites. Bedrock milling features, groundstone, lithic tools, and floral and faunal remains may all be present at temporary or seasonal habitation sites, though the assemblage would likely be less varied, and materials would be expected to be fewer in number when contrasted with permanent habitation sites.

- *Activity-specific sites* include those that were used for one purpose or for a very limited range of purposes. Lithic scatters, lithic quarry areas, or food processing locales are all examples of such sites. Typically used once or for a short duration, these sites are often characterized by limited assemblages that represent the narrow range of activities that would have occurred there.

6.2.2 Historic Period Site Types and Attributes

Historic period site types that have been encountered or might be anticipated within the APE would include intact or remnant farmstead or ranch sites, agricultural sites, transportation infrastructure, water conveyance features, prospect pits or mining sites, foundations or structure pads, and debris scatters or deposits. Historic period site types are usually based on functional categories and are typically easy to distinguish based on their physical attributes. Cultural constituents often encountered at historic period sites include pits, privies, fences, ditches, water retention or conveyance features, other structural elements, and domestic or industrial debris.

- *Farmstead or ranch sites* frequently include a residence and one or more outbuildings or structures clearly associated with ranching or agricultural activity (e.g., barn, corral, livestock watering locale, and/or shed). They may feature associated historic period debris deposits or scatters and may contain pits, privies, fences, ditches, and livestock watering locales marked by troughs, windmills, and/or water pumps.

- *Agricultural sites* typically include features that are functionally related to the cultivation, production, and harvesting of crops. Such sites are often distinguished by irrigation ditches and canals, fence lines, modified or landscaped hedgerows or tree lines, and berms or mounded soil areas meant to aid water retention or abatement.

- *Transportation infrastructure* consists of historic period features such as paved or unpaved roads and railroad lines or grades. Railroad lines or grades generally feature a relatively level grade, typically on a constructed berm that may or may not include rails, ties, or spikes. Former railroad lines are often dismantled and repurposed as roads and can be difficult to distinguish in the form of berms that have been converted into unpaved roads. Roads are usually easier to distinguish and are sometimes associated with bridges, culverts, and/or secondary debris deposits or scatters left casually or deliberately by passing vehicles.

- *Water conveyance features* include infrastructural elements such as canals, ditches, dams, and dikes and are generally easy to distinguish in form and function, though they can be hard to discern or differentiate when encountered as a part of a larger water conveyance system. For instance, an agricultural canal and ditch system may contain hundreds of elements that have been added, removed, or transformed through time, and it can be difficult to distinguish the precise date or period when certain elements were constructed or altered.

- *Foundations or structure pads* include the material remains of a building's base and are generally constructed of stone, concrete, or wood. Structure pads are areas that have been leveled, typically for the placement of small, less permanent structures, and do not contain foundation elements.

- *Prospect pits or mining sites* typically comprise excavated pits or quarry areas made to test for or extract rocks, gravels, minerals, or metals. Spoils piles, or areas of mounded soils or displaced stone, are often found in conjunction with prospect or mining sites.

- *Debris scatters or deposits* are usually composed of domestic and/or industrial materials that have been scattered or deposited in the area in which they were used (i.e., a primary deposit) or in an area unassociated with their use (i.e., a secondary deposit). For instance, a farmstead or ranch site might feature one or more primary debris scatters containing domestic items such as glass, metal, and ceramics and might contain debris associated with ranching or farming activities such as barbed wire, fencepost remnants, and horseshoes. A historic period road might feature a secondary scatter of domestic or industrial items representing one or more roadside discard events.

6.3 ARCHAEOLOGICAL RESOURCE EVALUATIONS

6.3.1 DMC-CRP-001

DMC-CRP-001 is a historic period ditch segment consisting of four features: a hand-operated flood gate (Feature 1); an earthen ditch (Feature 2), an earthen berm (Feature 3), and a discrete flat area with grasses that differ from the surrounding vegetation (Feature 4). Feature 1 is an iron hand-operated flood gate with wood and concrete elements. It is located on Feature 2, an earthen drainage that has been partially cut through stone. It appears to be a channelized natural drainage. The drainage is depicted on topographic maps as early as 1917. It appears to have been channelized ca. 1953 based upon historic aerial imagery (NETROnline 2022). Feature 3 is a north-south oriented earthen berm approximately 15 ft. long by 2 ft. 4 in. tall. Feature 4 is a distinct area of green, lawn-like vegetation that is approximately 40 ft. (E/W) by 15 ft. (N/S). The resource may be associated with flood control for a channelized drainage that was installed in association with the construction of the Delta-Mendota Canal, or it may be part of an irrigation system. The site is located west of Newman in Township 8 South, Range 8 East, Section 4 in Stanislaus County.

Historic Context

As part of the Central Valley, the Newman area was primarily used for agriculture employing both dry and irrigated farming techniques. In 1871, the Joaquin and Kings River Canal Company formed to build a canal, which Miller and Lux later constructed after they acquired control of the company. This canal ran north-south for 75 mi. from Crows Landing to Firebaugh past Newman and became the first irrigation canal in Stanislaus County. This started irrigated farming on the west side of the San Joaquin River in Stanislaus County (Barnes 1987). Between the 1870s and 1920s, irrigation infrastructure, including the Main Canal and Outside Canal, were constructed. The Sullivan Extension of the Outside Canal was constructed between 1941 and 1949 (Jensen 2017; NETROnline 2022; USGS 1941). In 1951, the Central California Irrigation District (CCID) was organized, which acquired the infrastructure and a large territory along the west side of Stanislaus County between Crows Landing and Mendota (Barnes 1987:Chapter 3; Central CA Irrigation District 2020; Jensen 2017:6). DMC-CRP-001 is located outside of the CCID (2020) boundaries as currently depicted. It is not known if the larger irrigation system that included the site was ever associated with the CCID system.

By 1900, two farming households were situated within a mile of the site location in T8S, R8E, Sections 4 and 5 and might be associated with the site. An unpaved road that ran between the farms and passed the site location is seen depicted on USGS topographic maps (1917, 1919, 1941). A 1906 county map (Carlton 1906) identified these early twentieth century households established by A. L. Yates and W. F. Draper. Yates started farming in Stanislaus County by 1880 and retired to Pacific Grove in Monterey County between 1906 and 1910 (US Census Bureau 1880: 285D, 1900:10; 1910:11A). Draper came to Merced County in 1870 and was farming in Stanislaus County by 1884 (Merced County 1870; Stanislaus County 1884). When he retired by 1910, he remained in Newman Township until his death in 1919 (FindaGrave 2022a; US Census Bureau 1900:7, 1910:13A). Neither of these farmers were considered important enough to be included in a 1921 county history with biographical sketches of prominent residents (Tinkham 1921). Based on the dates, neither of these farmers appears to be associated with the channelizing and expansion of the irrigation system that includes DMC-CRP-001 between 1949 and the early 1950s. The California Water Board was checked for ditch water rights that might identify the owner, however, neither the ditch nor a later owner were identified (California Water Board 2022). The builders have not been identified.

The drainage/ditch appears on historic period maps (USGS 1917, 1919, 1941, 1952) and on a 1949 aerial photograph (Fairchild Aerial Surveys, Inc. 1949) as a natural drainage that extended from the western hills to flow east towards Newman. The drainage was channelized by 1953, based on 1953 and 1957 aerial photographs (NETROnline 2022). During the 1949 to 1953 time period, the north-south oriented Delta Mendota Canal was constructed near the site location and appears to have cut the segment off from the rest of the irrigation system (Reclamation 1959). The 1957, 1958 and 1982 aerial photographs depict the ditch continuing on the east side of the Delta-Mendota Canal. The ditch extends northeast to intersect Flanders Court and then turns east to follow Pete Miller Road toward the Sullivan Extension Canal and/or the Main Canal of the Central California Irrigation District (CCID). The site vicinity is not currently within the CCID boundaries, but it may have been in the past. Currently, the eastern extension of the site segment of the irrigation ditch is obscured by current farming crops and does not appear connected to the site segment. There is a visible ditch segment along the north side of Pete Miller Road to Eastin Road where it disappears.

Evaluation

DMC-CRP-001 is an abandoned remnant irrigation ditch segment with a berm and a former pond that have been cut off from a larger irrigation system by the Delta-Mendota Canal between 1949 and 1952. The ditch segment appears to have been used as a water source in its natural drainage form starting by the early twentieth century but was not channelized until the early 1950s. The irrigation ditch is not part of the first irrigation canal system in the region, nor does it contribute notably to the history of the development of irrigation systems nationally, state-wide or locally. The ditch site is not clearly associated with either the early twentieth century farmers, Draper and Yates, nor is it clearly associated with the CCID and its later irrigation complex. The builder who channelized and expanded the irrigation system in the 1950s has not been identified. As such, DMC-CRP-001 is not recommended eligible for listing on the NRHP or CRHR under Criterion A/1 or under Criterion B/2. DMC-CRP-001 exhibited no unusual or outstanding workmanship or engineering and, therefore, is recommended not eligible for the NRHP or CRHR under Criterion C/3. The ditch complex had no associated artifact deposits or potentially buried features and has been fully recorded. As such, it is unlikely to possess the data potential to contribute significant new information to research related to historical water systems. The site, therefore, is recommended not eligible for the NRHP or CRHR under Criterion D/4.

The site condition is fair. The features are overgrown and in disrepair, but the layout and function of the site segment is still apparent. The construction of Interstate 5 and the Delta-Mendota Canal have isolated this segment of the canal, though a tunnel to allow flow is present where the ditch meets Interstate 5. The connection with irrigation on the east side of the Delta-Mendota Canal is no longer obvious. The ditch segment site retains its integrity aspects of location, materials and workmanship. The association and design aspects are retained with regard to the function of the site and association with irrigation to the west of Interstate 5, however, it is diminished by the loss of clear association with the irrigation system to the east of the Delta-Mendota Canal. The setting and feeling aspects are diminished by the presence of the interstate highway and the canal resulting in a fair integrity of the site. DMC-CRP-001 has fair integrity, however, the site does not meet Criteria A/1, B/2, C/3, or D/4 and is recommended not eligible for listing on the NRHP or CRHR.

6.3.2 DMC-CRP-002

This resource is a historic period refuse scatter. It comprises over 15 glass bottle fragments with a minimum number of individuals (MNI) of 5 bottles. Eight diagnostic glass bottle fragments were identified. The remaining 7 glass fragments were non-diagnostic. Artifact A-01 is a colorless bottle base fragment that measures 1.75 in. (l) x 5 in. (w). It features an Owens Illinois maker's mark, "OI",

that dates from 1954 to present (Toulouse 1971:403). A-02, A-06, and A-08 are three colorless bottle finish and neck fragments with threaded metal caps. The caps are marked "Old Sunny Brook/ TURN TO OPEN" printed around the caps. Old Sunny Brook brand was in use from the 1890s to 1975 (Sullivan 2013). A-03 is a stippled bottle base fragment that measures 2.9 in. square. It features a maker's mark from the Obear-Nester Company, "N [in square] 4…", that provides a partial date code for a 1940s date (Whitten 2022). A-04 is a bottle base fragment marked "4/5 quart". A-05 is a bottle base fragment embossed "57". A-07 is a bottle base fragment marked "800…/10 [H on anchor] …/3", an Anchor Hocking mark that dates from 1937 to 1968 (Anchor Hocking Museum 2015). The diagnostic bottle marks suggest the artifact scatter dates between the 1940s and 1968. The site is located on the top of a berm that appears to be the result of grading the access road along the Delta-Mendota Canal. The site is located west of Newman and southeast of the Stimba Pumping Station in Township 6 South, Range 8 East, Section 32 in Stanislaus County.

Historic Context

DMC-CRP-002 is on agricultural lands west of Crows Landing. In the 1870s, Miller and Lux constructed the San Joaquin and Kings River Canal from Crows Landing to Firebaugh, which started irrigated farming on the west side of Stanislaus County (Barnes 1987). Between the 1870s and 1920s, irrigation infrastructure including the Main Canal and Outside Canal were constructed on the west side of the San Joaquin River in association with the San Joaquin and Kings River Canal (Jensen. In Section 32, the Stimba Pumping Station appears on USGS topographic maps starting in 1917 (USGS 1917, 1919, 1941, 1952). It is just northwest of the site location. It appears to be a water pumping station for the channelized Crow Creek (Metsker Map Company 1939; USGS 1917).

Historical map research demonstrates that the area was fully parceled for farming by ca. 1900. A 1906 county map identified the site area belonged to the Yancey family. Although John Yancey managed a local lumber yard, his wife, Merle C. Yancey, owned the parcel and they may have farmed it as a sideline (Carlton 1906; US Census Bureau 1910:3A). The Yanceys remained in the area until at least 1944 (Stanislaus County 1944). Mr. Yancey died the following year (FindaGrave 2022b). The north-south oriented Delta-Mendota Canal was constructed between 1949 and 1953 (Reclamation 1959). DMC-CRP-002 is located along the Delta-Mendota Canal near a canal check station and south of a county highway and bridge depicted on a 1939 road map (Reclamation 1959; Metsker Map Company 1939). The road and berm associated with the site were part of the Delta-Mendota Canal system and not part of an earlier road, based on USGS topographic and other maps (Metsker Map Company 1939; USGS 1917, 1919, 1941 and 1952).

Evaluation

DMC-CRP-002 is a scatter of historic period glass bottle fragments located on the Delta-Mendota Canal access road. The artifact scatter was deposited between the 1940s and 1968, based on the bottle date ranges. The scatter may be associated with the construction, maintenance, or construction personnel associated with the Delta-Mendota Canal; however, it does not appear to directly contribute to any historic significance the canal may possess. The site scatter may be associated with persons or activities associated with the Stimba Pumping Station nearby. Since the road and berm are not fenced off, the scatter may be associated with passersby who used the access road to access the nearby orchards. The site scatter is unlikely to be associated with the Yancey family as the patriarch died in 1945 before the bottles were manufactured. The historical association for DMC-CRP-002 is not clear and no individuals were clearly associated with the scatter deposition. As such, the DMC-CRP-002 site is not recommended eligible for listing on the NRHP or CRHR under Criterion A/1 or under Criterion B/2.

DMC-CRP-002, as an artifact scatter, does not retain any standing structures that might represent an outstanding example of architecture or engineering. As such, the site is recommended not eligible under Criterion C/3.

DMC-CRP-002 consisted of 15 artifact fragments, with an MNI of 5. At least three of the bottles were alcohol bottles of the same brand, "Old Sunny Brook". This assemblage does not possess sufficient quantity and quality of materials to retain data potential sufficient to address historical archaeology research questions. There do not appear to be any signs of intact hollow-fill features or stratigraphic depth present, which might provide intact deposits. Based on this, the site is recommended not eligible for the NRHP or CRHR under Criterion D/4.

The site condition is poor. This site has been heavily impacted by canal maintenance and road grading. All of the soil has been disturbed, and there is nearly no vegetation due to regular mowing. The berm upon which the site lies appears to be an artificial build-up as a result of road grading. The deposit does not appear to be intact. The site scatter retains its integrity aspects of materials and workmanship. It is unknown whether the scatter is primary or secondary deposition, and it has been disturbed by maintenance activities. The site is unlikely to retain its integrity aspects of location and design. The setting, association and feeling aspects are diminished by construction of the nearby freeway, a lack of knowledge as to who might have deposited the scatter or under what circumstances. The site integrity is poor. DMC-CRP-002 has poor integrity and the site does not meet Criteria A/1, B/2, C/3, or D/4 and, as a result, is recommended not eligible for listing on the NRHP or CRHR.

6.4 Built Environment Resource Evaluations

JRP staff recorded and evaluated five built environment resources in the APE: Delta-Mendota Canal, two rural residential properties, and two drainage canals. The JRP report concludes (Appendix F) that the Delta-Mendota Canal and San Luis Drain are considered eligible for the NRHP or CRHR significance criteria. The three other newly discovered resources evaluated, the two rural residential properties on Lammers Road (APN 251-050-120 and 240-140-260) in San Joaquin County and a drainage canal that is part of Firebaugh Canal Water District in Fresno County, were recommended not eligible for the NRHP or CRHR. The Santa Fe Grade, San Joaquin Pipelines – Hetch Hetchy Aqueduct, and the Outside Canal have been previously determined eligible for the NRHP and CRHR.

7.0 STUDY FINDINGS AND CONCLUSIONS

7.1 ARCHAEOLOGICAL RESOURCES

Pacific Legacy completed an intensive pedestrian survey of 5,736 acres of the APE. The remaining portions of the APE were not surveyed due to total development with no ground visibility (2.0 acres), or a lack of access permission to private lands (161 acres). Two newly identified archaeological sites and two archaeological isolates were located during the survey. Appendix D contains the site and isolate records for all cultural resources encountered in the survey area.

The two newly identified archaeological sites, temporarily designated as DMC-CRP-001 and DMC-CRP-002, both date to the historic period. DMC-CRP-001 is a ditch complex that was partially obliterated by the construction of the Delta-Mendota Canal and Interstate 5. It comprises an earthen ditch that has portions carved into rock, an earthen linear berm, the ruins of a flood gate, and a patch of green grass that was anomalous to the surrounding survey corridor that may suggest a buried feature. Ground surface visibility at the site was low due to dense brush and grasses. DMC-CRP-002 is a trash scatter comprising 15 glass bottle fragments, some of which feature maker's marks and finishes that date to the 1950s. Ground surface visibility at the site was 100% as the grasses had been mowed recently. Both DMC-CRP-001 and DMC-CRP-002 are recommended to be ineligible for inclusion in the NRHP and CRHR.

Two new archaeological isolates were identified within the APE. DMC-CRP-ISO-001 comprised two crypto-crystalline silicate (CCS) flakes located near the old San Luis Creek bank. Ground surface visibility at the isolate was 100%. DMC-AAS-ISO-001 is the remains of a historic period plow located in a field along the Delta-Mendota Canal. The surface visibility around this isolate was very low due to tall grasses.

No archaeological resources have been identified within the APE that are considered historic properties. If Reclamation agrees with this determination, then the Delta-Mendota Canal Subsidence Correction Project would not have an adverse effect on archaeological resources.

7.2 BUILT ENVIRONMENT

Five resources have been identified as historic properties. This includes the Delta-Mendota Canal, San Luis Drain, The Santa Fe Grade, San Joaquin Pipelines – Hetch Hetchy Aqueduct, and the Outside Canal. JRP, in their finding of effect analysis (Appendix F), concluded that the Delta-Mendota Canal Subsidence Correction Project would adversely affect Delta-Mendota Canal but would not adversely affect the other historic properties in the APE. This conclusion is the same for both Alternatives 1 and 2.

7.3 CONCLUSIONS

A Draft Initial Study/Environmental Assessment (IS/EA) is being prepared by Reclamation and the Authority that addresses potential impacts of the two Project alternatives to cultural resources under NEPA and CEQA. Given the information available, adverse effects to significant cultural resources (i.e., historic properties) may result from implementation of Alternative 2. Mitigation measures to resolve adverse effects on historic properties, pursuant to Section 106 of the NHPA, cannot be determined until all cultural resources in the APE for the undertaking have been fully evaluated for NRHP eligibility and consultations are conducted under Section 106 of the NHPA. This will not

occur until after the submission of the draft IS/EA to Reclamation. Any adverse effects to historic properties would be resolved through completion of the Section 106 process.

The resolution of adverse effects to historic properties occurs through the implementation of measures agreed on through consultation with the SHPO, ACHP, and other Section 106 consulting parties. These measures are discussed in the 2021 Amendment One Programmatic Agreement Between the Bureau of Reclamation, Interior Region 10 California-Great Basin; and the California State Historic Preservation Officer Regarding Compliance with Section 106 of the National Historic Preservation Act Pertaining to the Implementation of the Delta-Mendota Canal Subsidence Correction Project, which remains in review. In general, significant impacts to cultural resources under NEPA would be mitigated through the measures agreed to through the Section 106 process and the preparation of a Historic Properties Treatment Plan. Cultural resources that are formally determined not eligible for inclusion in the NRHP or the CRHR would require no further management prior to Project implementation. If cultural resources determined not eligible for listing in the NRHP but eligible for listing in the CRHR are identified as part of the Project, such resources will be managed per CEQA requirements.

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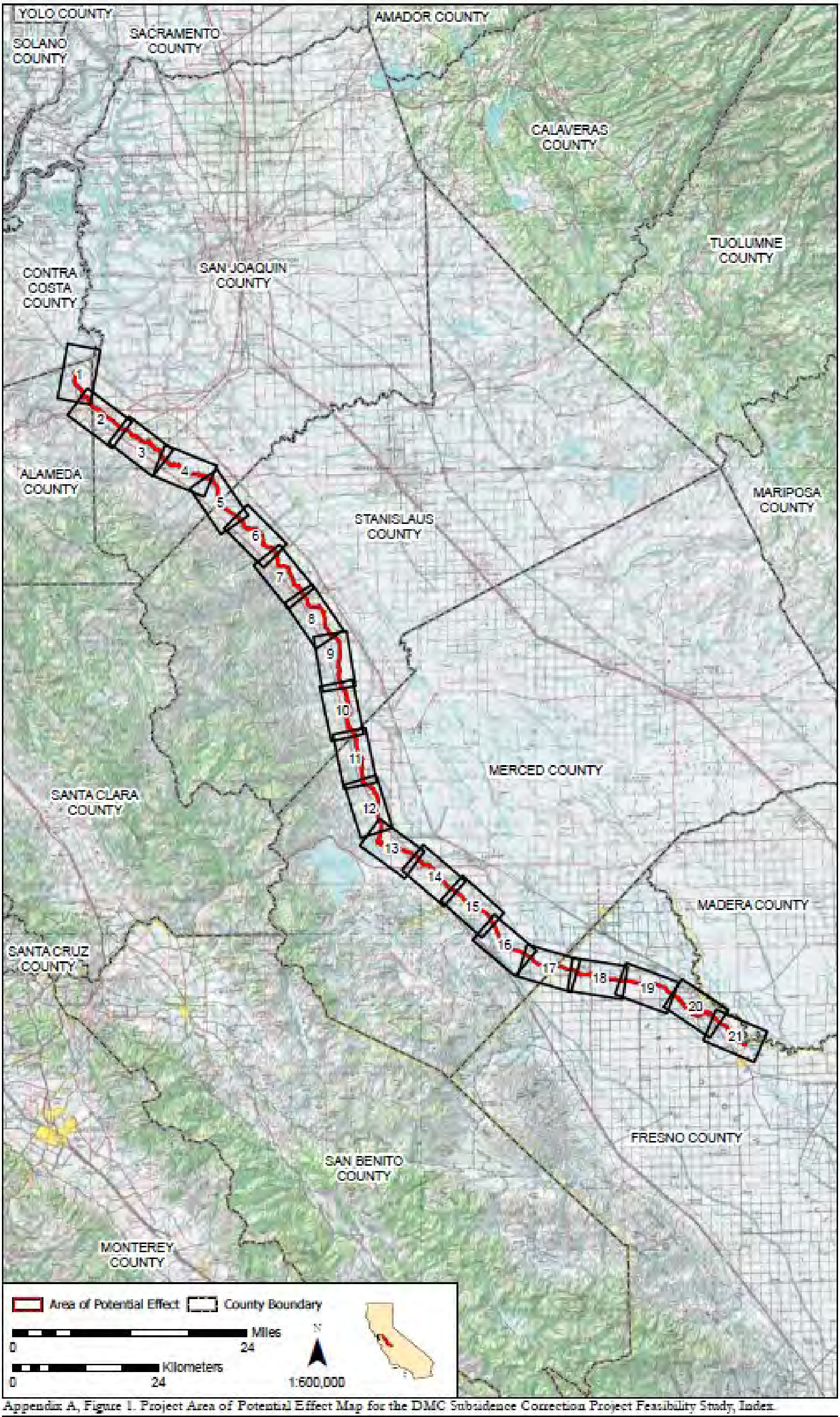
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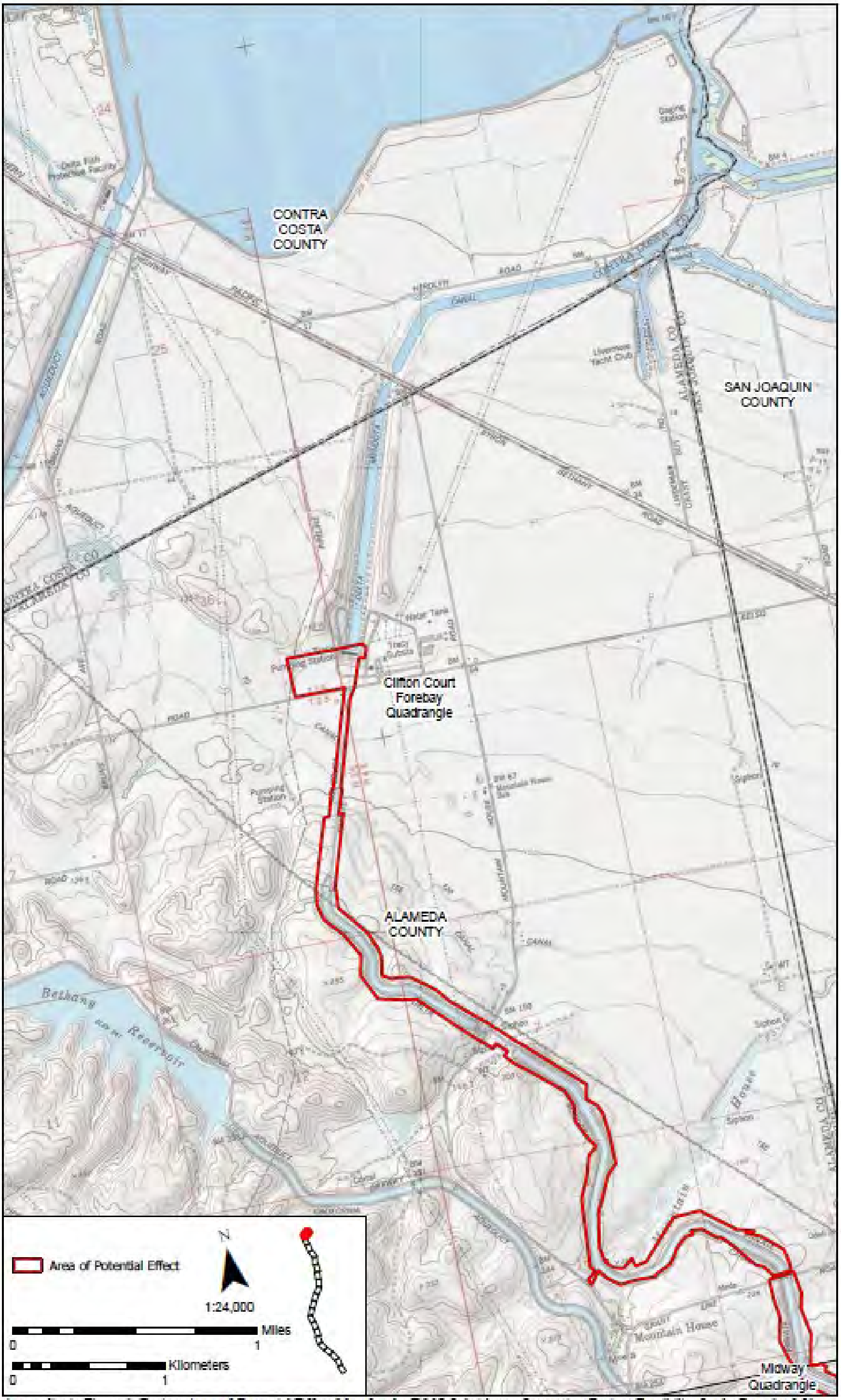
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APPENDIX A – PROJECT FIGURES (REDACTED)

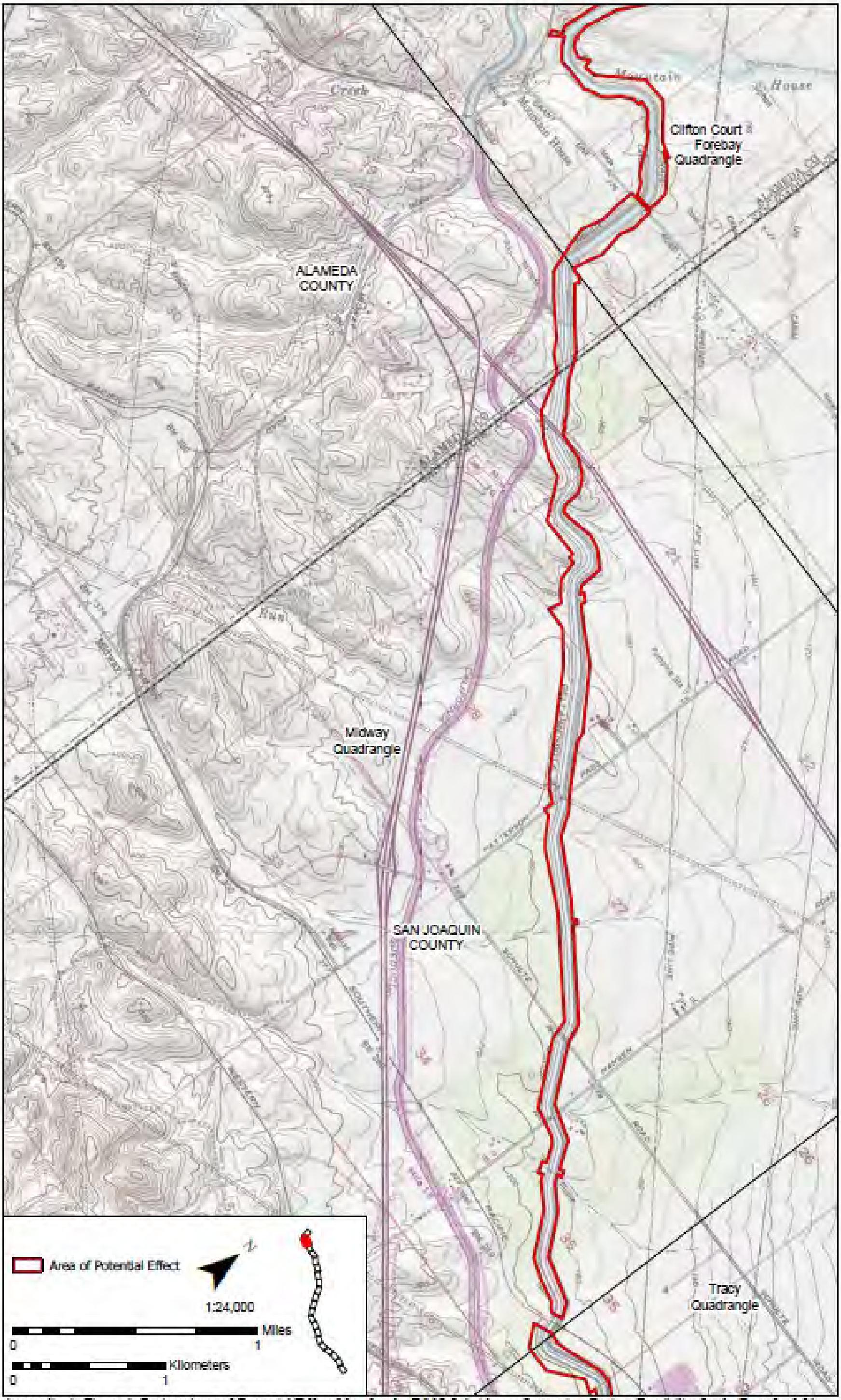
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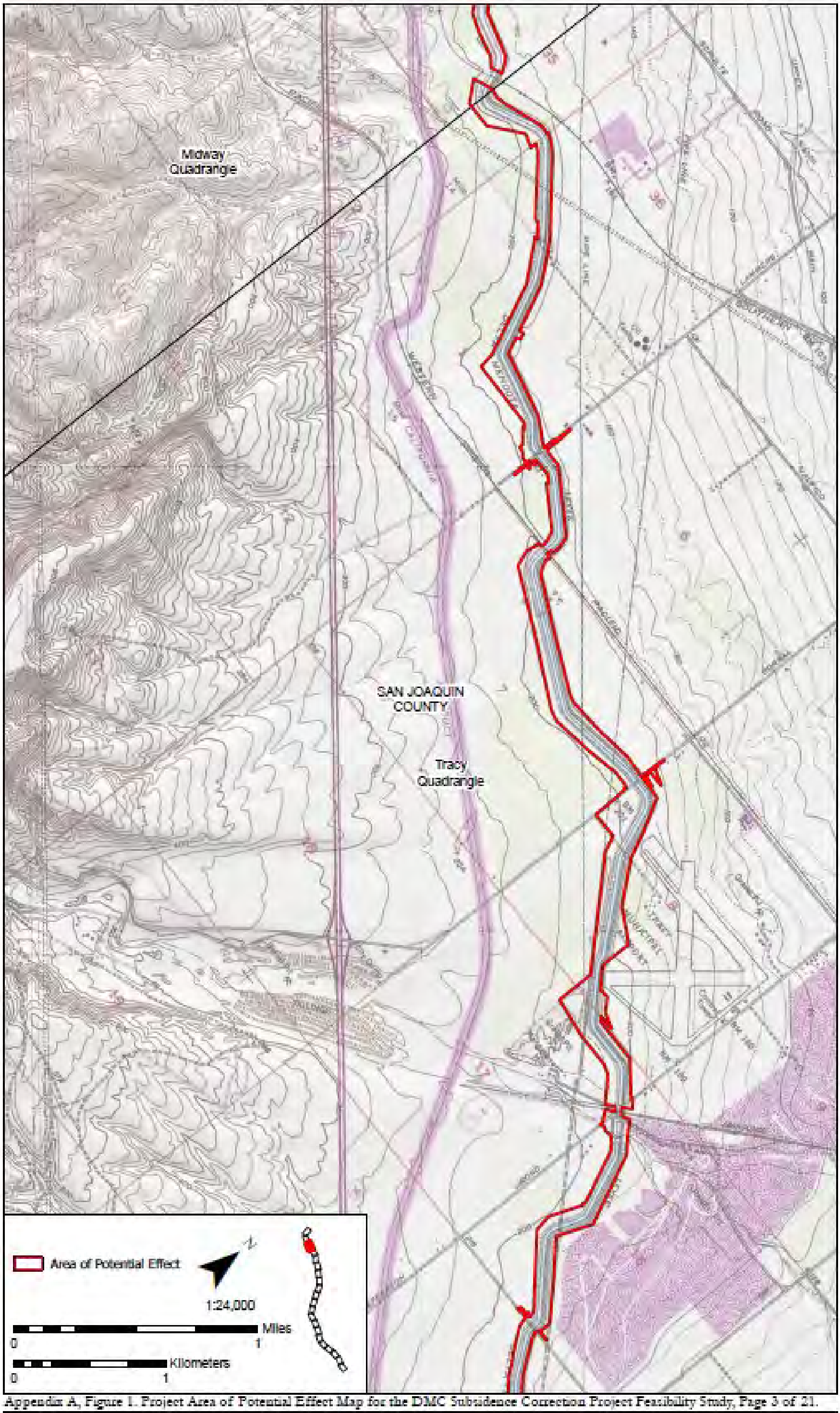
Appendix A, Figure 1. Project Area of Potential Effect Map for the DMC Subsidence Correction Project Feasibility Study, Index.



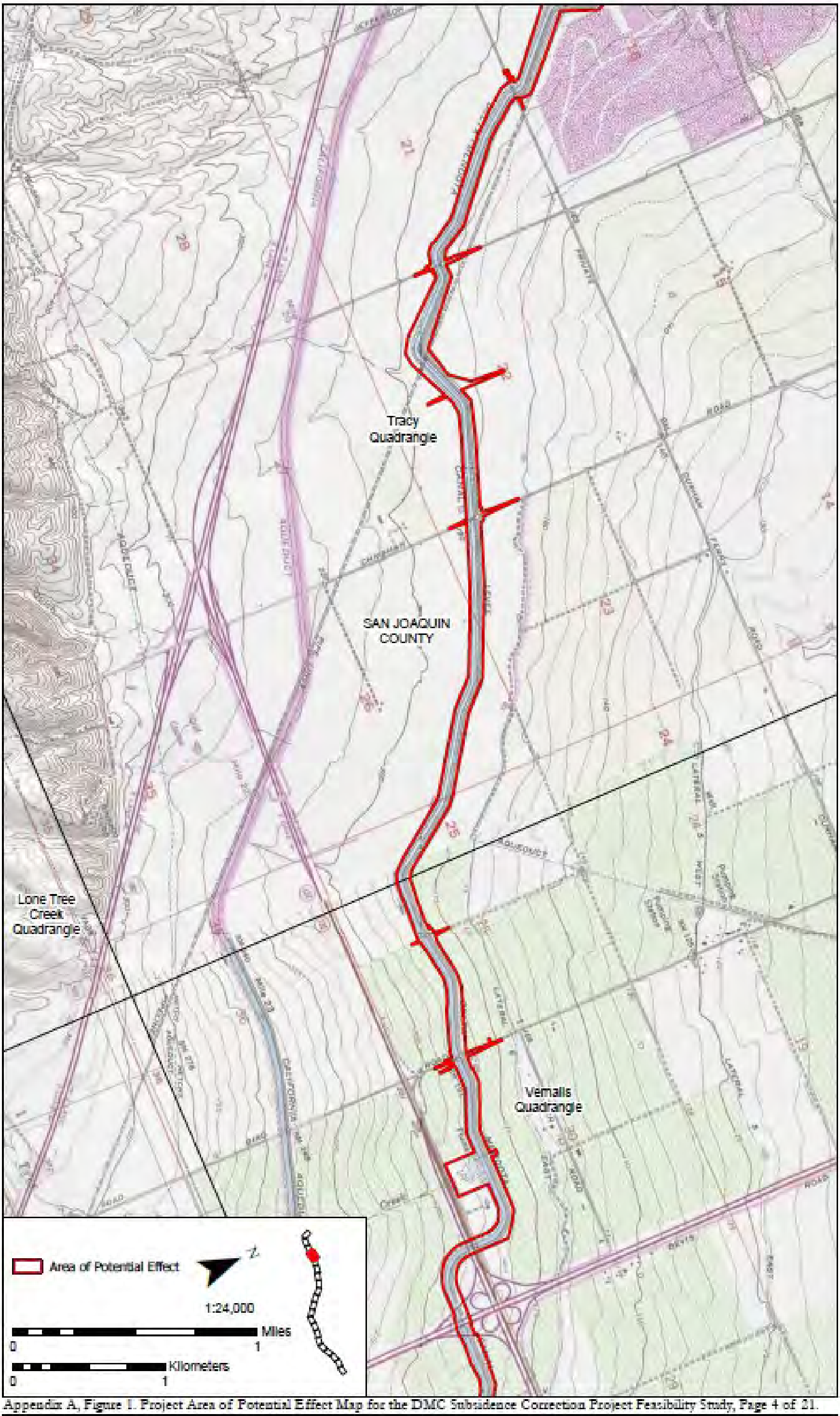
Appendix A, Figure 1. Project Area of Potential Effect Map for the DMC Subsidence Correction Project Feasibility Study, Page 1 of 21.



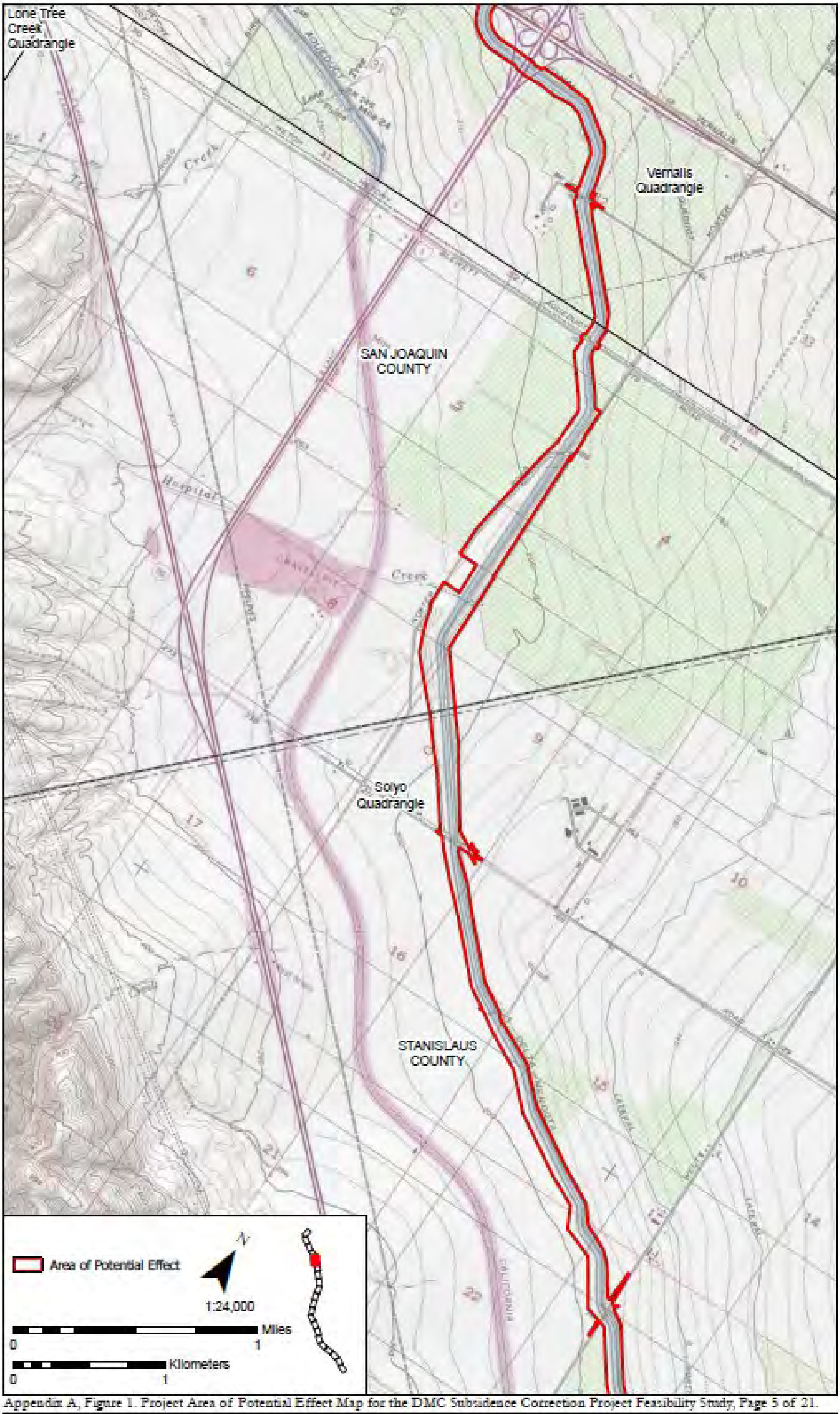
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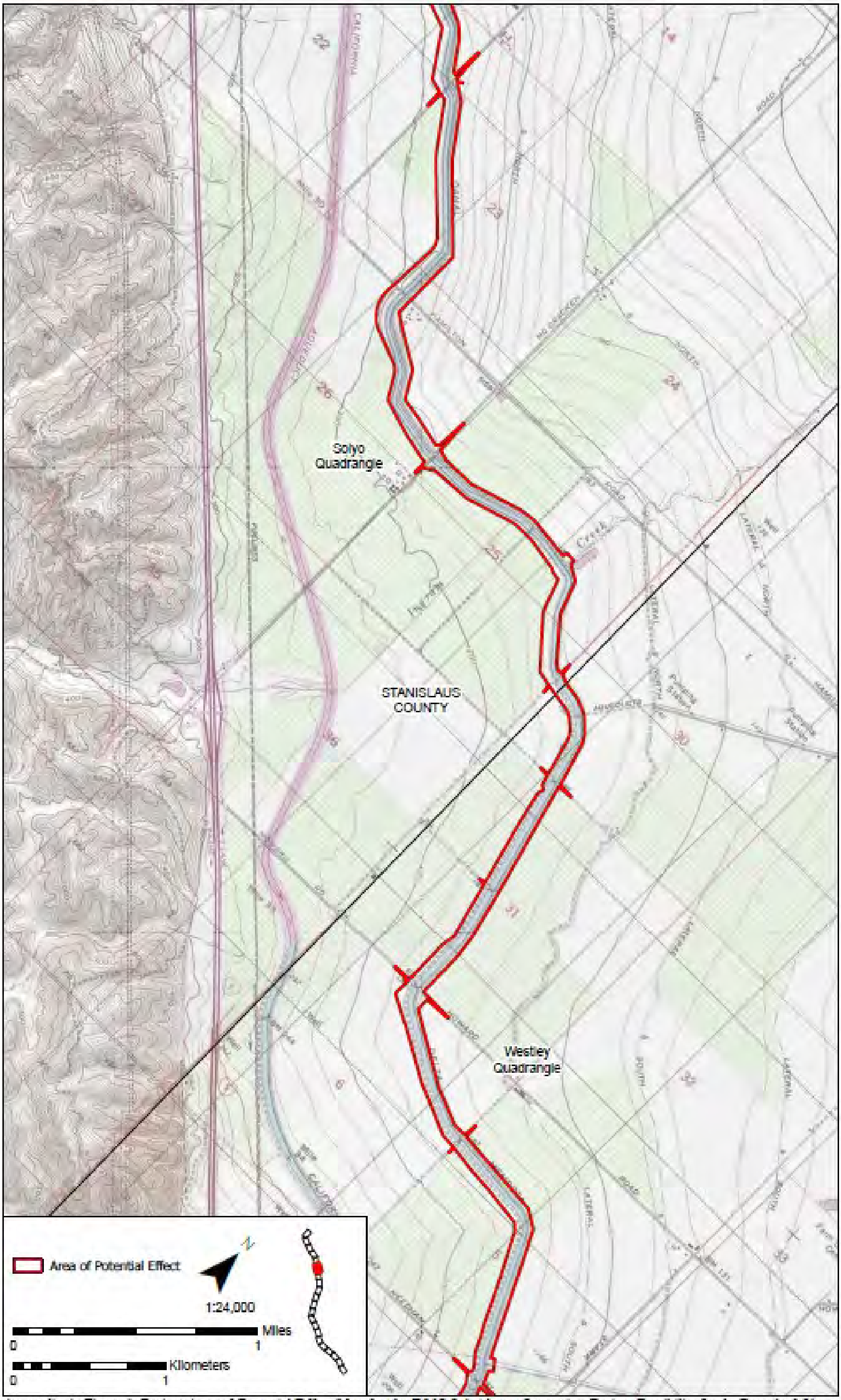
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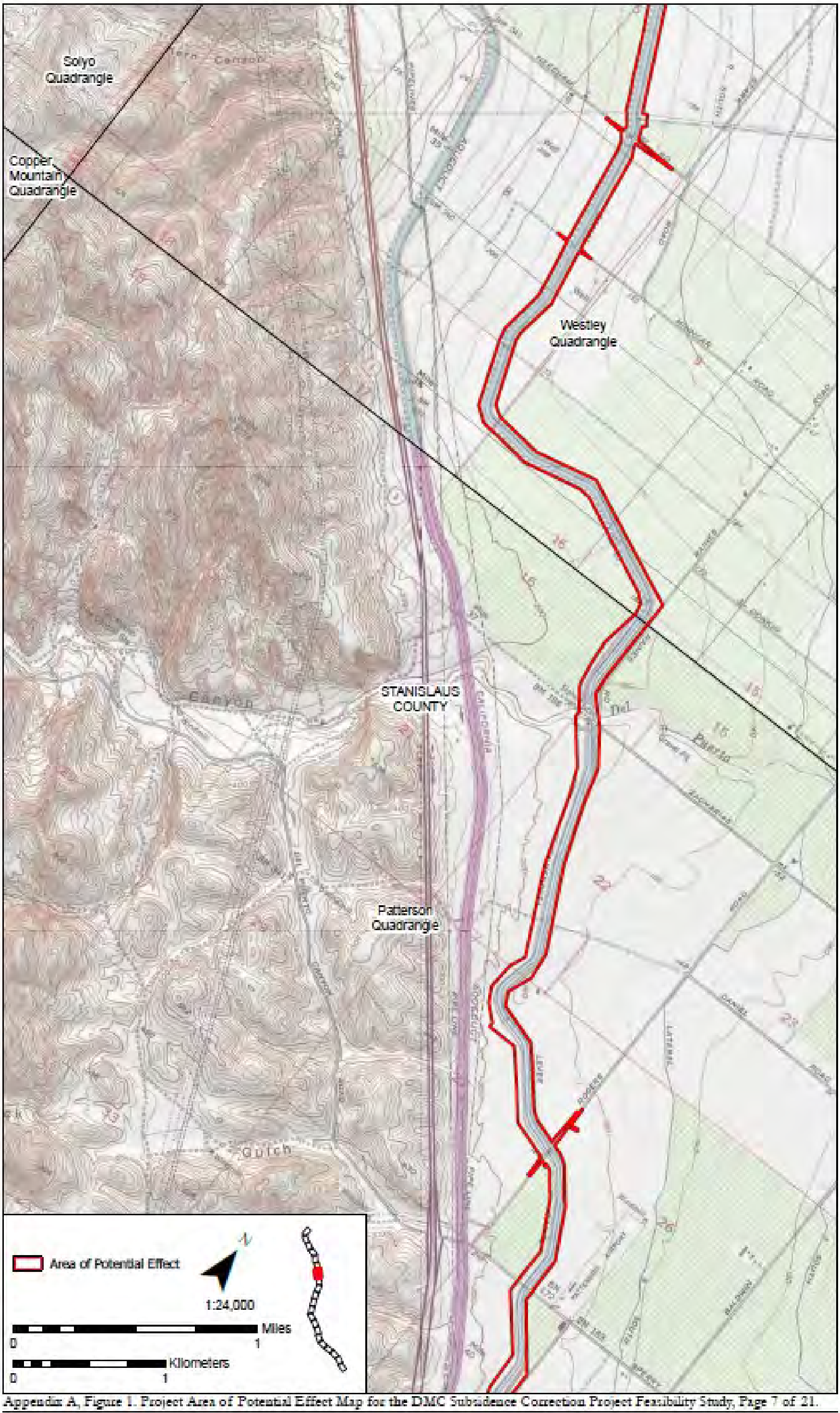
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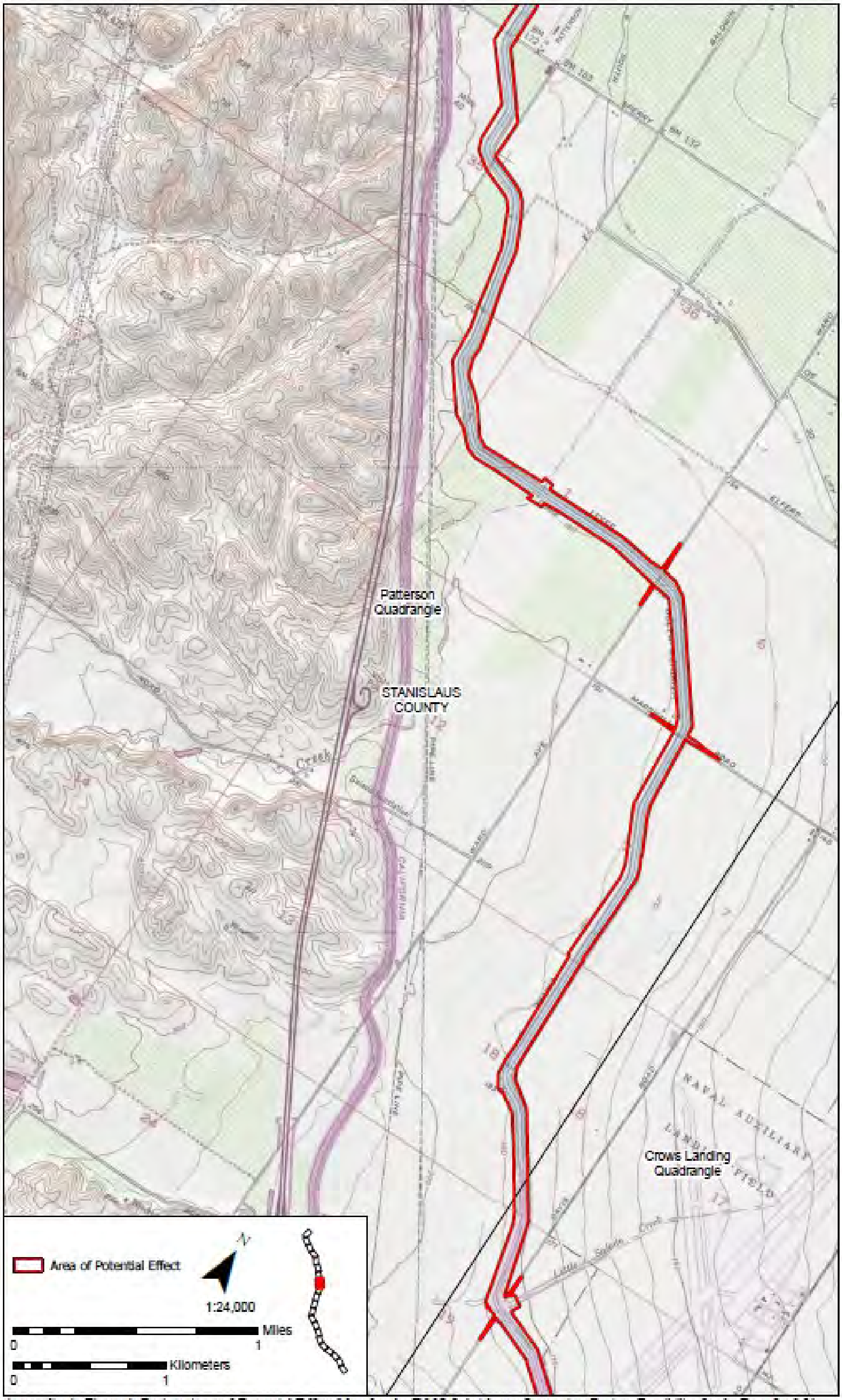
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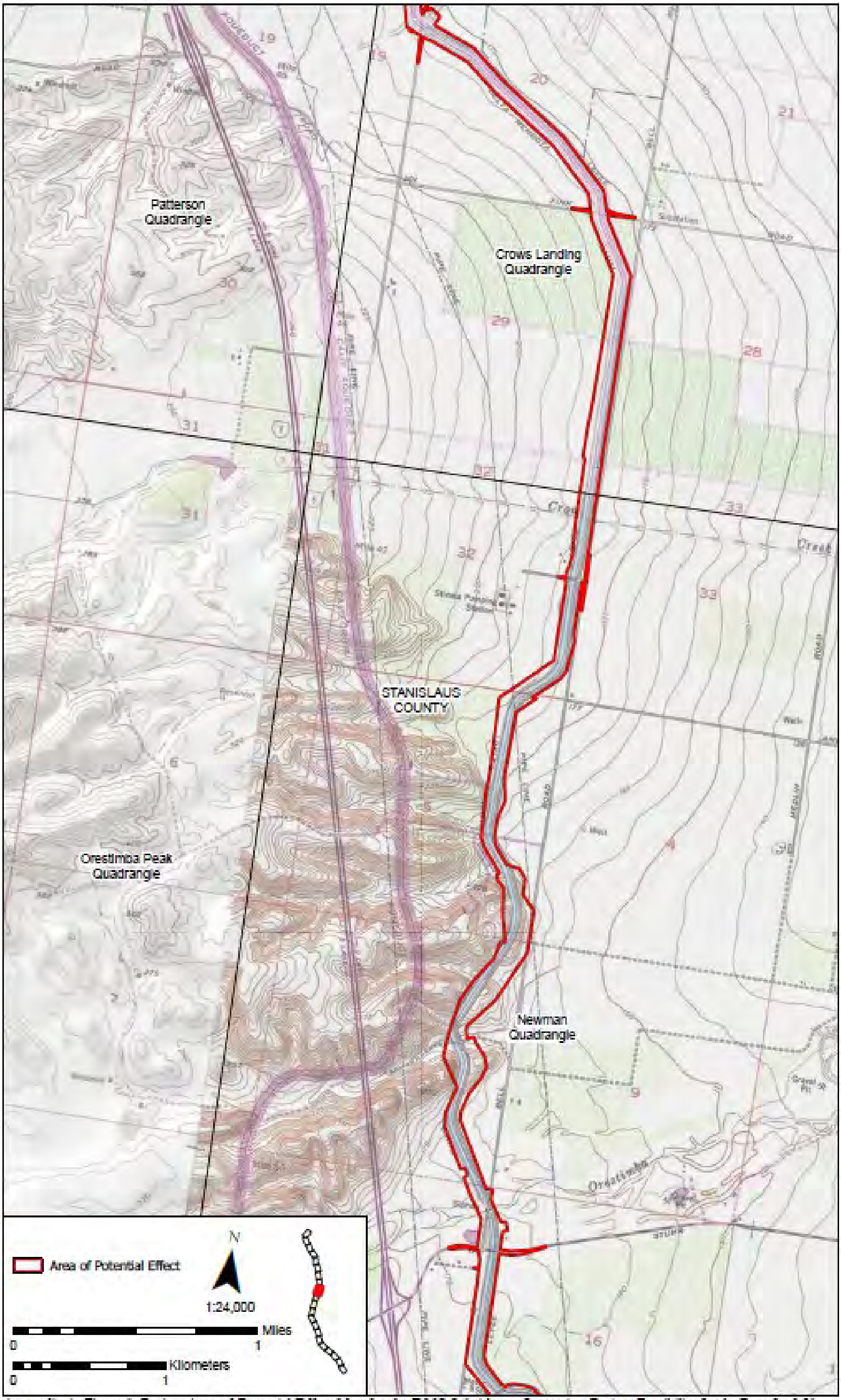
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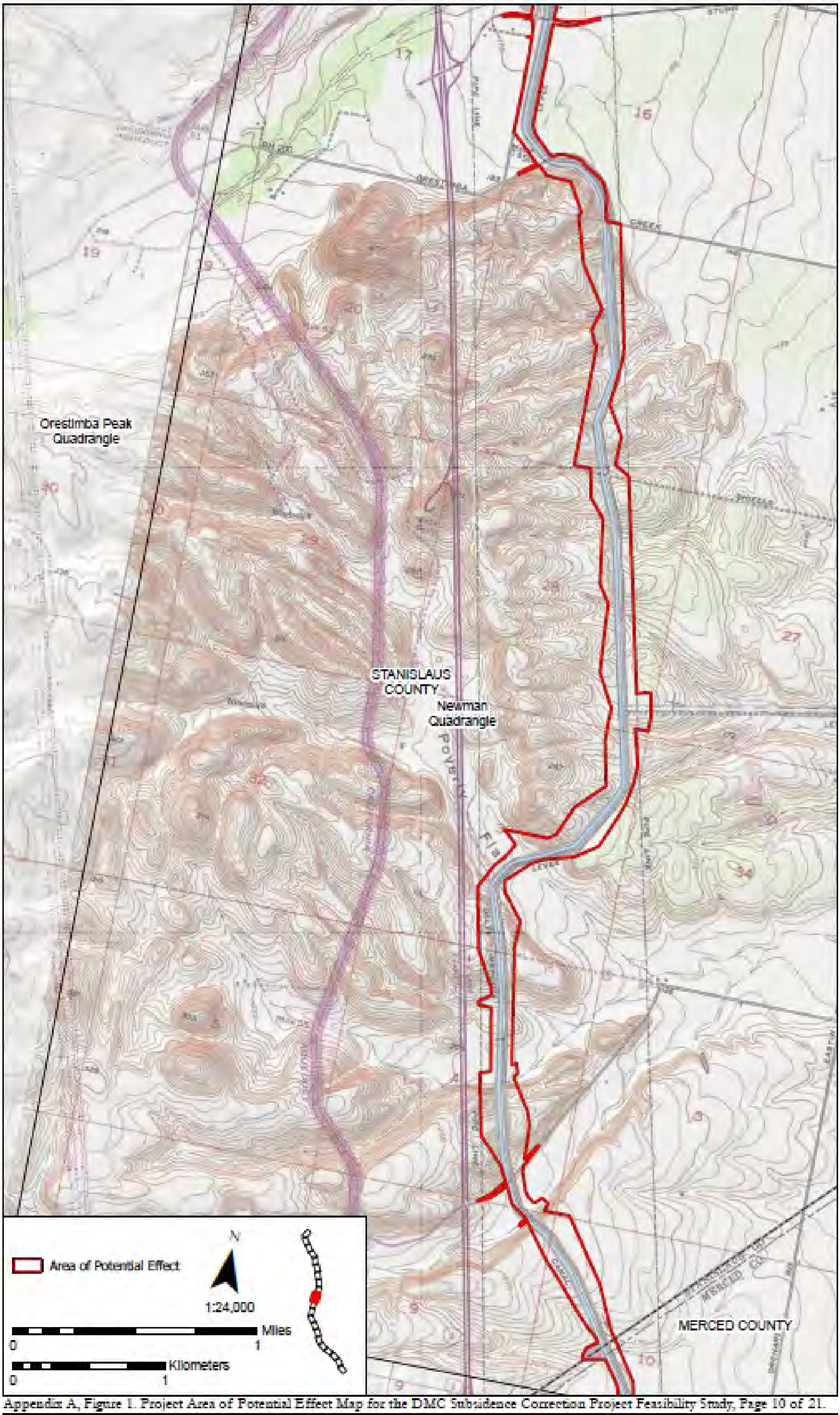
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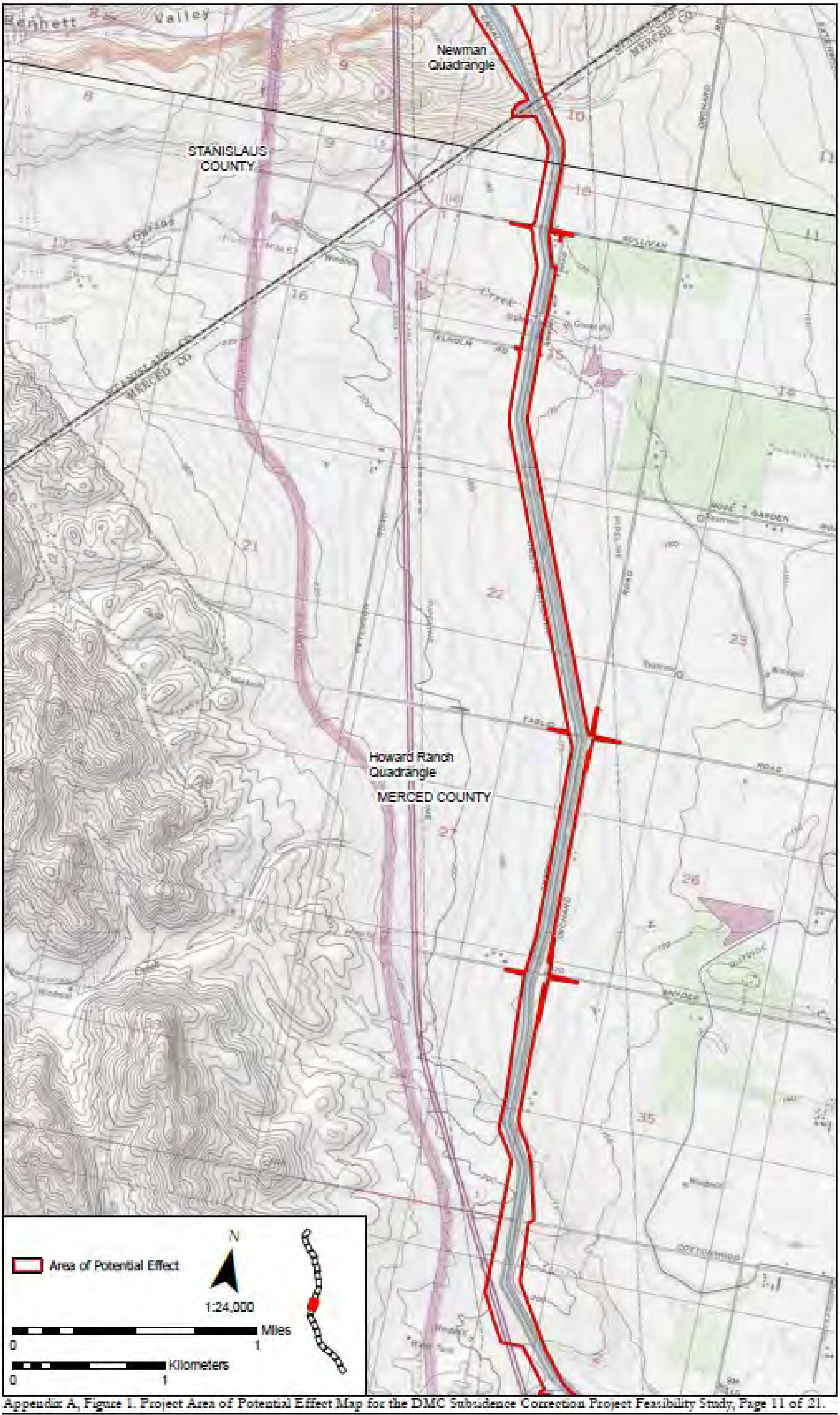
Appendix A, Figure 1. Project Area of Potential Effect Map for the DMC Subsidence Correction Project Feasibility Study, Page 8 of 21.



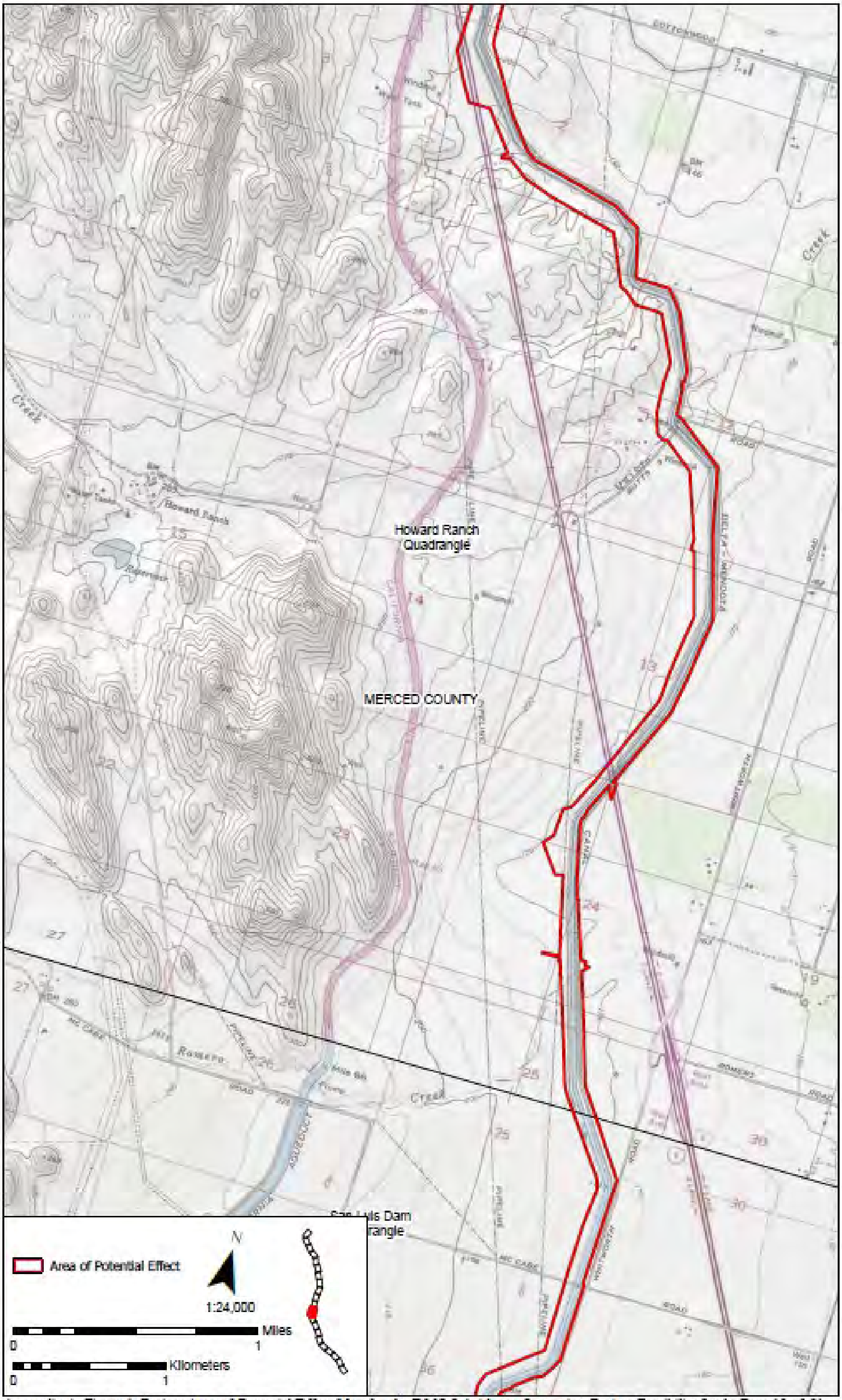
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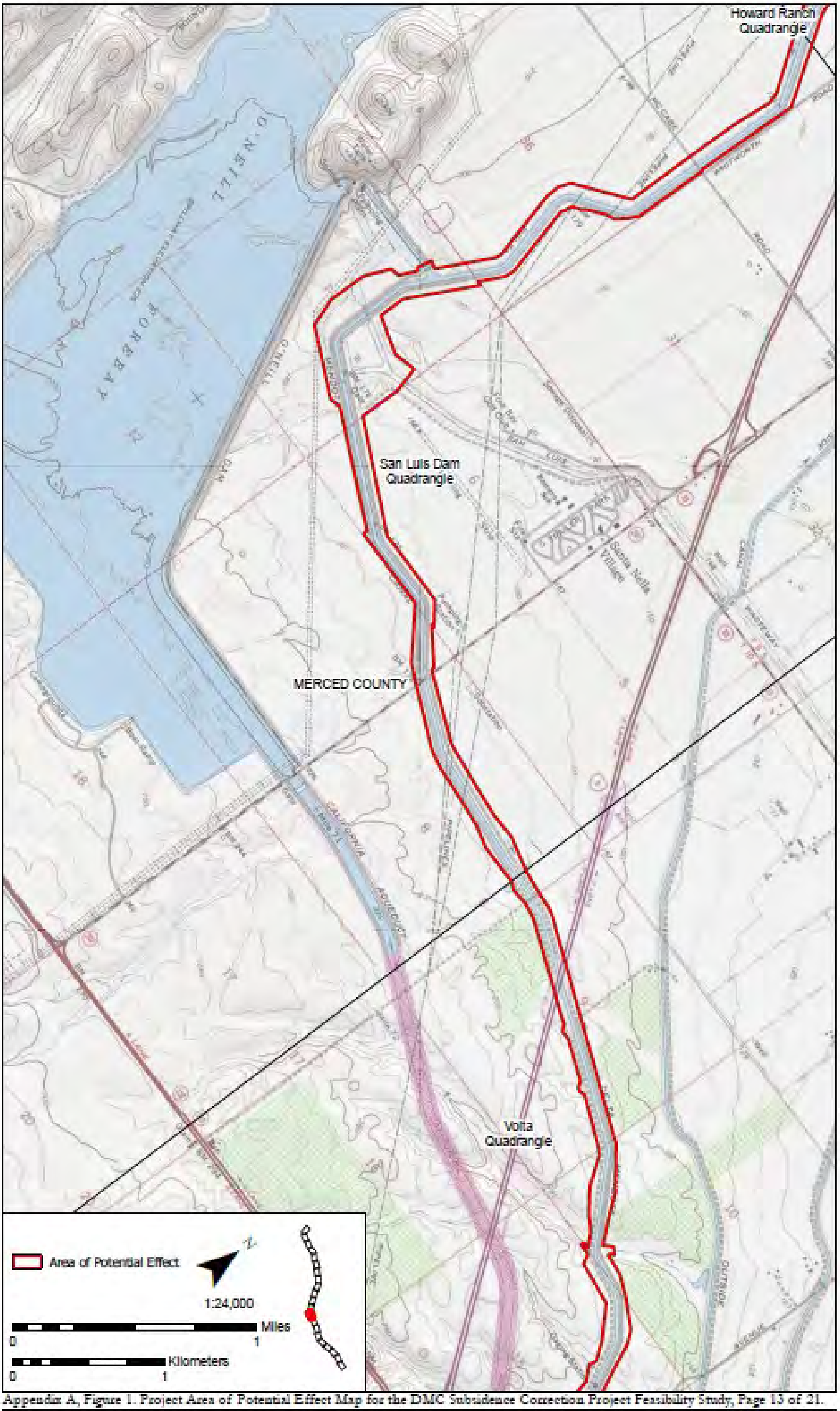
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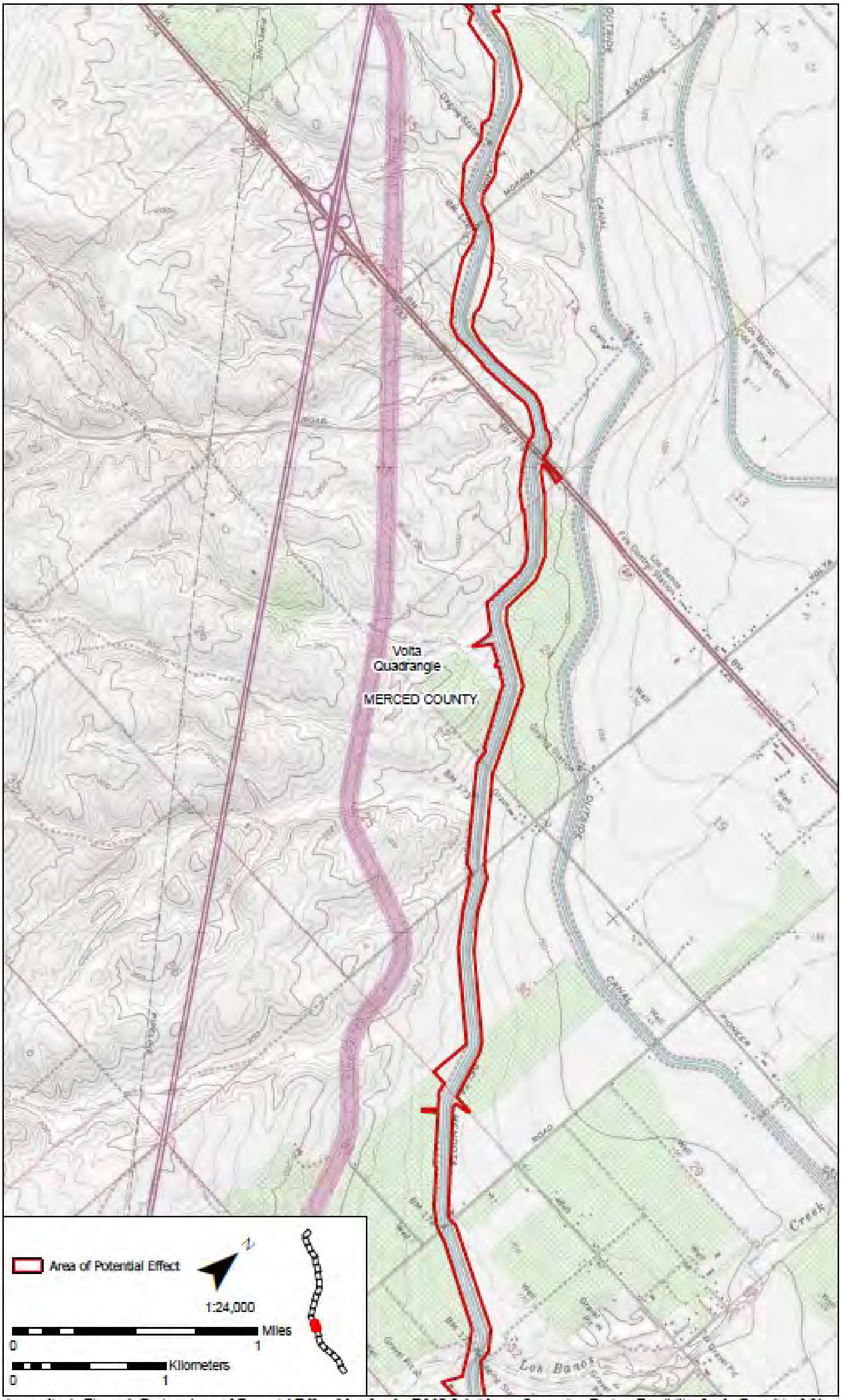
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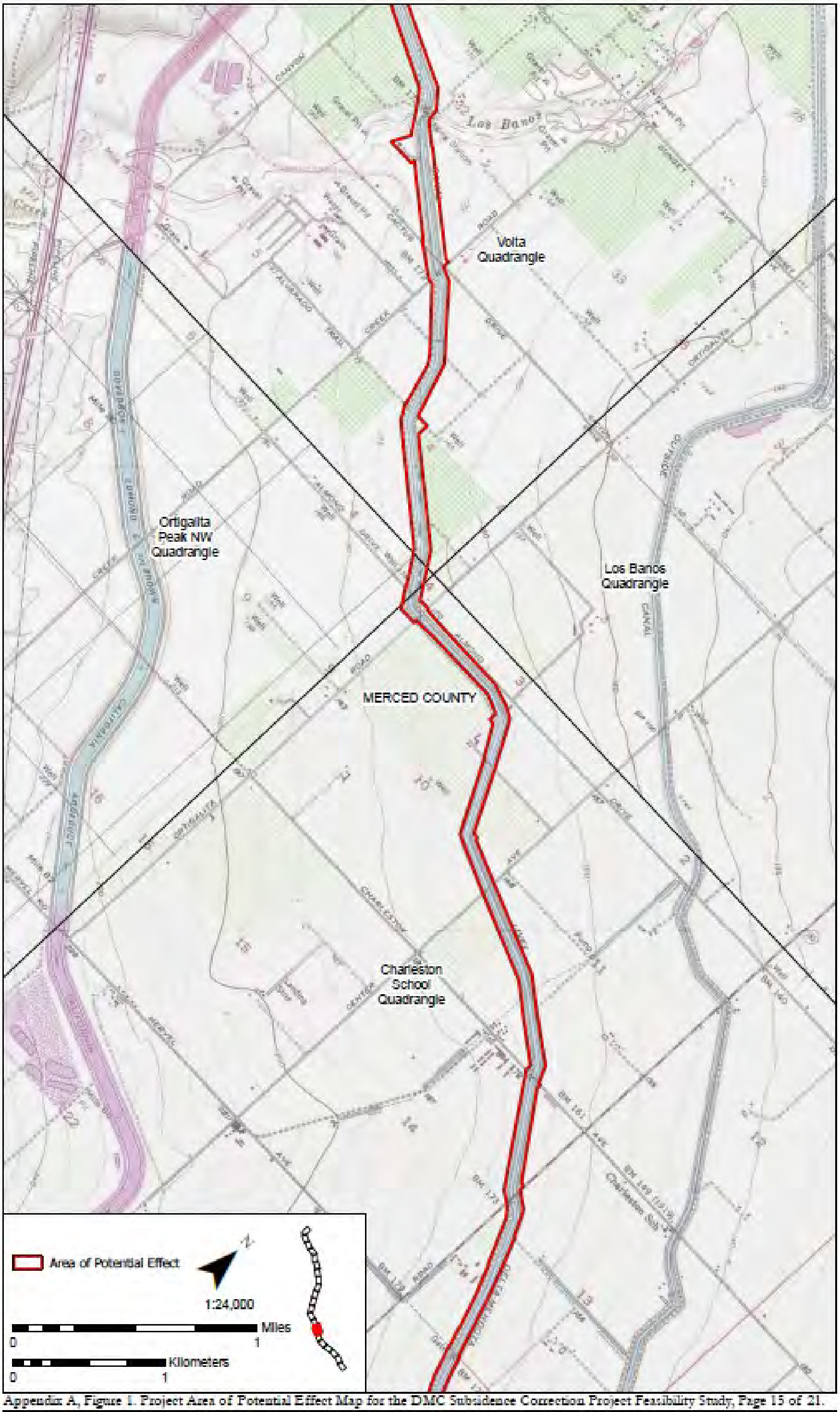
Appendix A, Figure 1. Project Area of Potential Effect Map for the DMC Subsidence Correction Project Feasibility Study, Page 12 of 21.



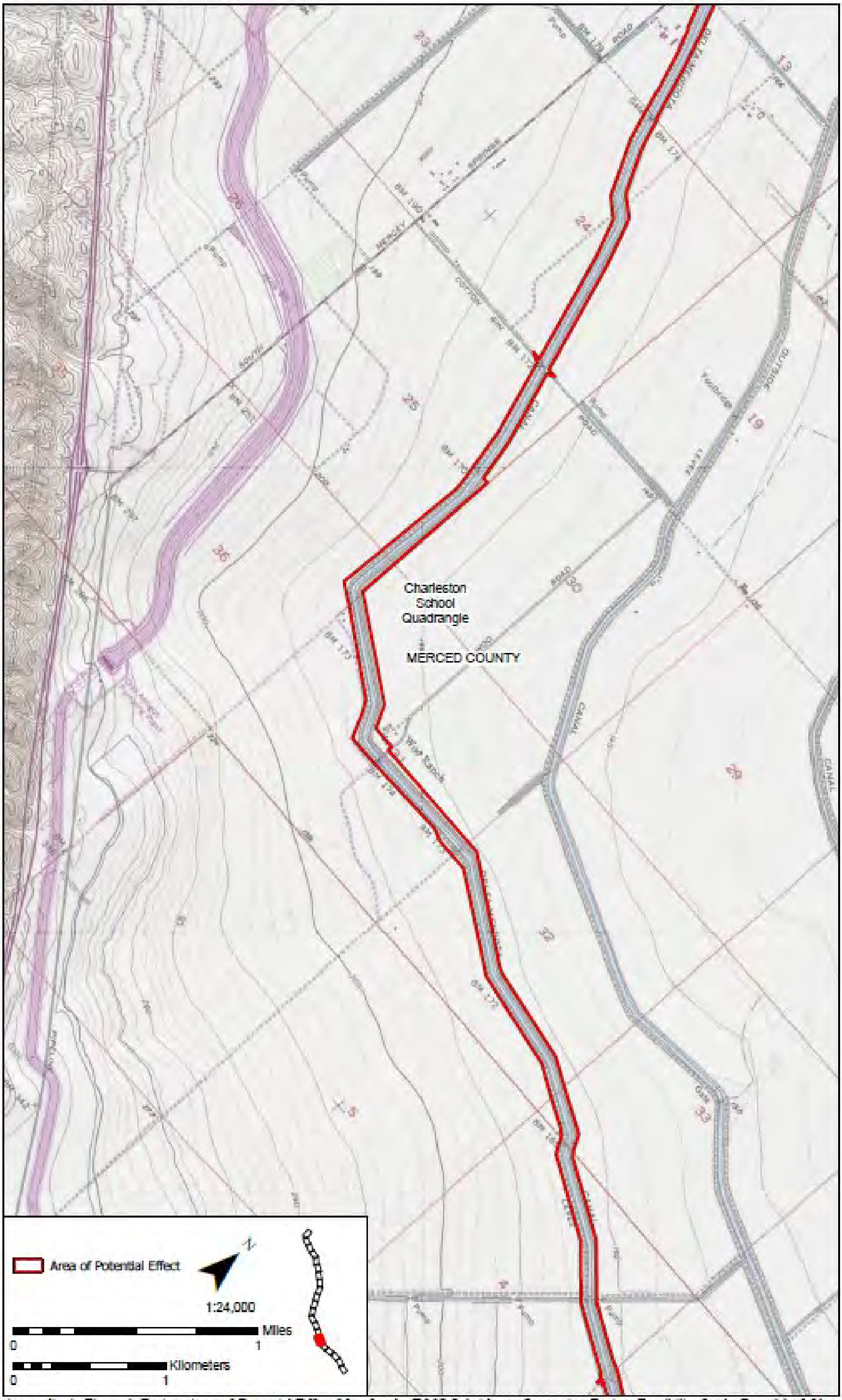
Appendix A, Figure 1. Project Area of Potential Effect Map for the DMC Subsidence Correction Project Feasibility Study, Page 13 of 21.



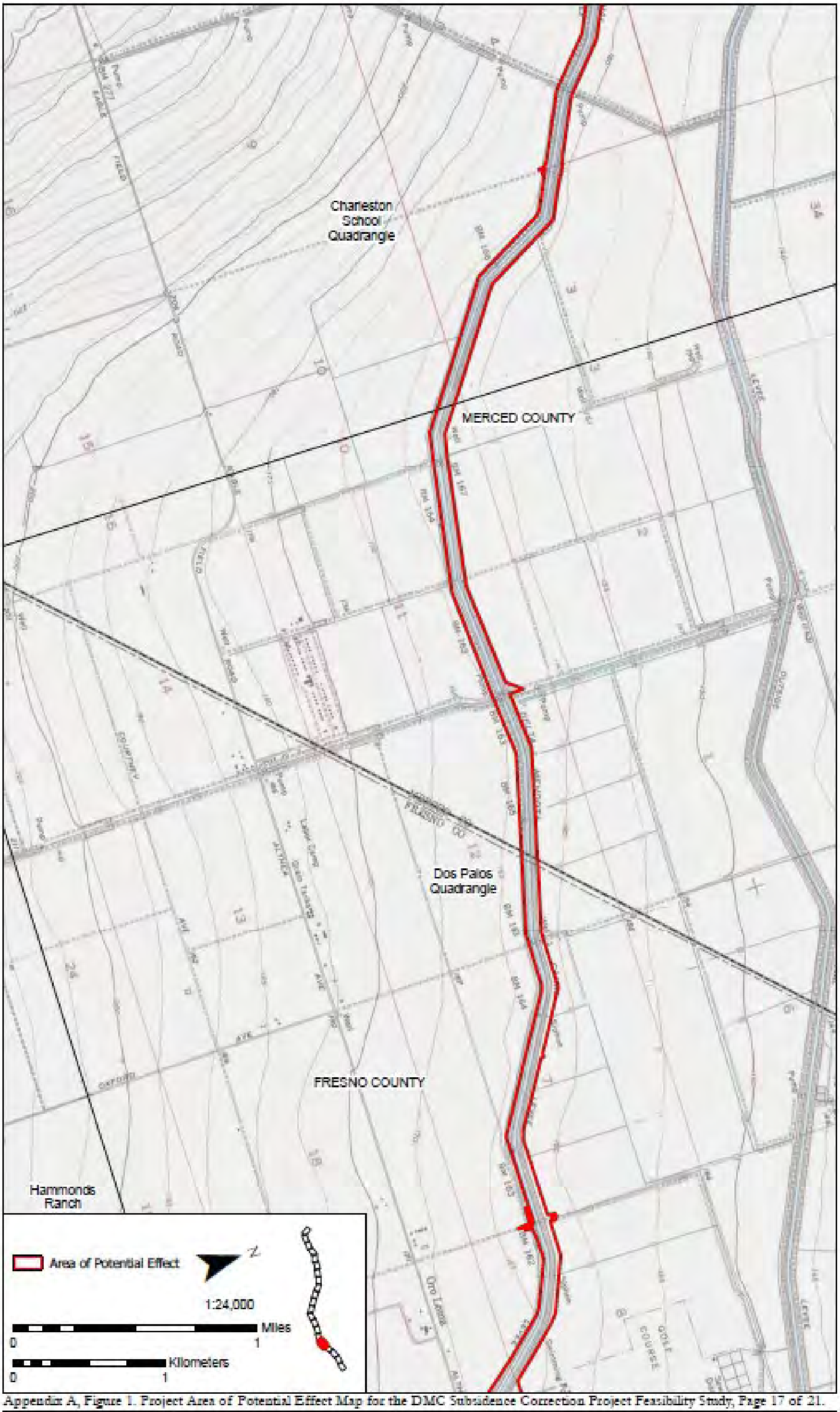
Appendix A, Figure 1. Project Area of Potential Effect Map for the DMC Subsidence Correction Project Feasibility Study, Page 14 of 21.



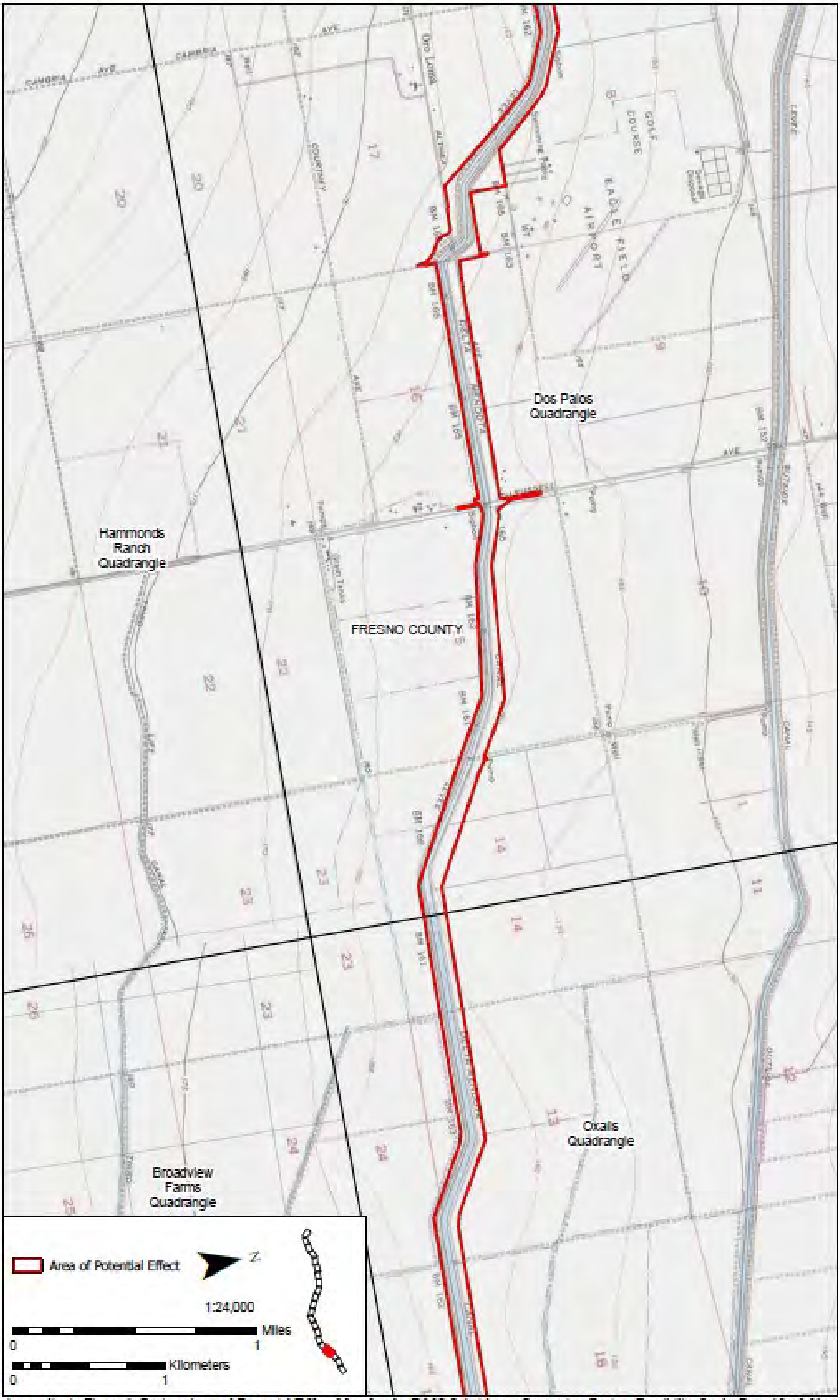
Appendix A, Figure 1. Project Area of Potential Effect Map for the DMC Subsidence Correction Project Feasibility Study, Page 15 of 21.



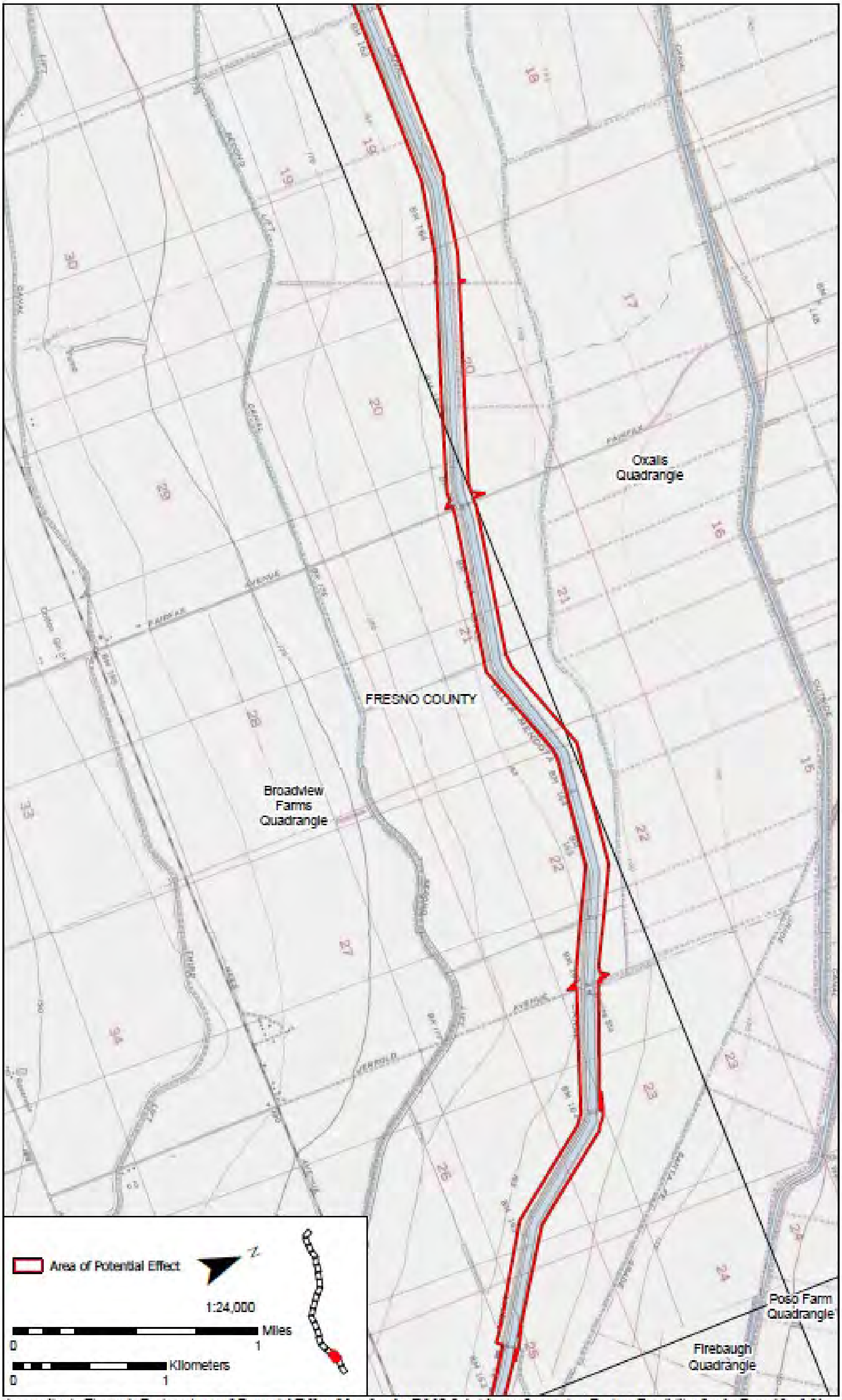
Appendix A, Figure 1. Project Area of Potential Effect Map for the DMC Subsidence Correction Project Feasibility Study, Page 16 of 21.



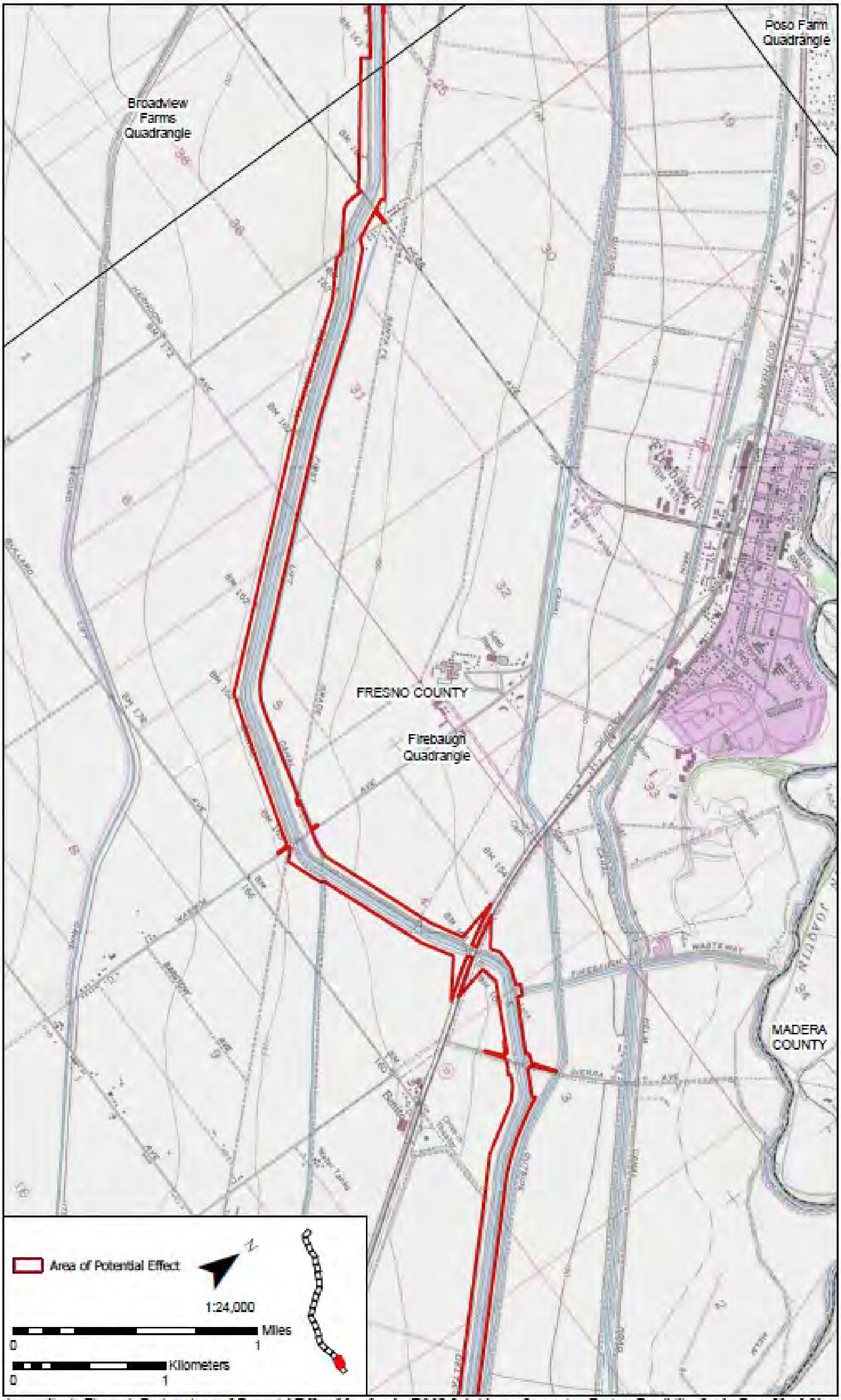
Appendix A, Figure 1. Project Area of Potential Effect Map for the DMC Subsidence Correction Project Feasibility Study, Page 17 of 21.



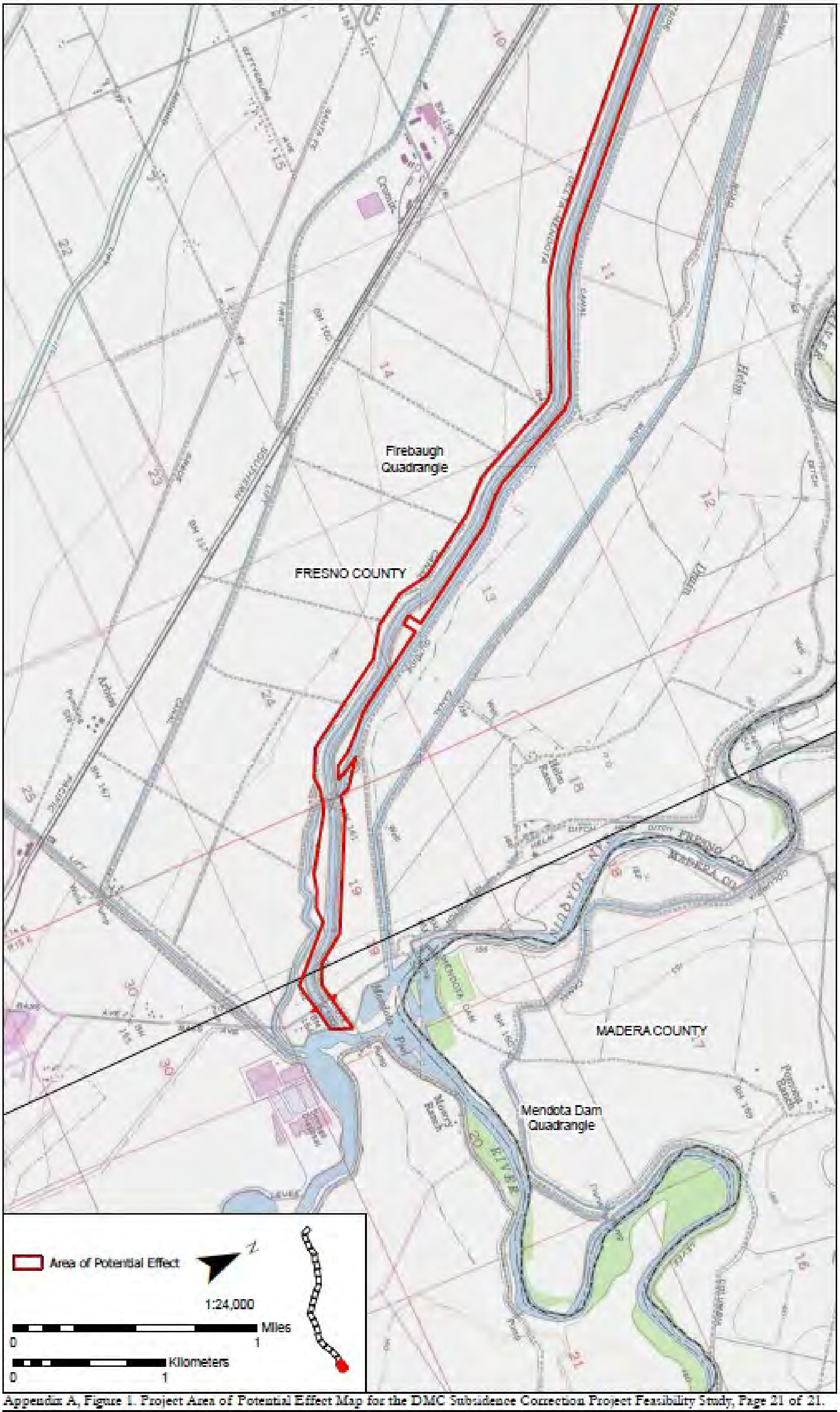
Appendix A, Figure 1. Project Area of Potential Effect Map for the DMC Subsidence Correction Project Feasibility Study, Page 18 of 21.



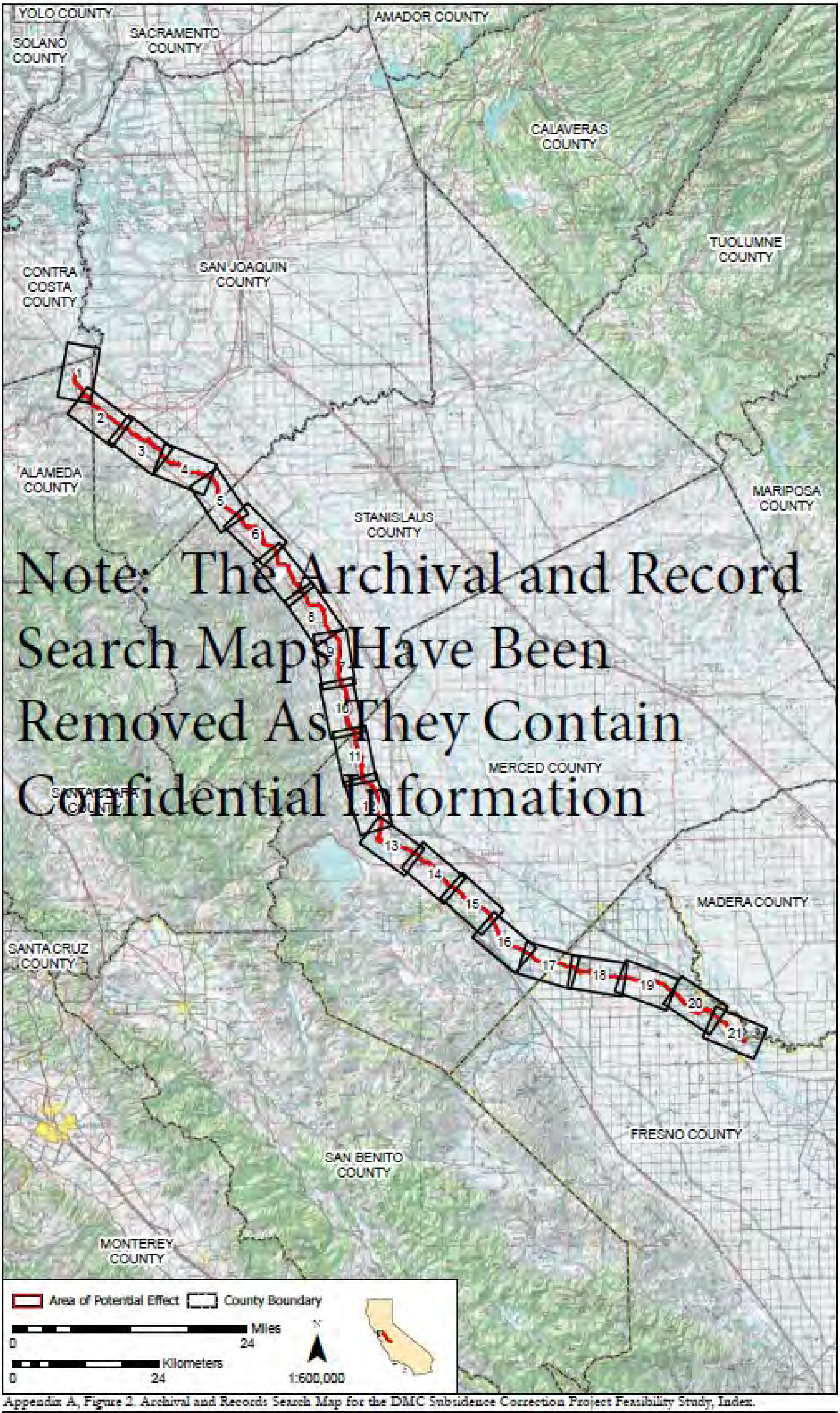
Appendix A, Figure 1. Project Area of Potential Effect Map for the DMC Subsidence Correction Project Feasibility Study, Page 19 of 21.



Appendix A, Figure 1. Project Area of Potential Effect Map for the DMC Subsidence Correction Project Feasibility Study, Page 20 of 21.

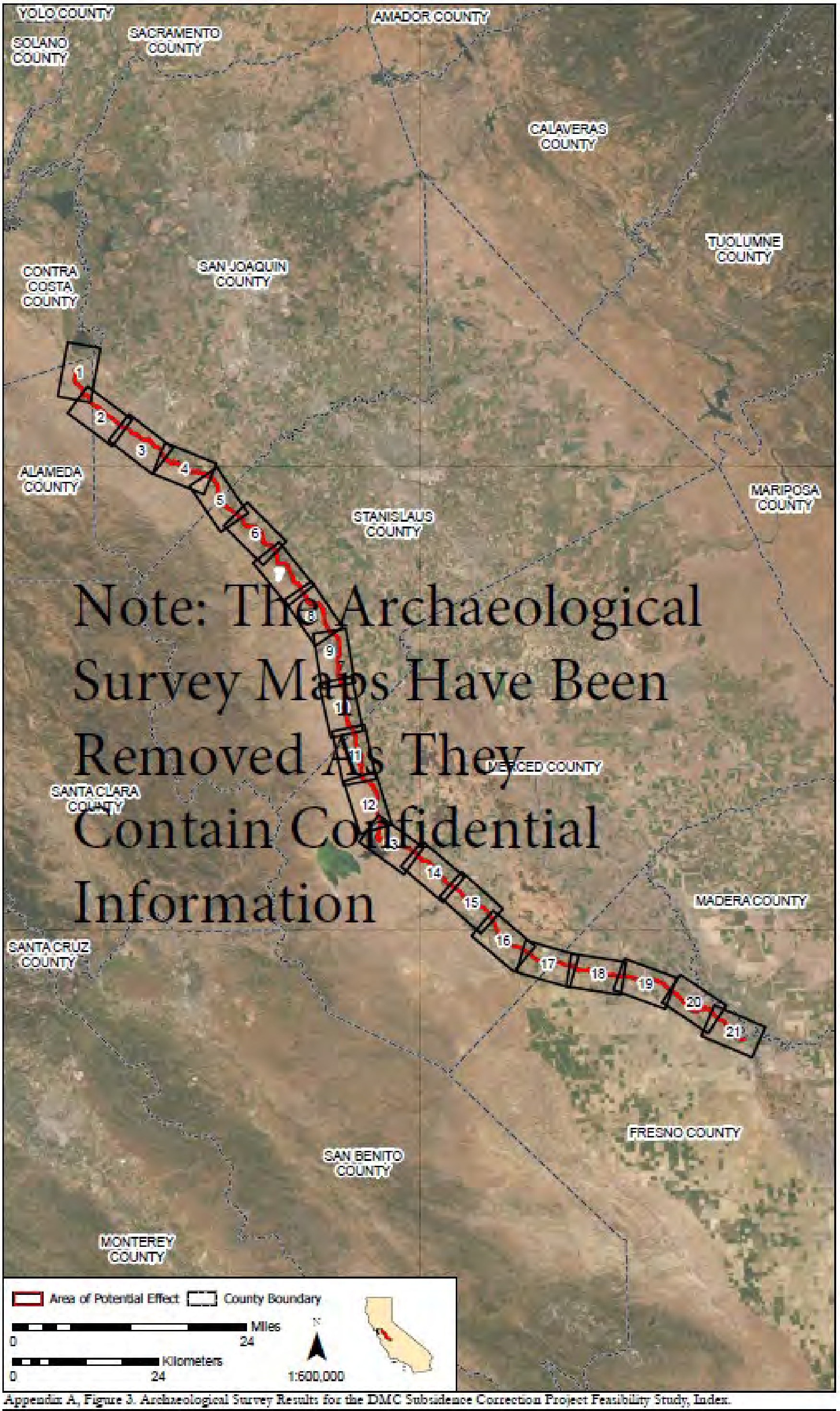


Appendix A, Figure 1. Project Area of Potential Effect Map for the DMC Subsidence Correction Project Feasibility Study, Page 21 of 21.



Note: The Archival and Record Search Maps Have Been Removed As They Contain Confidential Information

Appendix A, Figure 2. Archival and Records Search Map for the DMC Subsidence Correction Project Feasibility Study, Index.



Appendix A, Figure 3. Archaeological Survey Results for the DMC Subsidence Correction Project Feasibility Study, Index.

APPENDIX B – ARCHIVAL AND RECORDS SEARCH (REDACTED)

Note: This Appendix Has Been Removed As It Contains Confidential Information

APPENDIX C – NATIVE AMERICAN CONSULTATION

NATIVE AMERICAN HERITAGE COMMISSION

CHAIRPERSON
Laura Miranda
Luiseño

VICE CHAIRPERSON
Reginald Pagaling
Chumash

PARLIAMENTARIAN
Russell Attebery
Karuk

SECRETARY
Sara Dutschke
Miwok

COMMISSIONER
William Mungary
Paiute/White Mountain Apache

COMMISSIONER
Isaac Bojorquez
Ohlone-Costanoan

COMMISSIONER
Buffy McQuillen
Yokayo Pomo, Yuki, Nomlaki

COMMISSIONER
Wayne Nelson
Luiseño

COMMISSIONER
Stanley Rodriguez
Kumeyaay

EXECUTIVE SECRETARY
Raymond C. Hitchcock
Miwok/Nisenan

NAHC HEADQUARTERS
1550 Harbor Boulevard
Suite 100
West Sacramento,
California 95691
(916) 373-3710
nahc@nahc.ca.gov

April 20, 2022

Christopher Peske
Pacific Legacy, Inc.

Via Email to: peske@pacificlegacy.com

Re: 3950-01 Delta-Mendota Canal Feasibility Study Project, Alameda, Contra Costa, Fresno, Madera, Merced, San Joaquin, and Stanislaus Counties

Dear Mr. Peske:

A record search of the Native American Heritage Commission (NAHC) Sacred Lands File (SLF) was completed for the information you have submitted for the above referenced project. The results were positive. Please contact the tribes on the attached list for more information. Other sources of cultural resources should also be contacted for information regarding known and recorded sites.

Attached is a list of Native American tribes who may also have knowledge of cultural resources in the project area. This list should provide a starting place in locating areas of potential adverse impact within the proposed project area. I suggest you contact all of those indicated; if they cannot supply information, they might recommend others with specific knowledge. By contacting all those listed, your organization will be better able to respond to claims of failure to consult with the appropriate tribe. If a response has not been received within two weeks of notification, the Commission requests that you follow-up with a telephone call or email to ensure that the project information has been received.

If you receive notification of change of addresses and phone numbers from tribes, please notify me. With your assistance, we can assure that our lists contain current information.

If you have any questions or need additional information, please contact me at my email address: Pricilla.Torres-Fuentes@nahc.ca.gov.

Sincerely,

Pricilla Torres-Fuentes

Pricilla Torres-Fuentes
Cultural Resources Analyst

Attachment

Native American Heritage Commission
Native American Contact List
Contra Costa, Madera, Fresno, Merced, Alameda,
San Joaquin, Stanislaus Counties
4/20/2022

Amah Mutsun Tribal Band
Valentin Lopez, Chairperson
P.O. Box 5272 — Costanoan
Galt, CA, 95632 — Northern Valley
Phone: (916) 743 - 5833 — Yokut
vlopez@amahmutsun.org

Amah MutsunTribal Band of Mission San Juan Bautista
Irene Zwierlein, Chairperson
3030 Soda Bay Road — Costanoan
Lakeport, CA, 95453
Phone: (650) 851 - 7489
Fax: (650) 332-1526
amahmutsuntribal@gmail.com

Big Sandy Rancheria of Western Mono Indians
Elizabeth Kipp, Chairperson
P.O. Box 337 — Western Mono
Auberry, CA, 93602
Phone: (559) 374 - 0066
Fax: (559) 374-0055
lkipp@bsrnation.com

Buena Vista Rancheria of Me-Wuk Indians
Rhonda Morningstar Pope, Chairperson
1418 20th Street, Suite 200 — Me-Wuk
Sacramento, CA, 95811
Phone: (916) 491 - 0011
Fax: (916) 491-0012
rhonda@buenavistatribe.com

Calaveras Band of Mi-Wuk Indians
Gloria Grimes, Chairperson
P.O. Box 899 — Mi-wuk
West Point, CA, 95255
Phone: (209) 419 - 5675
calaverasband.miwukindians@gmail.com

Calaveras Band of Mi-Wuk Indians - Grimes
Debra Grimes, Cultural Resources Specialist
P.O. Box 1015 — Mi-wuk
West Point, CA, 95255
Phone: (209) 470 - 8688
calaverasmiwukpreservation@gmail.com

California Valley Miwok Tribe
AKA Sheep Rancheria of Me-Wuk Indians of CA,
P.O. Box 395 — Miwok
West Point, CA, 95255
Phone: (209) 293 - 4179
l.ewilson@yahoo.com

California Valley Miwok Tribe
14807 Avenida Central — Miwok
La Grange, CA, 95329
Phone: (209) 931 - 4567
Fax: (209) 931-4333

Chicken Ranch Rancheria of Me-Wuk Indians
Lloyd Mathiesen, Chairperson
P.O. Box 1159 — Me-Wuk
Jamestown, CA, 95327
Phone: (209) 984 - 9066
Fax: (209) 984-9269
lmathiesen@crtribal.com

Cold Springs Rancheria of Mono Indians
Jared Aldern,
P. O. Box 209 — Mono
Tollhouse, CA, 93667
Phone: (559) 855 - 5043
Fax: (559) 855-4445
csrepa@netptc.net

Cold Springs Rancheria of Mono Indians
Carol Bill, Chairperson
P.O. Box 209 — Mono
Tollhouse, CA, 93667
Phone: (559) 855 - 5043
Fax: (559) 855-4445
coldsprgstribe@netptc.net

This list is current only as of the date of this document. Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resource Section 5097.98 of the Public Resources Code.

This list is only applicable for contacting local Native Americans with regard to cultural resources assessment for the proposed 3950-01 Delta-Mendota Canal Feasibility Study Project, Contra Costa, Madera, Fresno, Merced, Alameda, San Joaquin, Stanislaus Counties.

Native American Heritage Commission
Native American Contact List
Contra Costa, Madera, Fresno, Merced, Alameda,
San Joaquin, Stanislaus Counties
4/20/2022

Costanoan Rumsen Carmel Tribe
Tony Cerda, Chairperson
244 E. 1st Street — Costanoan
Pomona, CA, 91766
Phone: (909) 629 - 6081
Fax: (909) 524-8041
rumsen@aol.com

Dumna Wo-Wah Tribal Government
Robert Ledger, Chairperson
2191 West Pico Ave. — Foothill Yokut, Mono
Fresno, CA, 93705
Phone: (559) 540 - 6346
ledgerrobert@ymail.com

Dunlap Band of Mono Indians
Benjamin Charley, Chairman
P. O. Box 14 — Mono
Dunlap, CA, 93621
Phone: (559) 338 - 2545
ben.charley@yahoo.com

Dunlap Band of Mono Indians
Dirk Charley, Tribal Secretary
5509 E. Mckenzie Avenue — Mono
Fresno, CA, 93727
Phone: (559) 554 - 5433
dcharley2016@gmail.com

Guidiville Indian Rancheria
Donald Duncan, Chairperson
P.O. Box 339 — Pomo
Talmage, CA, 95481
Phone: (707) 462 - 3682
Fax: (707) 462-9183
admin@guidiville.net

Indian Canyon Mutsun Band of Costanoan
Ann Marie Sayers, Chairperson
P.O. Box 28 — Costanoan
Hollister, CA, 95024
Phone: (831) 637 - 4238
ams@indiancanyons.org

Indian Canyon Mutsun Band of Costanoan
Kanyon Sayers-Roods, MLD Contact
1615 Pearson Court — Costanoan
San Jose, CA, 95122
Phone: (408) 673 - 0626
kanyon@kanyonkonsulting.com

Ione Band of Miwok Indians
Sara Dutschke, Chairperson
9252 Bush Street — Miwok
Plymouth, CA, 95669
Phone: (209) 245 - 5800
consultation@ionemiwok.net

Kings River Choinumni Farm Tribe
Stan Alec,
3515 East Fedora Avenue — Foothill Yokut
Fresno, CA, 93726
Phone: (559) 647 - 3227

Muwekma Ohlone Indian Tribe of the SF Bay Area
Monica Arellano, Vice Chairwoman
20885 Redwood Road, Suite 232 — Costanoan
Castro Valley, CA, 94546
Phone: (408) 205 - 9714
marellano@muwekma.org

Nashville Enterprise Miwok-Maidu-Nishinam Tribe
Cosme Valdez, Chairperson
P.O. Box 580986 — Miwok
Elk Grove, CA, 95758-0017
Phone: (916) 429 - 8047
Fax: (916) 429-8047
valdezcome@comcast.net

North Fork Mono Tribe
Ron Goode, Chairperson
13396 Tollhouse Road — Mono
Clovis, CA, 93619
Phone: (559) 299 - 3729
rwgoode911@hotmail.com

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North Fork Rancheria of Mono Indians
Elaine Fink, Chairperson
P.O .Box 929
North Fork, CA, 93643
Phone: (559) 877 - 2461
Fax: (559) 877-2467
efink@nfr-nsn.gov
Mono

North Valley Yokuts Tribe
Katherine Perez, Chairperson
P.O. Box 717
Linden, CA, 95236
Phone: (209) 887 - 3415
canutes@verizon.net
Costanoan
Northern Valley Yokut

North Valley Yokuts Tribe
Timothy Perez,
P.O. Box 717
Linden, CA, 95236
Phone: (209) 662 - 2788
huskanam@gmail.com
Costanoan
Northern Valley Yokut

Picayune Rancheria of Chukchansi Indians
Claudia Gonzales, Chairwoman
P.O. Box 2226
Oakhurst, CA, 93644
Phone: (559) 412 - 5590
cgonzales@chukchansitribe.net
Foothill Yokut

Picayune Rancheria of Chukchansi Indians
Heather Airey, Tribal Historic Preservation Officer
P.O. Box 2226
Oakhurst, CA, 93644
Phone: (559) 795 - 5986
hairey@chukchansi-nsn.gov
Foothill Yokut

Salinan Tribe of Monterey, San Luis Obispo Counties
Patti Dunton, Tribal Administrator
7070 Morro Road, Suite A
Atascadero, CA, 93422
Phone: (805) 464 - 2650
info@salinantribe.com
Salinan

Santa Rosa Rancheria Tachi Yokut Tribe
Leo Sisco, Chairperson
P.O. Box 8
Lemoore, CA, 93245
Phone: (559) 924 - 1278
Fax: (559) 924-3583
Southern Valley Yokut

Southern Sierra Miwuk Nation
Sandra Chapman, Chairperson
P.O. Box 186
Mariposa, CA, 95338
Phone: (559) 580 - 7871
sandra47roy@gmail.com
Miwok
Northern Valley Yokut
Paiute

Table Mountain Rancheria
Bob Pennell, Cultural Resource Director
P.O. Box 410
Friant, CA, 93626
Phone: (559) 325 - 0351
Fax: (559) 325-0394
rpennell@tmr.org
Yokut

Table Mountain Rancheria
Brenda Lavell, Chairperson
P.O. Box 410
Friant, CA, 93626
Phone: (559) 822 - 2587
Fax: (559) 822-2693
rpennell@tmr.org
Yokut

The Ohlone Indian Tribe
Andrew Galvan,
P.O. Box 3388
Fremont, CA, 94539
Phone: (510) 882 - 0527
Fax: (510) 687-9393
chochenyo@AOL.com
Bay Miwok
Ohlone
Patwin
Plains Miwok

Traditional Choinumni Tribe
David Alvarez, Chairperson
2415 E. Houston Avenue
Fresno, CA, 93720
Phone: (559) 217 - 0396
Fax: (559) 292-5057
davealvarez@sbcglobal.net
Foothill Yokut

This list is current only as of the date of this document. Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resource Section 5097.98 of the Public Resources Code.

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Tule River Indian Tribe
Neil Peyron, Chairperson
P.O. Box 589 Yokut
Porterville, CA, 93258
Phone: (559) 781 - 4271
Fax: (559) 781-4610
neil.peyron@tulerivertribe-nsn.gov

Tule River Indian Tribe
Kerri Vera, Environmental Department
P. O. Box 589 Yokut
Porterville, CA, 93258
Phone: (559) 783 - 8892
Fax: (559) 783-8932
kerri.vera@tulerivertribe-nsn.gov

Tule River Indian Tribe
Joey Garfield, Tribal Archaeologist
P. O. Box 589 Yokut
Porterville, CA, 93258
Phone: (559) 783 - 8892
Fax: (559) 783-8932
joey.garfield@tulerivertribe-nsn.gov

Tuolumne Band of Me-Wuk Indians
Andrea Reich, Chairperson
P.O. Box 699 Me-Wuk
Tuolumne, CA, 95379
Phone: (209) 928 - 5300
Fax: (209) 928-1677
andrea@mewuk.com

Tuolumne Band of Me-Wuk Indians
Stanley Cox, Cultural Resources Director
P. O. Box 699 Me-Wuk
Tuolumne, CA, 95379
Phone: (209) 928 - 5300
receptionist@mewuk.com

United Auburn Indian Community of the Auburn Rancheria
Gene Whitehouse, Chairperson
10720 Indian Hill Road Maidu
Auburn, CA, 95603 Miwok
Phone: (530) 883 - 2390
Fax: (530) 883-2380
bguth@auburnrancheria.com

Wilton Rancheria
Steven Hutchason, THPO
9728 Kent Street Miwok
Elk Grove, CA, 95624
Phone: (916) 683 - 6000
Fax: (916) 863-6015
shutchason@wiltonrancheria-nsn.gov

Wilton Rancheria
Dahlton Brown, Director of Administration
9728 Kent Street Miwok
Elk Grove, CA, 95624
Phone: (916) 683 - 6000
dbrown@wiltonrancheria-nsn.gov

Wilton Rancheria
Jesus Tarango, Chairperson
9728 Kent Street Miwok
Elk Grove, CA, 95624
Phone: (916) 683 - 6000
Fax: (916) 683-6015
jtarango@wiltonrancheria-nsn.gov

Wuksache Indian Tribe/Eshom Valley Band
Kenneth Woodrow, Chairperson
1179 Rock Haven Ct. Foothill Yokut
Salinas, CA, 93906 Mono
Phone: (831) 443 - 9702
kwood8934@aol.com

Xolon-Salinan Tribe
Karen White, Chairperson
P. O. Box 7045 Salinan
Spreckels, CA, 93962
Phone: (831) 238 - 1488
xolon.salinan.heritage@gmail.com

This list is current only as of the date of this document. Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resource Section 5097.98 of the Public Resources Code.

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Xolon-Salinan Tribe
Donna Haro, Tribal Headwoman
P. O. Box 7045 — Salinan
Spreckels, CA, 93962
Phone: (925) 470 - 5019
dhxolonaakletse@gmail.com

The Confederated Villages of Lisjan
Corrina Gould, Chairperson
10926 Edes Avenue — Bay Miwok
Oakland, CA, 94603 — Ohlone
Phone: (510) 575 - 8408 — Delta Yokut
cvltribe@gmail.com

Tamien Nation
Johnathan Wasaka Costillas, THPO
PO Box 866 — Costanoan
Clearlake Oaks, CA, 94523
Phone: (925) 336 - 5359
thpo@tamien.org

Tamien Nation
Quirina Luna Geary, Chairperson
PO Box 8053 — Costanoan
San Jose, CA, 95155
Phone: (707) 295 - 4011
qgeary@tamien.org

This list is current only as of the date of this document. Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resource Section 5097.98 of the Public Resources Code.

This list is only applicable for contacting local Native Americans with regard to cultural resources assessment for the proposed 3950-01 Delta-Mendota Canal Feasibility Study Project, Contra Costa, Madera, Fresno, Merced, Alameda, San Joaquin, Stanislaus Counties.

Consulting Party Contact Information	Letter Sent	Delivered	Emailed/ Called	Comments
Andrea Reich, Chairperson **Tuolumne Band of Me-Wuk Indians** P.O. Box 699 Tuolumne, CA, 95379 Phone: (209) 928 - 5300 Fax: (209) 928 - 1677 andrea@mewuk.com	6/14/2022	6/21/2022	N/A	No reply as of 8/10/22
Andrew Galvan **The Ohlone Indian Tribe** P.O. Box 3388 Fremont, CA, 94539 Phone: (510) 882 - 0527 Fax: (510) 687 - 9393 chochenyo@aol.com	6/14/2022	6/21/2022	N/A	No reply as of 8/10/22
Ann Marie Sayers, Chairperson **Indian Canyon Mutsun Band of Costanoan** P.O. Box 28 Hollister, CA, 95024 Phone: (831) 637 - 4238 ams@indiancanyons.org	6/14/2022	6/25/2022	N/A	No reply as of 8/10/22
Benjamin Charley, Chairman **Dunlap Band of Mono Indians** P. O. Box 14 Dunlap, CA, 93621 Phone: (559) 338 - 2545 ben.charley@yahoo.com	6/14/2022	6/22/2022	N/A	No reply as of 8/10/22
Bob Pennell, Cultural Resource Director **Table Mountain Rancheria** P.O. Box 410 Friant, CA, 93626 Phone: (559) 325 - 0351 Fax: (559) 325 - 0394 rpennell@tmr.org	6/13/2022	6/15/2022: delivered, no confirmation receipt	N/A	No reply as of 8/10/22
Brenda Lavell, Chairperson **Table Mountain Rancheria** P.O. Box 410 Friant, CA, 93626 Phone: (559) 822 - 2587 Fax: (559) 822 - 2693 rpennell@tmr.org	6/13/2022	6/15/2022: delivered, no confirmation receipt	N/A	No reply as of 8/10/22

Consulting Party Contact Information	Letter Sent	Delivered	Emailed/ Called	Comments
California Valley Miwok Tribe P.O. Box 395 West Point, CA, 95255 Phone: (209) 293 - 4179 l.ewilson@yahoo.com			N/A	This address was provided by NAHC, no letter sent
Carol Bill, Chairperson **Cold Springs Rancheria of Mono Indians** P.O. Box 209 Tollhouse, CA, 93667 Phone: (559) 855 - 5043 Fax: (559) 855 - 4445 coldsprgstribe@netptc.net	6/14/2022	6/17/2022	N/A	No reply as of 8/10/22
Chadd Everyone, Administrator **California Valley Miwok Tribe** 2000 Allston Way #401 Berkeley, California, 94701	6/13/2022	6/23/2022: delivered, no confirmation receipt	N/A	7/27/2022: This individual was not on the list from the NAHC but a letter was sent to him,
Claudia Gonzales, Chairwoman **Picayune Rancheria of Chukchansi Indians** P.O. Box 2226 Oakhurst, CA, 93644 Phone: (559) 412 - 5590 cgonzales@chukchansitribe.net	6/14/2022	6/17/2022	N/A	No reply as of 8/10/22
Corrina Gould, Chairperson **The Confederated VILLAGESS of Lisjan** 10926 Edes Avenue Oakland, CA, 94603 Phone: (510) 575 - 8408 cvltribe@gmail.com	6/14/2022	6/15/2022	Update mailed 8/18/22	June 17. 2022: Response received. Would like to be informed of the results of the NAHC sacred lands file search in Alameda, Contra Costa, and San Joaquin counties to determine whether consultation is necessary.

Consulting Party Contact Information	Letter Sent	Delivered	Emailed/ Called	Comments
Cosme Valdez, Chairperson **Nashville Enterprise Miwok-Maidu-Nishinam Tribe** P.O. Box 580986 Elk Grove, CA, 95758-0017 Phone: (916) 429 - 8047 Fax: (916) 429 - 8047 valdezcome@comcast.net	6/14/2022	6/17/2022	N/A	No reply as of 8/10/22
Dahlton Brown, Director of Administration **Wilton Rancheria** 9728 Kent Street Elk Grove, CA, 95624 Phone: (916) 683 - 6000 dbrown@wiltonrancheria-nsn.gov	6/14/2022	6/16/2022	Update sent to Venesa Kremer 8/18/22	7/28/22: Requested further information, participate in fieldwork, copies of records and reports. Email from Venesa Kremer but replies should go to cpd@wiltonrancheria-nsn.gov
David Alvarez, Chairperson **Traditional Choinumni Tribe** 2415 E. Houston Avenue Fresno, CA, 93720 Phone: (559) 217 - 0396 Fax: (559) 292 - 5057 davealvarez@sbcglobal.net	6/14/2022	6/16/2022	N/A	No reply as of 8/10/22
Debra Grimes, Cultural Resources Specialist **Calaveras Band of Mi-Wuk Indians** P.O. Box 1015 West Point, CA, 95255 Phone: (209) 470 - 8688 calaverasmiwukpreservation@gmail.com	6/14/2022		N/A	7/27/2022: No confirmed delivery, in transit as of 7/13
Dirk Charley, Tribal Secretary **Dunlap Band of Mono Indians** 5509 E. Mckenzie Avenue Fresno, CA, 93727 Phone: (559) 554 - 5433 dcharley2016@gmail.com	6/14/2022	6/16/2022	N/A	No reply as of 8/10/22
Donald Duncan, Chairperson **Guidiville Indian Rancheria** P.O. Box 339 Talmage, CA, 95481 Phone: (707) 462 - 3682 Fax: (707) 462 - 9183 admin@guidiville.net	6/14/2022	6/22/2022	N/A	No reply as of 8/10/22

Consulting Party Contact Information	Letter Sent	Delivered	Emailed/ Called	Comments
Donna Haro, Tribal Headwoman **Xolon-Salinan Tribe** P. O. Box 7045 Spreckels, CA, 93962 Phone: (925) 470 - 5019 dhxolonaakletse@gmail.com	6/14/2022	6/22/2022	N/A	No reply as of 8/10/22
Elaine Fink, Chairperson **North Fork Rancheria of Mono Indians** P.O .Box 929 North Fork, CA, 93643 Phone: (559) 877 - 2461 Fax: (559) 877-2467 efink@nfr-nsn.gov	6/14/2022	6/16/2022	N/A	No reply as of 8/10/22
Elizabeth Kipp, Chairperson **Big Sandy Rancheria of Western Mono Indians** P.O. Box 337 Auberry, CA, 93602 Phone: (559) 374 - 0066 Fax: (559) 374 - 0055 lkipp@bsrnation.com	6/14/2022	6/16/2022	N/A	No reply as of 8/10/22
Gene Whitehouse, Chairperson **United Auburn Indian Community of the Auburn Rancheria** 10720 Indian Hill Road Auburn, CA, 95603 Phone: (530) 883 - 2390 Fax: (530) 883 - 2380 bguth@auburnrancheria.com	6/14/2022	6/16/2022	N/A	June 30, 2022: Response received, indicated that APE was outside of their geographic area of traditional and cultural affiliations and would not be commenting on the project.
Gloria Grimes, Chairperson **Calaveras Band of Mi-Wuk Indians** P.O. Box 899 West Point, CA, 95255 Phone: (209) 419 - 5675 calaverasband.miwukindians@gmail.com	6/14/2022		N/A	7/27/2022: No confirmed delivery, in transit as of 7/13
Heather Airey, THPO **Picayune Rancheria of Chukchansi Indians** P.O. Box 2226 Oakhurst, CA, 93644 Phone: (559) 795 - 5986 hairey@chukchansi-nsn.gov	6/14/2022	6/17/2022	N/A	No reply as of 8/10/22

Consulting Party Contact Information	Letter Sent	Delivered	Emailed/ Called	Comments
Jared Aldern **Cold Springs Rancheria of Mono Indians** P. O. Box 209 Tollhouse, CA, 93667 Phone: (559) 855 - 5043 Fax: (559) 855 - 4445 csrepa@netptc.net	6/14/2022	6/17/2022	N/A	No reply as of 8/10/22
Jesus Tarango, Chairperson **Wilton Rancheria** 9728 Kent Street Elk Grove, CA, 95624 Phone: (916) 683 - 6000 Fax: (916) 683-6015 jtarango@wiltonrancheria-nsn.gov	6/14/2022	6/16/2022	N/A	7/28/22; reply from cultural department see other
Joey Garfield, Tribal Archaeologist **Tule River Indian Tribe** P. O. Box 589 Porterville, CA, 93258 Phone: (559) 783 - 8892 Fax: (559) 783-8932 joey.garfield@tulerivertribensn.gov	6/14/2022	6/16/2022	N/A	No reply as of 8/10/22
Johnathan Wasaka Costillas, THPO **Tamien Nation** PO Box 866 Clearlake Oaks, CA, 94523 Phone: (925) 336 - 5359 thpo@tamien.org	6/14/2022	6/22/2022	N/A	No reply as of 8/10/22
Kanyon Sayers-Roods, MLD **Indian Canyon Mutsun Band of Costanoan** 1615 Pearson Court San Jose, CA, 95122 Phone: (408) 673 - 0626 kanyon@kanyonkonsulting.com	6/14/2022	6/16/2022	N/A	No reply as of 8/10/22
Karen White, Chairperson **Xolon-Salinan Tribe** P. O. Box 7045 Spreckels, CA, 93962 Phone: (831) 238 - 1488 xolon.salinan.heritage@gmail.com	6/14/2022	6/22/2022	N/A	No reply as of 8/10/22

Consulting Party Contact Information	Letter Sent	Delivered	Emailed/ Called	Comments
Katherine Perez, Chairperson **North Valley Yokuts Tribe** P.O. Box 717 Linden, CA, 95236 Phone: (209) 887 - 3415 canutes@verizon.net	6/14/2022	6/16/2022	Update sent 8/18/22	June 18, 2022: Response received, requested to initiate AB52 consultation, participate in cultural fieldwork
Kenneth Woodrow, Chairperson **Wuksache Indian Tribe/Eshom Valley Band** 1179 Rock Haven Ct. Salinas, CA, 93906 Phone: (831) 443 - 9702 kwood8934@aol.com	6/14/2022	6/17/2022: no signature, received delivery confirmation receipt	N/A	No reply as of 8/10/22
Kerri Vera, Environmental Department **Tule River Indian Tribe** P. O. Box 589 Porterville, CA, 93258 Phone: (559) 783 - 8892 Fax: (559) 783 - 8932 kerri.vera@tulerivertribe-nsn.gov	6/14/2022	6/16/2022	N/A	No reply as of 8/10/22
Leo Sisco, Chairperson **Santa Rosa Rancheria Tachi Yokut Tribe** P.O. Box 8 Lemoore, CA, 93245 Phone: (559) 924 - 1278 Fax: (559) 924 - 3583	6/14/2022	6/17/2022	Update sent to Paige Berrgen on 8/18/22	July 27: Tribe has concerns and is asking to be retained as monitor for any ground disturbing activity. Cc Shana Powers and Samantha McCarty on any emails (emails provided in response)
Lloyd Mathiesen, Chairperson **Chicken Ranch Rancheria of Me-Wuk Indians** P.O. Box 1159 Jamestown, CA, 95327 Phone: (209) 984 - 9066 Fax: (209) 984 - 9269 lmathiesen@crtribal.com	6/14/2022	6/17/2022	N/A	No reply as of 8/10/22

Consulting Party Contact Information	Letter Sent	Delivered	Emailed/ Called	Comments
Monica Arellano, Vice Chairwoman **Muwekma Ohlone Indian Tribe of the SF Bay Area** 20885 Redwood Road, Suite 232 Castro Valley, CA, 94546 Phone: (408) 205 - 9714 marellano@muwekma.org	6/14/2022	6/16/2022	N/A	No reply as of 8/10/22
Mr. Valentin Lopez, Chairperson **Amah Mutsun Tribal Band** P.O. Box 5272 Galt, CA, 95632 Phone: (916) 743 - 5833 vlopez@amahmutsun.org	6/14/2022	6/18/2022	N/A	No reply as of 8/10/22
Ms. Irene Zwierlein, Chairperson **Amah Mutsun Tribal Band of Mission San Juan Bautista** 3030 Soda Bay Road Lakeport, CA, 95453 Phone: (650) 851 - 7489 Fax: (650) 332 - 1526 amahmutsuntribal@gmail.com	6/14/2022	6/23/2022	N/A	No reply as of 8/10/22
Neil Peyron, Chairperson **Tule River Indian Tribe** P.O. Box 589 Porterville, CA, 93258 Phone: (559) 781 - 4271 Fax: (559) 781-4610 neil.peyron@tulerivertribe-nsn.gov	6/14/2022	6/16/2022	N/A	No reply as of 8/10/22
Patti Dunton, Tribal Administrator **Salinan Tribe of San Luis Obispo and Monterey Counties** 7070 Morro Road, Suite A Atascadero, CA, 93422 Phone: (805) 464 - 2650 info@salinantribe.com	6/14/2022	6/16/2022	N/A	No reply as of 8/10/22
Quirina Luna Geary, Chairperson **Tamien Nation** PO Box 8053 San Jose, CA, 95155 Phone: (707) 295 - 4011 qgeary@tamien.org	6/14/2022	7/1/2022	N/A	No reply as of 8/10/22

Consulting Party Contact Information	Letter Sent	Delivered	Emailed/ Called	Comments
Rhonda Morningstar Pope, Chairperson **Buena Vista Rancheria of Me-Wuk Indians** 1418 20th Street, Suite 200 Sacramento, CA, 95811 Phone: (916) 491 - 0011 Fax: (916) 491 - 0012 rhonda@buenavistatribe.com	6/14/2022	6/21/2022	N/A	No reply as of 8/10/22
Robert Ledger, Chairperson **Dumna Wo-Wah Tribal Government** 2191 West Pico Ave. Fresno, CA, 93705 Phone: (559) 540 - 6346 ledgerrobert@ymail.com	6/14/2022	6/16/2022	N/A	No reply as of 8/10/22
Ron Goode, Chairperson **North Fork Mono Tribe** 13396 Tollhouse Road Clovis, CA, 93619 Phone: (559) 299 - 3729 rwgoode911@hotmail.com	6/14/2022	6/16/2022: delivered, no confirmation receipt	N/A	No reply as of 8/10/22
Sandra Chapman, Chairperson **Southern Sierra Miwuk Nation** P.O. Box 186 Mariposa, CA, 95338 Phone: (559) 580 - 7871 sandra47roy@gmail.com	6/14/2022	6/27/2022	N/A	No reply as of 8/10/22
Sara Dutschke, Chairperson **Ione Band of Miwok Indians** 9252 Bush Street Plymouth, CA, 95669 Phone: (209) 245 - 5800 consultation@ionemiwok.net	6/14/2022	6/17/2022	N/A	No reply as of 8/10/22
Silvia Burley, Chairperson **California Valley Miwok Tribe** 14807 Avenida Central La Grange, CA, 95329 Phone: (209) 931 - 4567 Fax: (209) 931 - 4333	6/14/2022	6/16/2022	N/A	No reply as of 8/10/22

Consulting Party Contact Information	Letter Sent	Delivered	Emailed/ Called	Comments
Stan Alec **Kings River Choinumni Farm Tribe** 3515 East Fedora Avenue Fresno, CA, 93726 Phone: (559) 647 - 3227	6/14/2022	6/18/2022: Returned, not delivered	N/A	No reply as of 8/10/22
Stanley Cox, Cultural Resources Director **Tuolumne Band of Me-Wuk Indians** P. O. Box 699 Tuolumne, CA, 95379 Phone: (209) 928 - 5300 receptionist@mewuk.com	6/14/2022	6/21/2022	N/A	No reply as of 8/10/22
Steven Hutchason, THPO **Wilton Rancheria** 9728 Kent Street Elk Grove, CA, 95624 Phone: (916) 683 - 6000 Fax: (916) 863-6015 shutchason@wiltonrancheriansn.gov	6/14/2022	6/16/2022	N/A	7/28/22: Cultural group replying, see other.
Timothy Perez **North Valley Yokuts Tribe** P.O. Box 717 Linden, CA, 95236 Phone: (209) 662 - 2788 huskanam@gmail.com	6/14/2022	6/16/2022	N/A	No reply as of 8/10/22
Tony Cerda, Chairperson **Costanoan Rumsen Carmel Tribe** 244 E. 1st Street Pomona, CA, 91766 Phone: (909) 629 - 6081 Fax: (909) 524 - 8041 rumsen@aol.com	6/14/2022		N/A	7/27/2022: Not delivered, package returning to sender according to tracking no.

From: Park, Christopher
To: John Holson; Lisa Holm
Cc: Kashyap, Anusha V.
Subject: FW: Delta - Mendota Canal Subsidence Project
Date: Monday, June 20, 2022 8:27:14 AM

Morning John and Lisa,
This AB52 response just came in on the DMC Project. Please note the request for a discussion on how environmental review will consider effects on tribal cultural resources, and to have observers present for surveys. Should we have an internal call to talk through how to address this?

Chris Park I Planner I AICP I PMP
CDM Smith I www.cdmsmith.com I P: 916.576.7497

From: Pablo Arroyave <pablo.arroyave@sldmwa.org>
Sent: Monday, June 20, 2022 7:36 AM
To: Park, Christopher <ParkCE@cdmsmith.com>; Kashyap, Anusha V. <kashyapav@cdmsmith.com>; 'bbruce@usbr.gov' <bbruce@usbr.gov>
Subject: FW: Delta - Mendota Canal Subsidence Project

FYI, please let me know if there is someone else I should share this with.

Pablo R. Arroyave
Chief Operating Officer
209-832-6230

From: Katherine Perez <canutes@verizon.net>
Sent: Saturday, June 18, 2022 8:50 PM
To: Pablo Arroyave <pablo.arroyave@sldmwa.org>
Cc: Jacob Bejarano <jacob.bejarano@sldmwa.org>
Subject: Delta - Mendota Canal Subsidence Project

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June 18, 2022

San Luis Bureau & Delta-Mendota Water Authority
United States Bureau of Reclamation
Pablo R. Arroyave
15990 Kelso Road

Byron, CA 94514
209.832.6200

RE: AB 52 Consultation Request for the Proposed Delta-Mendota Canal Subsidence Project, in the Central Valley.

Dear City of Freemont Representative,

Northern Valley Yokuts Tribe and Nototomne Cultural Preservation received a letter from San Luis & Delta-Mendota Water Authority dated June 08, 2022, formally notifying us of a proposed project, in the Central Valley, and an opportunity to consult under AB 52. This letter is notice that Northern Valley Yokuts Tribe and Nototomne Cultural Preservation would like to initiate consultation under AB 52.

We would like to discuss the topics listed in Cal. Public Resources Code section 21080.3.2(a), including the type of environmental review to be conducted for the project; project alternatives; the project's significant effects; and mitigation measures for any direct, indirect, or cumulative impacts the project may cause to tribal cultural resources. As consultation progresses, we may also wish to discuss design options that would avoid impacts to tribal cultural resources; the scope of any environmental document that is prepared for the project; pre-project surveys; and tribal cultural resource identification, significance evaluations and culturally-appropriate treatment.

This letter is also a formal request to allow Northern Valley Yokuts Tribe and Nototomne Cultural Preservation tribal representatives to observe and participate in all cultural resource surveys, including initial pedestrian surveys for the project. Please send us all existing cultural resource assessments, as well as requests for, and the results of, any records searches that may have been conducted prior to our first consultation meeting. If tribal cultural resources are identified within the project area, it is our policy that tribal monitors must be present for all ground disturbing activities. Finally, please be advised that our strong preference is to preserve tribal cultural resources in place and avoid them whenever possible. Subsurface testing and data recovery must not occur without first consulting with and receiving written consent from Northern Valley Yokuts Tribe and Nototomne Cultural Preservation.

In the letter you are identified as the lead contact person for consultation on the proposed project. I will be our point of contact for this consultation. Please contact me by phone 209.649.8972 or email at canutes@verizon.net begin the consultation process.

Thank you for involving Northern Valley Yokuts Tribe and Nototomne Cultural Preservation in the planning process at an early stage. We ask that you make this letter a part of the project record and we look forward to working with you to ensure that tribal cultural resources are protected.

Sincerely,

Nototome Cultural Preservation
Northern Valley Yokut / Ohlone / Patwin
Katherine Perez
P.O Box 717
Linden, CA 95236

Cell: 209.649.8972
Email: canutes@verizon.net

From:	Kashyap, Anusha V.
To:	Chris Peske; John Holson; Lisa Holm
Cc:	Park, Christopher
Subject:	FW: Delta-Mendota Canal Subsidence Project
Date:	Thursday, June 30, 2022 2:56:53 PM
Attachments:	image001.png

Please see email below from Auburn Rancheria.

Thank you,
Anusha Kashyap

From: Jacob Bejarano <jacob.bejarano@sldmwa.org>
Sent: Thursday, June 30, 2022 2:55 PM
To: Park, Christopher <ParkCE@CDMSmith.com>; Kashyap, Anusha V. <kashyapav@cdmsmith.com>
Cc: jaime.mcneil <jaime.mcneil@sldmwa.org>; Pablo Arroyave <pablo.arroyave@sldmwa.org>; Rebecca R. Akroyd <rebecca.akroyd@sldmwa.org>; Bruce, Brandee E <BBruce@usbr.gov>
Subject: FW: Delta-Mendota Canal Subsidence Project

Chris and Anusha,

Please share the below email with Pacific Legacy so they can mark this one off the list.

Thanks,

Jacob Bejarano, P.E.
Office: 209/832-6216

From: Anna Cheng <acheng@auburnrancheria.com>
Sent: Thursday, June 30, 2022 2:16 PM
To: Pablo Arroyave <pablo.arroyave@sldmwa.org>; Jacob Bejarano <jacob.bejarano@sldmwa.org>
Cc: Anna Starkey <astarkey@auburnrancheria.com>
Subject: Delta-Mendota Canal Subsidence Project

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Dear Mr. Arroyave,

On behalf of the United Auburn Indian Community's Tribal Historic Preservation Department, thank you for the notification about the project referenced above. We have reviewed the project location and determined that it falls outside of the UAIC's geographic area of traditional and cultural affiliations. Therefore, we will not be commenting on the project.

I would like to also alert your attention to our preferred online submission portal linked below. Please use the following portal to submit all new and incoming notifications. It will provide an automatic response that the notification was received and provide a copy of the filled out form.

Please direct all incoming letters to our Cultural Regulatory Specialist, Ms. Anna Starkey, UAIC's Tribal Historic Preservation Officer, Mr. Matthew Moore, or UAIC's Tribal Chairman, Gene Whitehouse. Notifications via other methods may be missed or delayed. Please use the portal below for faster response. Thank you.

https://auburnrancheria.com/programs-services/tribal-preservation/

Best,
Anna Cheng

The United Auburn Indian Community is now accepting electronic consultation request, project notifications, and requests for information! Please fill out and submit through our website. Do not mail hard copy letters or documents. *https://auburnrancheria.com/programs-services/tribal-preservation* ***Bookmark this link!***

Anna Cheng
Tribal Heritage Coordinator
Tribal Historic Preservation Department| UAIC
10720 Indian Hill Road
Auburn, CA 95603
Direct Line: (530) 217-4083 | Cell: (530) 492-4822
acheng@auburnrancheria.com |www.auburnrancheria.com

Nothing in this e-mail is intended to constitute an electronic signature for purposes of the Electronic Signatures in Global and National Commerce Act (E-Sign Act), 15, U.S.C. §§ 7001 to 7006 or the Uniform Electronic Transactions Act of any state or the federal government unless a specific statement to the contrary is included in this e-mail.

From: Kashyap, Anusha V.
To: John Holson
Cc: Park, Christopher; Quan, Jenna R.
Subject: FW: Delta-Mendota Canal Subsidence Project
Date: Saturday, June 18, 2022 8:15:09 AM

John,
See below for response on the AB-52 letters.

Thank you,
Anusha Kashyap

From: Pablo Arroyave <pablo.arroyave@sldmwa.org>
Sent: Saturday, June 18, 2022 8:08 AM
To: Brandee E Bruce <BBruce@usbr.gov>; Park, Christopher <parkCE@cdmsmith.com>; Kashyap, Anusha V. <kashyapav@cdmsmith.com>
Subject: Fwd: Delta-Mendota Canal Subsidence Project

FYI.

Sent from my iPhone

Begin forwarded message:

> **From:** Corrina Gould <cvltribe@gmail.com>
> **Date:** June 17, 2022 at 6:12:48 PM PDT
> **To:** Pablo Arroyave <pablo.arroyave@sldmwa.org>
> **Subject: Delta-Mendota Canal Subsidence Project**
>
> CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.
>
> Thank you for your letter. As this project stretches through our Tribal territory we would like to be updated when you have received confirmation from the NAHC with Negative/Positive findings for the following counties, Alameda, Contra Costa, and San Joaquin. When the Tribe has received this information and has time to review it we will update whether consultation is necessary.
>
> **'Uni (Respectfully),**
>
> ***Corrina Gould, Tribal Chair***
> Confederated Villages of Lisjan Nation

SAMPLE REQUEST LETTER

June 8, 2022

Andrew Galvan
The Ohlone Indian Tribe
P.O. Box 3388
Fremont, CA, 94539

RE: Delta-Mendota Canal Subsidence Project

Dear Andrew Galvan:

The San Luis & Delta-Mendota Water Authority (Authority), in cooperation with the United States Bureau of Reclamation (Reclamation), is conducting environmental studies for the proposed Delta-Mendota Canal Subsidence Project in the Central Valley. Reclamation is the lead agency responsible for compliance with Section 106 of the National Historic Preservation Act (NHPA), while the Authority is the lead agency responsible for compliance with the California Environmental Quality Act (CEQA). Pursuant to CEQA, the Authority consults with Native American tribes on projects early in the planning process to identify and discuss relevant cultural resource issues and resolve concerns regarding historical and tribal cultural resources while allowing adequate time for consideration of such concerns. This letter is issued in compliance with Assembly Bill 52 (AB 52), which requires notification of the Native American community regarding the proposed project and consultation with interested stakeholders.

The Delta-Mendota Canal (DMC), a key feature of the Central Valley Project (CVP), was completed in 1952 and is owned by Reclamation. The Authority is party to a Transfer Agreement with Reclamation, under which the Authority is responsible for the operation, maintenance, and replacement of certain CVP facilities, including the DMC. Regional subsidence has been observed within the Central Valley of California and along the length of the DMC since its construction. As a result of subsidence, the available freeboard for the canal lining and the canal embankment, and clearances between water surface elevations and structures crossing the canal, no longer meet Reclamation standards. The project has been developed to analyze potential alternatives to restore the capacity of the DMC. A Feasibility Report must be

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BYRON, CA
94514
209 832-6200
209 833-1034 FAX

completed prior to pursuing final project design. As part of the feasibility study, the cultural resources along the canal are being identified. The project area of potential effects (APE) is approximately 116.5 miles long, stretching the entire length of the DMC. The APE is located on multiple U.S. Geological Survey topographic quadrangle maps and within various Townships, Ranges, and Sections as shown in Exhibit 1. Reclamation's entire DMC right-of-way (ROW) is included in the APE and spans Alameda, Fresno, Merced, San Joaquin, and Stanislaus counties. All access and staging will occur within the ROW along existing DMC operations and maintenance access roads. The maximum depth of disturbance for the project will be 100 feet for geophysical testing (cone penetration testing and soil boring). The APE extends to either side of the DMC and is no more than 250 feet in width from the centerline of the canal.

Pacific Legacy, Inc., the Authority's qualified cultural resource consultant, received the results of a Sacred Lands File review from the Native American Heritage Commission (NAHC) for the APE on April 20, 2022. The NAHC review of the Sacred Lands File yielded positive results, though no locational data were given. The NAHC recommended contact with several Native American tribes to obtain further information regarding areas of concern within the DMC ROW. Pacific Legacy also received the results of an archival and records search of the California Historical Resources Information System (CHRIS) from the Southern San Joaquin Valley Information Center and the Central California Information Center in April 2020. Those results revealed two Native American archaeological resources within the project APE, one recorded along the Firebaugh Wasteway in Fresno County in 1951 and the other recorded along the Westley Wasteway in Stanislaus County in 1946. To date, Pacific Legacy has not yet received CHRIS results from the Northwest Information Center for Alameda and Contra Costa counties.

To support compliance with Section 106 of the NHPA, Reclamation is developing a programmatic agreement for the project with the State Historic Preservation Officer (SHPO). As part of its compliance efforts, Reclamation may have contacted your group about this effort.

Please consider this letter the initiation of the Authority's consultation under AB 52 and as formal notification of the proposed project as required under Public Resources Code (PRC) 21080.3.1 and Chapter 532 Statutes of 2014. If you would like to consult on this project, we respectfully request that you respond within 30 days of receipt of this letter pursuant to PRC 21080.3.1(d), by July 6, 2022. Please also provide a designated lead contact person for future communications.

The Authority is eager to discuss with you any concerns you might have regarding areas within the APE that may be important to your community. The Authority requests your participation in the identification and protection of cultural resources, sacred lands, and other heritage sites

within the above-described APE with the understanding that you or other members of your community might possess specialized knowledge of the area.

If you or any of your tribal members have any questions or concerns regarding this project, please contact myself or Jacob Bejarano at 209.832.6200, pablo.arroyave@sldmwa.org or Jacob.bejarano@sldmwa.org.

Sincerely,

Pablo Arroyave

Pablo R. Arroyave
Chief Operating Officer

Attachments – Area of Potential Effects Maps

SAMPLE UPDATE LETTER

August 18, 2022

Katherine Perez
Nototome Cultural Preservation
Northern Valley Yokut / Ohlone / Patwin
P.O. Box 717
Linden, CA 95236
Sent via email: canutes@verizon.net

Dear Katherine Perez,

The purpose of this letter is to summarize archaeological survey and evaluation efforts for the Delta-Mendota Canal Subsidence Project in the Central Valley and provide an update on project status. This update is in regards to your request for Assembly Bill 52 (AB 52) consultation for the project. The U.S. Bureau of Reclamation is consulting separately pursuant to Section 106 of the National Historic Preservation Act. The current cultural resources identification effort for the project began in March 2022 with a records search request to the appropriate CHRIS Information Center and the Native American Heritage Commission. A notification letter was sent out in June of 2022 by the San Luis and Delta-Mendota Water Authority (Authority) in compliance with AB 52. Your response to that letter requesting consultation was received by the Authority in July of 2022.

On behalf of the Authority, Pacific Legacy Inc. completed a pedestrian survey of the Area of Potential Effect (APE) in July of 2022. The APE is approximately 97 miles long which has been reduced from the original 116 miles noted in our initial consultation letter based on consideration of potential project construction impacts. The APE for the proposed construction activities amounts to 5,899 acres in total and no eligible Native American resources have been identified, other than one isolated find noted within the current APE. The isolated find, DMC-CRP-ISO-001, is comprised of two crypto-crystalline silicate (CCS) flakes (artifact manufacturing debris) located near the San Luis Creek bank. Ground surface visibility at the find was 100%. Two newly identified archaeological sites, a historic period resource associated with an earlier canal and a historic debris scatter were recorded as archaeological resources during the survey. The two newly identified archaeological sites, DMC-CRP-001 and DMC-

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209 833-1034 FAX

CRP-002, were evaluated for eligibility for the National Register of Historic Places (NRHP) and the California Register of Historical Places (CRHR) and were recommended as determined to be ineligible. However, that determination has not been reviewed by Reclamation. We anticipate that the final survey report will be completed in late September or early October depending on the timing of Reclamation's review.

Pacific Legacy, Inc., on behalf of the Authority, is currently planning to conduct a Geoarchaeological Assessment to identify potential buried cultural resources. The Geoarchaeological Assessment Workplan currently identifies 10 areas of geoarchaeological sensitivity based on modeling of soil profiles. These areas will be targeted for subsurface exploration. Subsurface exploration will consist of both trenching and coring, accompanied by soil stratigraphic analysis. The Geoarchaeological Assessment Workplan is currently under review by Reclamation and we are awaiting their permit to complete the work. The Authority will keep you informed of the field schedule.

While the pedestrian survey of the APE did not result in the identification of any Native American resources considered an archaeological site, the Authority will keep you informed of the progress of the geoarchaeological testing. Your previous concerns have been noted and once Reclamation has approved the survey report it will be available for your review. We do not have the funding for Native American monitors that were requested by some of the consulting parties. However, should you wish to monitor during the geotechnical fieldwork, the Authority's consultants can coordinate with you on the planning for that fieldwork. Please respond to this email indicating your interest in monitoring the geotechnical fieldwork. If you have any further comments or questions, please email my staff at jacob.bejarano@sldmwa.org and copy me at Pablo.arroyave@sldmwa.org. Thank you in advance for you continued interest in our project.

Best Regards,

Pablo Arroyave

Pablo Arroyave
Chief Operating Officer
San Luis and Delta-Mendota Canal Water Authority

APPENDIX D – ARCHAEOLOGICAL SITE RECORDS (REDACTED)

Note: This Appendix Has Been Removed As It Contains Confidential Information

APPENDIX E – ARCHAEOLOGICAL PHOTOGRAHIC DOCUMENTATION (REDACTED)

Note: Photographs Containing Confidential Information Have Been Removed

Appendix E: Photographic Documentation

Photograph No. 1

Direction: East

Date: 5/18/22

Photographer:
Ashley Schmutzler

Description:
Starting point at Sierra avenue (Frame AS014).



Photograph No. 2

Direction: North

Date: 5/19/22

Photographer:
Ashley Schmutzler

Description:
Overview from Helm Canal Rd. Location of P-10-000105. (AS024).



Photograph No. 3

Direction: North

Date: 5/19/22

Photographer: Ashley Schmutzler

Description: Overview from Jerold Avenue (Frame AS030).



Photograph No. 4

Direction: East

Date: 5/20/22

Photographer: Ashley Schmutzler

Description: Overview from North Russel Avenue (Frame AS037).



Photograph No. 5

Direction: East

Date: 5/20/22

Photographer:
Ashley Schmutzler

Description:
Overview from W. Cambia Avenue (Frame AS040).



Photograph No. 6

Direction: East

Date: 5/20/22

Photographer:
Ashley Schmutzler

Description:
Overview from North Oxford Avenue (Frame AS043).



Photograph No. 7

Direction: West

Date: 5/21/22

Photographer:
Ashley Schmutzler

Description:
Overview from N. Hamburg Avenue (Frame 46).



Photograph No. 8

Direction: East

Date: 5/21/22

Photographer:
Ashley Schmutzler

Description:
Private property within survey area , photo from South Woo Avenue (Frame AS048).



Photograph No. 9

Direction: South

Date: 5/21/22

Photographer:
Ashley Schmutzler

Description:
Overview from Cotton Gin Road
(Frame AS51).



Photograph No. 10

Direction: Northeast

Date: 5/21/22

Photographer:
Ashley Schmutzler

Description:
Overview of highway 165, bridge 84.38 (Frame AS57).



Photograph No. 11

Direction: West

Date: 5/22/22

Photographer:
Ashley Schmutzler

Description:
Overview of S Creek Road (Frame AS64).



Photograph No. 12

Direction: Northeast

Date: 5/22/22

Photographer:
Ashley Schmutzler

Description:
Overview of Delta Mendota Canal sign at State route 152 (Frame AS067).



Photograph No. 13

Direction: West

Date: 5/23/22

Photographer:
Ashley Schmutzler

Description:
Overview from Hilldale Avenue (Frame AS68).



Photograph No. 14

Direction: South

Date: 5/23/22

Photographer:
Ashley Schmutzler

Description:
Modern can scatter (Frame AS069).



Photograph No. 15

Direction: North

Date: 5/23/22

Photographer:
Ashley Schmutzler

Description:
Historic period ditch, previously recorded as P-24-002194, addressed as built-environment (Frame AS070).



Photograph No. 16

Direction: -

Date: 5/23/22

Photographer:
Ashley Schmutzler

Description:
DMC-CRP-ISO-001 Artifact -01 (Frame AS076).



Photograph No. 17

Direction: -

Date: 5/23/22

Photographer:
Ashley Schmutzler

Description:
DMC-CRP-ISO-001 Artifact-02 (Frame AS077).



Photograph No. 18

Direction: Northeast

Date: 5/24/22

Photographer:
Ashley Schmutzler

Description:
Overview of DMC-CRP-ISO-001 location in maintenance yard (Frame AS087).

Photograph No. 19

Direction: Southwest

Date: 5/25/22

Photographer:
Ashley Schmutzler

Description:
Private land between McCabe road and Snyder road. (Frame AS094).



Photograph No. 20

Direction: Northwest

Date: 5/25/22

Photographer:
Ashley Schmutzler

Description:
Overview of GSA-13 (Frame AS101).



Photograph No. 21

Direction: West

Date: 6/9/22

Photographer:
Ashley Schmutzler

Description: Overview of GSA-6 (Frame 176).



Photograph No. 22

Direction: South

Date: 5/26/22

Photographer:
Ashley Schmutzler

Description: Overview of field north of Byron Highway with survey crew (Frame AS106)



Photograph No. 23

Direction: East

Date: 5/26/22

Photographer:
Ashley Schmutzler

Description: No trespassing sign off Finck Road (Frame AS108).



Photograph No. 24

Direction: North

Date: 6/6/22

Photographer:
Ashley Schmutzler

Description: Delta-Mendota Canal, east of water authority entrance (Frame AS112).



Photograph No. 25

Direction: South

Date: 6/6/22

Photographer:
Ashley Schmutzler

Description:
Delta-Mendota Canal near Water Authority office (Frame 116).



Photograph No. 26

Direction: Northeast

Date: 6/6/22

Photographer:
Ashley Schmutzler

Description:
Start of GSA-2 between Mountain House Road and Grant Line Road (Frame AS130).



Photograph No. 27

Direction: North

Date: 6/6/22

Photographer:
Ashley Schmutzler

Description:
End of GSA-2 between Mountain House Road and Grant Line Road (Frame AS131).



Photograph No. 28

Direction: West

Date: 6/7/22

Photographer:
Ashley Schmutzler

Description:
Overview of GSA-3 at S Corral Hollow Road (Frame AS142).



Photograph No. 29

Direction: North

Date: 6/7/22

Photographer:
Ashley Schmutzler

Description:
GSA-3 overview (Frame AS144).



Photograph No. 30

Direction: North

Date: 6/7/22

Photographer:
Ashley Schmutzler

Description:
Overview of GSA-3 end point (Frame AS145).



Photograph No. 31

Direction: East

Date: 6/8/22

Photographer:
Ashley Schmutzler

Description:
DMC-AAS-ISO-001, an isolated historic period plow.
(Frame AS146)

Photograph No. 32

Direction: Plan

Date: 6/8/22

Photographer:
Ashley Schmutzler

Description:
DMC-AAS-ISO-001, B-865 stamp (Frame AS149).



Photograph No. 33

Direction: West

Date: 6/8/22

Photographer:
Ashley Schmutzler

Description:
Overview of Corral Hollow Road (Frame 153).



Photograph No. 34

Direction: Northwest

Date: 6/8/22

Photographer:
Ashley Schmutzler

Description: Overview from S. Bird Road (Frame AS157).



Photograph No. 35

Direction: East

Date: 6/9/22

Photographer:
Ashley Schmutzler

Description:
Starting point of GSA-4 from S Bird (Frame AS159).



Photograph No. 36

Direction: Southwest

Date: 6/9/22

Photographer:
Ashley Schmutzler

Description: GSA-4, private land (Frame AS160).



Photograph No. 37

Direction: West

Date: 6/9/22

Photographer:
Ashley Schmutzler

Description:
Overview of I-5, end of GSA-4 (Frame AS163).



Photograph No. 38

Direction: South

Date: 6/9/22

Photographer:
Ashley Schmutzler

Description:
Start of GSA-5 (Frame 165).



Photograph No. 39

Direction: East

Date: 6/9/22

Photographer:
Ashley Schmutzler

Description:
Overview of GSA-5 from S Koster Road (Frame AS167).



Photograph No. 40

Direction: South

Date: 6/9/22

Photographer:
Ashley Schmutzler

Description: End of GSA-5 at W Gaffrey Road (Frame AS169).



Photograph No. 41

Direction: East

Date: 6/9/22

Photographer:
Griffen Bragagnolo

Description:
Overview of start of GSA-6 (Frame AS172).



Photograph No. 42

Direction: North

Date: 6/9/22

Photographer:
Griffen Bragagnolo

Description:
Overview of end of GSA-6. (Frame AS173).



Photograph No. 43

Direction: North

Date: 6/13/22

Photographer:
Ashley Schmutzler

Description: Overview of GSA-8 Del Puerto Creek (Frame AS181).



Photograph No. 44

Direction: Southeast

Date: 6/13/22

Photographer:
Chris Peske

Description:
Overview of GSA-8 (Frame AS182).



Photograph No. 45

Direction: West

Date: 6/14/22

Photographer:
Chris Peske

Description:
Field north of SR 140, private land (Frame AS183).



Photograph No. 46

Direction: Southeast

Date: 6/15/22

Photographer:
Chris Peske

Description:
View of fencing blocking access to the western edge of project area south of GSA-10 (Frame AS195).



Photograph No. 47

Direction: West

Date: 6/15/22

Photographer:
Chris Peske

Description:
View of unsurveyed space on southern end of GSA-10 (Frame AS196).



Photograph No. 48

Direction: Northeast

Date: 6/15/22

Photographer:
Chris Peske

Description:
GSA-10 overview (Frame AS197).



Photograph No. 49

Direction: North

Date: 6/15/22

Photographer:
Chris Peske

Description:
GSA-10 overview
(Frame AS198).



Photograph No. 50

Direction: Northwest

Date: 6/15/22

Photographer:
Chris Peske

Description:
GSA-10 overview
(Frame AS199).



Photograph No. 51

Direction: Northwest

Date: 6/15/22

Photographer:
Chris Peske

Description:
GSA-10 wasteway
(Frame AS200).



Photograph No. 52

Direction: Northwest

Date: 6/15/22

Photographer:
Chris Peske

Description:
GSA-10 wasteway
(Frame AS201).



Photograph No. 53

Direction: East

Date: 6/15/22

Photographer:
Chris Peske

Description:
Drainage north of GSA-10 (Frame AS202).



Photograph No. 54

Direction: North

Date: 6/17/22

Photographer:
Chris Peske

Description:
GSA-09 wasteway (Frame AS205).



Photograph No. 55

Direction: East

Date: 6/15/22

Photographer:
Chris Peske

Description:
GSA-09, viewing the Delta-Mendota Canal. (Frame AS206)



Photograph No. 56

Direction: South

Date: 6/17/22

Photographer:
Myra Jamison

Description:
DMC-CRP-002 site overview (Frame AS219).

Photograph No. 57

Direction: -

Date: 6/17/22

Photographer:
Myra Jamison

Description:
DMC-CRP-002: A-01: Bottle base fragment with Owens-Illinois maker's mark ("I" within circle) (Frame AS209).



Photograph No. 58

Direction: -

Date: 6/17/22

Photographer:
Myra Jamison

Description:
DMC-CRP-002: A-02: Top fragment of "Sunny Brook" brand whiskey bottle (Frame AS210)



Photograph No. 59

Direction: -

Date: 6/17/22

Photographer:
Myra Jamison

Description:
DMC-CRP-002: A-03: Square bottle base with Obear-Nester Glass Co. maker's mark ("N" within square) (Frame AS212).



Photograph No. 60

Direction: -

Date: 6/17/22

Photographer:
Myra Jamison

Description:
DMC-CRP-002: A-04: Bottle base fragment with "4/5 quart" embossed on bottom (Frame AS213).



Photograph No. 61

Direction: -

Date: 6/17/22

Photographer:
Myra Jamison

Description:
DMC-CRP-002: A-06: Top fragment of "Sunny Brook" whiskey bottle (Frame AS214).



Photograph No. 62

Direction: -

Date: 6/17/22

Photographer:
Myra Jamison

Description:
DMC-CRP-002: A-07: Bottle base fragment with Anchor-Hocking Glass Co. maker's mark (Frame AS216).



Photograph No. 63

Direction: Northeast

Date: 6/17/22

Photographer:
Myra Jamison

Description:
DMC-CRP-001: Feature 1, ruins of flood dam (Frame AS220).



Photograph No. 64

Direction: North

Date: 6/17/22

Photographer:
Myra Jamison

Description:
DMC-CRP-001: Cut stone of ditch (Feature 2) in foreground, crew standing on Feature 4 (Frame AS221).



Photograph No. 65

Direction: North-northwest

Date: 6/17/22

Photographer:
Myra Jamison

Description:
DMC-CRP-001: Site overview with berm (Feature 3) in middle and flood dam (Feature 1) at right (Frame AS222).

Photograph No. 66

Direction: Northeast

Date: 6/17/22

Photographer:
Myra Jamison

Description:
DMC-CRP-001: Cut stone of ditch (Feature 2) in foreground, crew standing on Feature 4 (Frame AS223).



Photograph No. 67

Direction: West

Date: 6/17/22

Photographer:
Myra Jamison

Description:
DMC-CRP-001: Unusual grasses (Feature 4) (Frame AS224).



APPENDIX F – HISTORIC RESOURCES INVENTORY AND EFFECTS ANALYSIS REPORT

Draft

Historic Resources Inventory and Effects Analysis Report for the Delta-Mendota Canal Subsidence Correction Project



Prepared for:

U.S. Department of Interior, Bureau of Reclamation
and
San Luis & Delta-Mendota Water Authority

Prepared by:

JRP Historical Consulting LLC

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August 2022

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Appendices

Appendix A: Maps

- Project Vicinity & Location
- Area of Potential Effects (APE) Maps

Appendix B: DPR 523 Forms

Appendix C: Tables

Front piece: Delta-Mendota Canal near milepost 28.96. Camera facing downstream, May 11, 2022.

1. Executive Summary

This report identifies and evaluates built environment resources within the Area of Potential Effects for the U.S. Bureau of Reclamation's Delta-Mendota Canal Subsidence Correction Project in accordance with Section 106 of the National Historic Preservation Act of 1966 (as amended) (54 U.S.C. 306108) and its implementing regulations (Title 36 Code of Federal Regulation Part 800), and Section 15064.5(a)(2)-(3) of the California Environmental Quality Act (CEQA) Guidelines, using the criteria outlined in Section 5024.1 of the California Public Resources Code and applies the criteria of effect pursuant to 36 CFR Part 800.5 for the project. The project location / vicinity map and the Area of Potential Effects (APE) map are provided in **Appendix A**.

Historic properties are built environment resources that meet the significance criteria for listing in the National Register of Historic Places (NRHP) and retain historic integrity. Historic properties that have been determined eligible for listing in the NRHP are also listed in the California Register of Historical Resources. This report identified three linear historic properties that cross over or under Delta-Mendota Canal and have been previously determined eligible for listing in the National Register of Historic Places: San Joaquin Pipelines/Hetch Hetchy Aqueduct, Santa Fe Grade, and Outside Canal. This report and concludes that two additional properties – Delta-Mendota Canal and San Luis Drain – meet the significance criteria for listing. See **Appendix B** for Department of Parks and Recreation (DPR) 523 form sets for built environment resources evaluated for this report.

Delta-Mendota Canal is a 116.4-mile-long canal that is a primary component of the US Bureau of Reclamation's (Reclamation) Central Valley Project (CVP). Completed in 1952, the canal transports water from C.W. Bill Jones Pumping Station (formerly Tracy Pumping Station) along the western side of the San Joaquin Valley for irrigation, for use at the San Luis Reservoir, and for recharging the San Joaquin River where water has been diverted at Friant Dam for the Friant-Kern system. The National Register of Historic Places (NRHP) and California Register of Historical Resources (CRHR) inventory and evaluation contained herein conclude that Delta-Mendota Canal meets NRHP Criterion A and CRHR Criterion 1 at the state level of significance because of its primary role in accomplishing the visionary goal of the CVP to transfer water between the Sacramento River and San Joaquin River basins. Delta-Mendota Canal is also individually eligible for listing in the NRHP and CRHR under Criterion C and Criterion 3 because its size and scale demonstrate the magnitude of the CVP's engineering and construction accomplishment, and because it demonstrates Reclamation engineer Oscar Boden's important contributions to design of the Delta Division of the CVP. Overall, the canal retains historic integrity to its period of significance, 1946-1951. **Table 1** and **Appendix C** provide a list of contributing and non-contributing components of Delta-Mendota Canal.

Table 1: Contributing Status of Component Parts of DMC.

Structure Type	Contributing Status
Farm Bridges	Non-Contributing
Railroad Bridge	Non-Contributing
Pipe Crossings	Non-Contributing
County Highway	Non-Contributing
Overchutes	Non-Contributing
Inlet Drains	Non-Contributing
Road Drains	Non-Contributing
Culverts	Non-Contributing
Cattle Guards	Non-Contributing
Pumps	Non-Contributing
Ladders	Non-Contributing
Gates	Non-Contributing
Check Structures	All are Contributing
Siphons	All are Contributing
Wasteways	4 are Contributing, 1 is not – see Master Table in **App. C**
CVP Signs	All are Contributing
Lining / Prism	Lining to original specifications contributes
Operating Bridges	Non-contributing; integrity loss
Turnouts	Some are contributing – see Master Table in **App. D**
Pumping Plants	C.W. Bill Jones Pumping Plant is Contributing

The San Luis Drain is an 88-mile, concrete-lined, trapezoidal interceptor drain constructed between 1969 and 1973 as part of the San Luis Unit: a joint state-federal expansion of the CVP to deliver water and provide drainage to the western San Joaquin Valley. From the southern terminus located near Five Points in Fresno County, the San Luis Drain extends in a northerly alignment where it historically collected subsurface irrigation wastewater from adjacent irrigation districts enroute to its northern terminus outside Gustine in Merced County. Here, the drain discharged drainage water into a complex of 12 evaporation ponds at the former Kesterson Reservoir until 1986, when use of the reservoir and drain was ultimately discontinued following the discovery of selenium toxicosis among various fish and waterfowl species at the Kesterson National Wildlife Refuge (which encompassed the reservoir). JRP recorded two point-observations and a linear segment in and around the APE between Mendota and Firebaugh and finds the San Luis Drain historically significant under NRHP Criterion A and CRHR Criterion 1, meeting the standards under NRHP Criteria Consideration G, for its important associations with the Kesterson Reservoir ecological disaster, an environmental crisis that drew national attention to the issue of toxic selenium contamination and contributed to a dramatic policy shift toward agricultural drainage disposal practices in the United States. The San Luis Drain is significant at the national level, with a period of significance

spanning from 1982, when USFWS scientists first detected selenium toxicosis among various wildlife species at Kesterson, and 1988, when the U.S. Department of Interior--having discontinued use of the San Luis drainage facilities--remediated the selenium contamination problem at Kesterson by dewatering and infilling the evaporation ponds. The two point-observations and one linear segment recorded herein retain strong integrity to convey the San Luis Drain's period of significance.

In general, the character-defining features of the recorded segment of the San Luis Drain are its alignment, the size, shape, and dimensions of the canal prism, and its concrete lining material. Additionally, appurtenant structures that directly relate to the conveyance of subsurface irrigation drainage water like check structures and siphons all relate directly to the drain's significance and are therefore character defining. The boundaries of the San Luis Drain are the channel's right-of-way, encompassing the canal prism and two flanking embankments between the southern terminus--a point near Five Points in Fresno County--and the northern terminus at the former Kesterson Reservoir.

This report concludes that the project will have an adverse effect on Delta-Mendota Canal because the project proposes material demolitions and alterations that are not consistent with the SOI Standards. The project does not propose any actions that have the potential to adversely affect any other historic properties within the Area of Potential Effects.

2. Summary of Identification Efforts / Methodology

2.1. Area of Potential Effects

Reclamation established the APE for the DMC Subsidence Correction Project, with input from the Authority. The APE encompasses 5,948.6 acres and includes all areas that may be directly or indirectly affected by the Project. The APE includes the DMC ROW from PM 2.5 to PM 116.6 where staging, stock piling, borrow areas, and most project activities are located. Some areas of the DMC ROW are excluded where no project activities will occur and where non-Authority / Reclamation buildings / structures are located in, or have encroached into, the ROW, but where project activities have no potential to affect those resources. The APE also includes areas outside of the ROW where activities related to bridge replacements may impact bridge approach roads and areas adjacent to affected roadways, as well as the Authority's Operations and Maintenance Complex in Tracy adjacent to the C.W. Bill Jones Pumping Plant at the north end of the canal.

2.2. Identification

2.2.1. Records Search

Pacific Legacy submitted records searches to Southern San Joaquin Valley Information Center (File No. 22-107), Northwest Information Center (File No. 21-1476), and the Central California Information Center (Reference No. 12106ILN). The search results identified previously evaluated segments and appurtenant features of Delta-Mendota Canal. These resources are addressed in the NRHP/CRHR evaluation in **Section 4.4** below.

Information Center search results identified three linear historic properties that cross under or over Delta-Mendota Canal and have been previously determined eligible for listing in the NRHP, as well as nine additional linear built environment resources that cross under or over the DMC and have been previously determined not eligible for listing in the NRHP. See **Table 2** and APE maps for these previously evaluated historic linear resources.

Table 2: Previously evaluated built environment resources in APE

Primary String	Resource Name	OHP Status Code[1]	Status Notes	County Name
P-24-000082	CCID Main Canal; San Joaquin and Kings River Canal, Main Canal	2S2 (2018)	Criterion A	Merced
P-24-000083	Old Santa Fe Grade (Road)	2S2 (2017)		Merced
P-24-000434	Outside Canal	2S2 (2017)	Criterion A	Merced
P-24-000434	Outside Canal	2S2 (2017)	Criterion A	Merced
P-39-004860	San Joaquin Pipelines No. 1 & 2; Hetch Hetchy Aqueduct	3S (2007)	Criteria A & C	San Joaquin
P-10-003930	Southern Pacific Railroad	6Z		Fresno
P-10-007237	AE-4013-002; PG&E distribution line	6Z (2019)		Fresno
P-10-007240	AE-4013-005; power distribution line	6Z (2019)		Fresno
P-39-000002	Southern Pacific Railroad in San Joaquin County	6Z (2018)		San Joaquin
P-39-000098	Western Pacific Railroad/Union Pacific RR	6Z (2015)		San Joaquin
P-39-004289	Three sets of two transmission towers; TPP-5; PG & E Stanislaus-Newark Circuits #1 & 2	6Z (2001)		San Joaquin
P-39-004312	Byron Bethany Irrigation District Main Canal	6Z (2001)		San Joaquin
P-50-002328	Tesla-Salado-Manteca 115 kV Transmission Line	6Z (2017)		Stanislaus

[1] California Historical Resource Status Codes.
2S2: Individual Property determined eligible determined eligible for NR by a consensus through Section 106 process. Listed in the CR.
3S: Appears eligible for NR as an individual property through survey evaluation.
6Z: Found ineligible for NR, CR, or Local designation through survey evaluation.

Primary String	Resource Name	OHP Status Code[1]	Status Notes	County Name
P-01-010445	Byron Bethany Irrigation District Main Canal (No. 9)	6Z (2011)		Alameda

The following summarizes the eligibility conclusions of the previously identified historic properties that have been determined eligible for listing in the NRHP.

CCID Outside Canal

The Outside Canal is an earthen canal that delivers water from the San Joaquin River to farmland on the west side of the San Joaquin Valley near Los Banos. The Outside Canal was the second major canal built by the San Joaquin & Kings River Canal & Irrigation Company and the Miller and Lux Company, and is currently owned and operated by the CCID. The Main Canal crosses the APE at Mile Post 115.57. In 2017, the Outside Canal was evaluated and found eligible for listing in the NRHP/CRHR under Criterion A/1 at the local level for its association with Miller and Lux Company's reclamation and irrigation developments of western Merced County circa 1870 to 1925. The historic property boundary is the 37-mile canal structure. The period of significance is 1896–1897, the years the canal was built. Character-defining features of the Outside Canal are the unaltered portions of the canal, its setting in an agricultural community, its location and route, and its ability to convey water for flood control and irrigation. Non-contributing elements include the canal's design, workmanship, and operational components such as weirs, siphons, bridges, diversion gates, valves, and culverts. On July 1, 2019, SHPO concurred with this determination. Because the Main Canal was formally determined eligible for listing in the NRHP, it is automatically listed in the CRHR.

Old Santa Fe Grade

The Old Santa Fe Grade is a road grade that runs diagonally across wetlands near Los Banos in western Merced County. The grade is primarily an unpaved road, and in some locations the grade serves as a levee and access road. The Main Canal crosses the APE at Mile Post 110.12. In 2017, the Old Santa Fe Grade was evaluated and found eligible for listing in the NRHP/CRHR under Criteria A/1 at the local level as an important component of the Miller and Lux Company's early reclamation and development of western Merced County, and under Criteria B/2 for its direct association with both Henry Miller and Claus Spreckels. Its period of significance is 1890, the year the grade was constructed under the terms of the Miller and Lux Company's contract with Spreckels' rail company. The historic property boundary is the grade structure. Character-defining features are the road grade structure, its location and setting in western Merced County's reclaimed agricultural landscape, and its ability to function as a

roadway. On July 1, 2019, SHPO concurred with this determination. Because the Old Santa Fe Grade was formally determined eligible for listing in the NRHP, it is automatically listed in the CRHR.

Hetch Hetchy Aqueduct San Joaquin Pipelines Nos. 1 & 2

The Hetch Hetchy Aqueduct San Joaquin Pipelines Nos. 1 & 2 (SJPL 1 & 2) are part of the City and County of San Francisco municipal water system. The pipelines run mostly underground and convey water east to west 47.5 miles across the San Joaquin Valley from the Oakdale Portal to the Tesla Portal. SJPL 1 & 2 were built in 1932 and 1953, respectively. Both pipelines are steel with diameters between 56 inches to 72 inches. The pipelines cross the APE at Mile Post 23.95. In 2007, SJPL 1 & 2 were evaluated and found eligible for the NRHP/CRHR under Criterion A/1 at the local level due to their association with the development of the San Francisco water system and associated growth and prosperity of the San Francisco Bay Area. Additionally, SJPL No. 1 was found eligible under NRHP/CRHR Criterion C/3 for the innovative engineering techniques used by the Youdall Company for its construction. The boundary of the SJPL 1 & 2 historic property is the entire 47.5-milc-long San Joaquin Pipeline right-of-way, including the lands surrounding both the Oakdale Portal and Tesla Portal. The period of significance is 1932-1953 and the character-defining features include the cylindrical shape throughout its length, the diameter of the pipes, the use to convey water by gravity flow, the parallel positioning of the pipelines, and the original construction materials. Because the Old Santa Fe Grade was formally determined eligible for listing in the NRHP, it is automatically listed in the CRHR.

2.2.2. Inventory and Evaluation

JRP staff recorded and evaluated five built environment resources in the APE: Delta-Mendota Canal, two rural residential properties, and two drainage canals. The NRHP evaluation conclusions for each of these resources is listed in **Table 3** below. See **Appendix B** for DPR 523 form sets for each of these resources.

Table 3: Built environment resources evaluated by this study.

Resource Name	Status Code[2]	Status Notes	County
Delta-Mendota Canal	2S2	Criteria A & C	Alameda, Contra Costa, San Joaquin, Stanislaus, Merced, Fresno
San Luis Drain	2S2	Criterion A Criteria Consideration G	Fresno
Drain U-121.2	6Z		Fresno
4500 South Lammers Road / (APN) 240-140-260	6Z		San Joaquin
27655 South Lammers Road / (APN) 251-050-120	6Z		San Joaquin

JRP staff recorded Delta-Mendota Canal by visually observing the entire 116-mile canal from its headworks at the inlet canal upstream from C.W. Bill Jones Pumping Station to its outlet at Mendota Pool. JRP recorded the canal with digital photography and field notes. In order to photographically capture the characteristics of the canal, JRP took photographs of all major structures – check structures, siphon inlets and outlets, overchutes, turnouts, and bridges – and photographed representative examples of common and ubiquitous minor structures like inlet drains, culverts, road drains, and ladders. JRP photographed representative examples of the canal prism at regular intervals no greater than one-half mile for the entire length of the canal.

JRP recorded Delta-Mendota Canal on a set of DPR 523 forms that consists of a Primary Record, a Building, Structures and Object Record, 22 DPR 523 Linear Feature Records, and a Site Map (**Appendix B**). The Primary Record consists of a descriptive overview of the canal, and a typology discussion of each of the major feature types and sub-types. The 22 Linear Feature Records describe the 22 segments of the canal between check structures, referring to the typology discussion to characterize repetitive resource types, and providing descriptions of resources unique to the particular segment. The DPR 523 Forms do not include photographs of each of the approximately 750 appurtenant structures on the canal but do include photographs of representative examples.

The DPR 523 Form set documents the physical attributes of the canal and provides evaluations under NRHP Criteria A – D, as well as the CRHR Criteria 1 – 4 for historic significance and

[2] California Historical Resource Status Codes.
2S2: Individual Property determined eligible determined eligible for NR by a consensus through Section 106 process. Listed in the CR.
6Z: Found ineligible for NR, CR, or Local designation through survey evaluation.

identifies canal components as contributing or non-contributing elements. A table of each of the approximately 750 appurtenant structures, organized by milepost, is appended to the end of the form set and notes if the structure contributes to the significance of the canal. A summary table noting the types of component elements that contribute and do not contribute to the significance of the historic property is presented in the introduction, **Section 1** and in the evaluation, **Section 5**. This recordation of historic properties has been carried out in a manner consistent with the Office of Historic Preservation's *Instructions for Recording Historical Resources;* Reclamation's Directives and Standards (D&S) 02-01; and the *Secretary of the Interior's Standards for the Treatment of Historic Properties*.

JRP recorded two rural residential properties and two drainage ditches on DPR 523 forms sets that provide descriptions of the resources and NRHP and CRHR evaluations.

3. Historic Context

3.1. Delta-Mendota Canal

When viewing a topographic map of California, one particularly outstanding geographic feature presents itself above all others: an immense oblong alluvial plain in the interior of the state that extends nearly 500 miles from north to south and varies from about 60 to 100 miles in width (**Figure 1**). This Great Central Valley Basin occupies more than one-third of the entire state. It covers 18,810 square miles and is bounded on the east by a pair of formidable mountain ranges and on the west by a less imposing coastal mountain range. The valley itself contains three major drainage areas. The northern one-third is drained by the southerly flowing Sacramento River and its tributaries. The Sacramento is the longest river in the state and the largest, contributing about one-third of the total outflow of all river systems in the state. The southern and largest portion of the valley is drained by the San Joaquin River and its tributaries. The San Joaquin River flows west and north and drains a larger, but much more arid region. The two major rivers converge in the "Sacramento-San Joaquin Delta," a 153 square-mile labyrinth of reclaimed tule islands, river channels, and sloughs. The Delta also receives freshwater inflows directly from other rivers draining the imposing central region of the Sierra Nevada range to the east. These watercourses include the Cosumnes, Mokelumne and Calaveras rivers along with numerous other minor rivers and creeks. The flow from all of these waterways move westerly through the Delta, entering Suisun Bay and, together with the Sacramento and San Joaquin rivers, flow through Carquinez Straits into San Francisco Bay, a salt water tidal basin, and ultimately through the Golden Gate into the Pacific Ocean.

3.1.1. Historic Background: Early Land and Water Utilization in the Central Valley

California's water supply and development challenges stretch back to the mid-nineteenth century gold rush decade when gold miners in the mountains and foothills of the Sierra Nevada began diverting water from streams to expose placer deposits in streambeds and to process gold using a variety of hydraulic methods. The gold rush caused many significant changes in riverine ecosystems of the Central Valley. Hydraulic mining destroyed miles of riparian vegetation and habitat. Debris formed sandbars in streams, impaired navigation, and elevated riverbeds leading to massive flooding and destruction of thousands of acres of agricultural land, while in the mountains and foothills the hydraulic giants left behind barren amphitheaters and miles of waste tailings. Nevertheless, mining remained the most important economic use of water in California for some three decades following the mass migration of gold miners from around the world to California starting in 1849.[3]

[3] Robert Kelley, *Gold vs. Grain: The Hydraulic Mining Controversy in California's Sacramento Valley* (Glendale, CA: Greenwood Press, 1979).

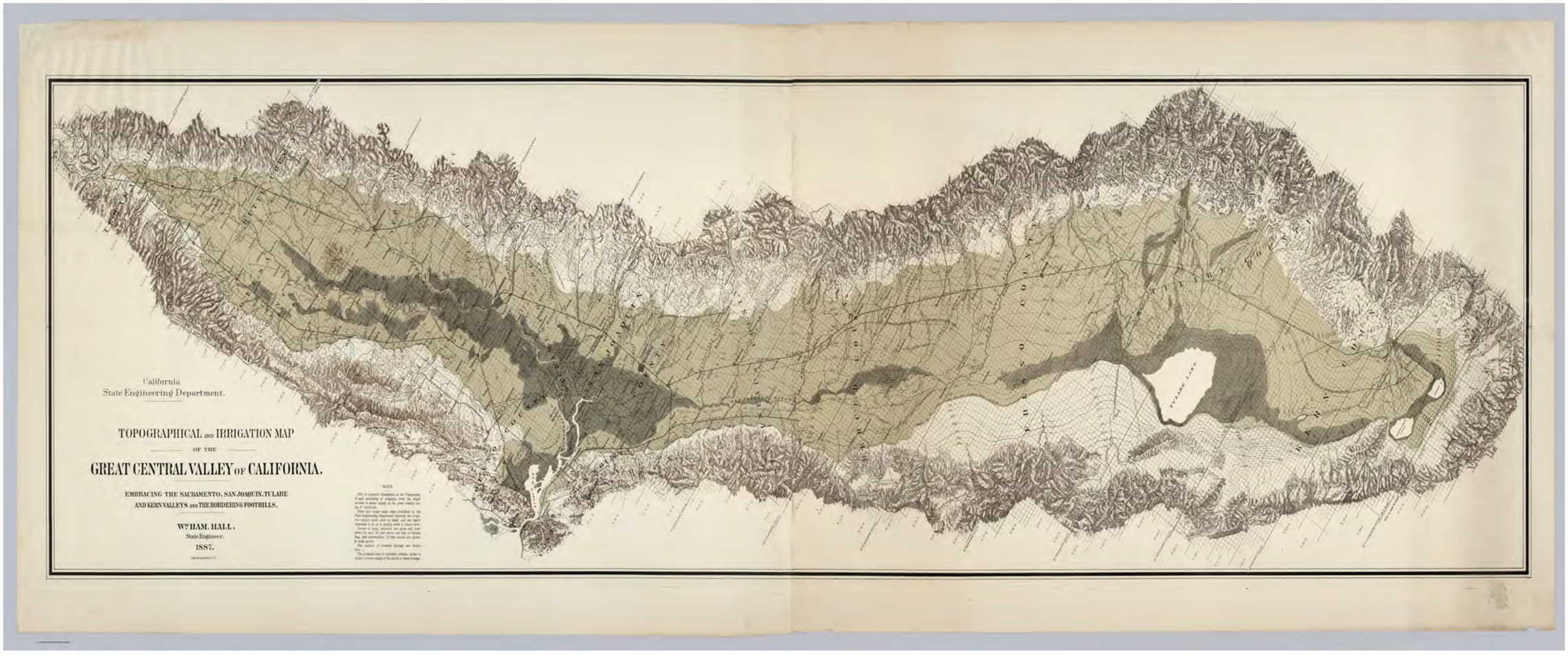


Figure 1: Great Central Valley of California, 1887.

Even during the height of the gold rush, some Californians already had begun to dream of converting the Central Valley into an agrarian wonderland. The Central Valley was a phenomenally rich and broad alluvial plain and was destined to become the state's most productive agricultural center. It was watered by streams flowing from the Sierra Nevada on the east and the coastal ranges on the west, but water was in short supply when needed the most during the rainless summer growing season. As a result, during the gold rush decade, open range grazing of sheep and cattle remained the principal land use on the natural pasture lands of the Great Central Valley.

In the middle to late 1860s, wheat culture emerged as an increasingly prominent land use and contributed to the decline, and later demise, of the open range cattle industry in the Central Valley in the ensuing decades. When planted in the fall and harvested in the spring, winter wheat and barley were two of only a handful of crops that could be successfully raised in the Central Valley without irrigation. All that was needed was access to a navigable stream or a railroad line to ship the grain to market and intermittent rainfall from November through April. In the San Joaquin Valley fifteen inches of rain produced bumper crops, although ten inches, if properly distributed, was enough to yield an acceptable harvest. The Great Valley offered rich, flat land that required little preparation, and grain farmers needed little farming experience because wheat or barley was easy to plant and virtually took care of itself. In many cases, grain farming did not even require a house, barn, or quarters. A remarkably diverse group of migrant workers, including down on their luck miners, performed the greatest portion of the required agricultural work. They were needed for only a span of three or four weeks during winter plowing and sowing and again in the summer for threshing and harvest. Most of these workers packed the necessities of life in a bindle and drifted between farms and agricultural districts. The wheat barons themselves mostly resided in the state's urban centers – Sacramento, Stockton, Oakland, and San Francisco – and left the comfort of their homes and families only to supervise the annual harvest or planting.[4]

Land speculators like E. H. Miller, George D. Roberts, William S. Chapman, Isaac Friedlander, Miller & Lux, and a host of others used generous federal and state land laws to monopolize land ownership in the Central Valley. For about three decades wheat was king in the valley, but its reign ended abruptly in the 1890s. Historians have identified numerous factors that explain the sharp decline of the California wheat industry, among them increasing competition in the international wheat market, soil exhaustion, new superior varieties of wheat, the increasing

[4] Richard Allen Eigenheer, "Early Perceptions of Agricultural Resources in the Central Valley of California" (PhD dissertation in Social Geography, University of California, Davis, 1976), 325-349; David Igler, *Industrial Cowboys: Miller & Lux and the Transformation of the Far West, 1850-1920* (Berkeley: University of California Press, 2001); Richard S. Street, *Beasts of the Field: A Narrative History of California Farmworkers, 1769-1913* (Stanford, California: Stanford University Press, 2004), 89-177.

value of farmland devoted to irrigation and horticulture, and growing opposition to "land monopoly."[5]

As wheat production declined, farmers turned increasingly to irrigated crops. Irrigation grew steadily in California from 60,000 acres in 1860 to nearly 400,000 acres in 1880, and by the early years of the twentieth century it had become the dominant feature of California's agriculture with more than 2,644,000 acres under irrigation.[6] The Central Valley developed a virtual monopoly on several irrigated crops: cotton in the arid southern portion of the San Joaquin Valley; rice in the clay soils of the trough lands of the Sacramento Valley; vineyards or orchards on the alluvial fans on the east side of the Great Valley where water was accessible; truck crops in the Delta peat soils; grapes in eastern Fresno County and nuts and olives in the Sacramento Valley; and orange groves occupied the sheltered coves on alluvial fans up and down the eastern edge of the Great Valley.[7]

The greatest problems with agriculture in the Central Valley were two-fold: the regional unevenness of water supply and the Mediterranean-type of climate characterized by prolonged dry summers that required irrigation of summer maturing crops. The San Joaquin Valley has a hot desert climate, accentuated near the southern end, where there is a mean annual precipitation of less than five inches. Northward, rainfall increases through a transitional zone to a Mediterranean climate in the Sacramento Valley with hot summers. Exposed to cooling summer west winds through Carquinez Straits, the Delta has a cooler Mediterranean climate. A decrease in rainfall from north to south is also a prevailing condition of climate in California and this differential is exaggerated in the Central Valley. A rain shadow is also associated with the Coast Ranges, resulting in the eastern margins of the valley receiving on average 50 percent more precipitation than the west side of the valley. The regional distribution of streamflow is even more unequal because of the high elevation and long slope of the Sierra Nevada on the east side of the valley compared to the short slope of the lower Coast Ranges on the west side. These factors make it imperative that any valley-wide plan for irrigation development needed to store surplus winter water and make it available in the summer months, and that surplus northern and eastern water needed to be made

[5] Eigenheer, "Early Perceptions of Agricultural Resources in the Central Valley of California," 325-349; Igler, *Industrial Cowboys*, 60-91; William L. Preston, *Vanishing Landscapes: Land and Life in the Tulare Lake Basin* (Berkeley: University of California Press, 1981), 85-120.

[6] Harding, *Water in California*, 80; Donald J. Pisani, *From the Family Farm to Agribusiness: The Irrigation Crusade in California and the West, 1850-1931* (Berkeley: University of California Press, 1984), 54-77.

[7] Joseph A. McGowan, *History of the Sacramento Valley*, 3 vols. (New York: Lewis Publishing Company,1961); J. J. Haley, "California's Change to Irrigation from Dry Farming," *Western Construction News*, 3 (February 1928): 83-84; William Reich, "King Cotton in California," *Land* 9 (Spring 1950): 65-71; William S. Richards, "Geographical Aspects of Rice Cultivation in California" (M.A. thesis, University of California, Berkeley, 1969).

available for use in the southern and western portions of the valley, if irrigation of irrigable land was to be maximized in the Central Valley.[8]

Irrigation developed initially in the Central Valley under private initiative and financing, using the natural flow of local streams. These early projects were concerned with relatively small tracts of land and not with the valley, or even an entire watershed, as a unit. In general, irrigation grew earlier and was more extensive in the southern portion of the San Joaquin Valley where growing crops without the benefits of irrigation was more tenuous. Settlers along the south bank of the Merced River began to irrigate alfalfa land, vineyards, and orchards in the vicinity of Snelling in the early 1850s. Ditches on Mill Creek and the Kaweah River irrigated grain fields and gardens as early as 1853. Settlers along the Tule River constructed several small ditches between 1859 and 1865. Once the Southern Pacific Railroad laid its tracks down the east side of the San Joaquin Valley in the early 1870s more extensive irrigation development ensued and company officials became avid promoters of irrigation as an essential component of economic development and land subdivision. The first large regional diversion project to be constructed was the San Joaquin and Kings River Canal (1871) that ran northwest from the bend of the San Joaquin River where it turns northward. The plan included subsequent construction phases that would extend the canal to Suisun Bay and utilize Tulare Lake as a reservoir connecting to the canal by way of Fresno Slough. Just a few years later Charles Crocker, one of the founders of the Central Pacific Railroad that built the western portion of the transcontinental railroad, invested his private capital in the Crocker-Huffman Land & Water Company's irrigation and land subdivision project utilizing water from the Merced River to irrigate more than 20,000 acres in the vicinity of the town of Merced. In 1880 when State Engineer William Hammond Hall conducted the first statewide irrigation survey in California, it showed that the San Joaquin Valley with 188,000 acres was the most heavily irrigated region of the state with forty-seven percent of the irrigated acreage statewide. In contrast, the wetter Sacramento Valley remained mostly dry farmed with only 13,400 acres irrigated.[9]

Irrigation in the San Joaquin Valley proceeded under many forms of organization using surface water supplies flowing in creeks and rivers, artesian waters, and groundwater. While irrigation was achieved on a small scale within land colonies organized by land speculators, large areas of land were also amassed within former Mexican-era land grants, as swamp and overflowed land, railroad grant land, by use of land script, and a host of other methods under the public land laws. In the 1870s and 1880s, private irrigation companies developed the San Joaquin and

[8] Peveril Meigs, "Water Planning in the Great Central Valley, California," *Geographical Review* 29, no. 2 (April 1939): 252-273.
[9] William Hammond Hall, *The Irrigation Question in California: Appendix to the Report of the State Engineer to His Excellency George C. Perkins, Governor of California* (Sacramento: California State Printing Office, 1881).

Kings River Canal along San Joaquin River, along with canals diverting water from the Kern, Kings, and Merced rivers. The companies that succeeded in delivering water to farmers frequently did so at the price of creating unpopular land and water monopolies. Some farmers, with the encouragement of private canal companies, experimented with creation of "mutual water companies," owned by the farmers themselves who raised money and acquired rights to use water through the purchase of company "stock."[10]

Private irrigation companies enjoyed only limited success during the latter decades of the nineteenth century and the largest projects undertaken inevitably failed. These institutional efforts at planning and financing irrigation projects fell into four general categories: private water companies; land colonies, mutual water companies, and irrigation districts.[11] The economic turmoil of the era and high rate of failure of these irrigation efforts helped popularize other institutional alternatives, including a proposal for a unique unified, coordinated, and centralized canal network designed to be built and operated by the state. Efforts by private investors to build mammoth irrigation schemes such as the San Joaquin and Kings River Canal aroused the interest of Congress and in 1873 an act was passed directing the War Department to appoint an investigating committee to examine irrigation. "The Alexander Commission," led by Lieutenant Barton Stone Alexander, an U.S. Army Engineer, was organized in 1873 to conduct the first federally funded irrigation survey and plan for coordinated irrigation development of the Central Valley. This federal irrigation commission carried out what State Engineer Edward Hyatt, "father of the State Water Project," later called "one of the earliest attempts at water resources planning on a regional scale." As detailed surveys were lacking, the report was a mere sketch of a development plan. However, the first state water agency, the State Engineers Office under William Hammond Hall, labored from 1878 to 1888 to implement many of the basic recommendations suggested by the Alexander Commission.[12]

The Alexander Commission's federal irrigation survey was grossly underfunded and was conducted over a scant six weeks in the field, but the report contained much valuable information and captured the imagination of future generations of water resources planners in California. The Commission predicted that 8.5 million acres could be irrigated in the Central

[10] Harding, *Water in California*, 79-83; JRP Historical Consulting Services and California Department of Transportation, *Water Conveyance Systems in California: Historic Context Development and Evaluation Procedures* (Sacramento: California Department of Transportation Environmental Program, Cultural Studies Office, December 2000), 8-15.

[11] Of these institutional models, the quasi-public irrigation district proved the most successful in development of large-scale irrigated tracts in California, but only a few of the irrigation districts organized under the original Wright Act of 1887 survived into the twentieth century. Changes in irrigation district law in 1911, gave these districts greater financial stability and irrigation districts had much greater success in the twentieth century.

[12] Edward Hyatt, "National Broadcast on California Agricultural Programs, Under the Auspices of the State Grange, NBC Studios, San Francisco, November 10, 1939," Edward Hyatt Papers 2, Water Resources Collection and Archives, University of California, Riverside.

Valley and 12 million if the low foothills surrounding the valley were included. The Commission proposed a complex network of canals. On the west side of the Central Valley, a north-south canal was suggested leaving the Sacramento River near Red Bluff, following the foot of the Coast Range to Fairfield with several west-east laterals irrigating land as it passed through Yolo County. From Antioch, the canal was to run south along the west side of the San Joaquin Valley connecting to Tulare, Buena Vista, and Kern lakes, three natural bodies of water fed by creeks, sloughs and rivers in Tulare and Kern counties. Because of the many streams flowing out of the Sierra Nevada, the commission did not favor a continuous canal down the east side of the Central Valley as the cost of siphons or aqueducts to bridge these streams was prohibitive. The report also paid little attention to construction of storage reservoirs, but did advocate damming many westerly flowing Sierra streams to raise water over the river bank into east-west distribution ditches running across the valley floor.

Because of the state's limited population and tax base, the Alexander Commission predicted that progress toward full construction of the massive water project would undoubtedly proceed at a slow pace and that it might take as long as 50 years to achieve full implementation. In other respects, the report was also prescient. The commissioners predicted that water conflicts would occur and require settlement before construction of any comprehensive water system and that the state needed to institute legal mechanisms to regulate the acquisition and distribution of water; that farmers be limited to "reasonable use" to reduce water waste; that drainage canals accompany construction of irrigation canals; and that a topographic and hydrologic survey precede adoption of a system of reclamation for the Central Valley. Finally, the Commission was prophetic in recognizing the fundamental principal behind the future State Water Project proposed in the late 1920s and the CVP launched by the federal government in the 1930s -- the need to transfer water from the water rich Sacramento Valley to the water deficient San Joaquin Valley.[13]

At the state level, the California legislature passed an act in 1878 providing for investigation regarding irrigation and appointment of a State Engineer. William Hammond Hall, another former officer in the U.S. Army Engineering Corps with experience as a hydrographer, draftsman and field engineer, was appointed California's first State Engineer. Over the next decade, Hall proposed an increasingly activist stance by the state in navigation improvement projects, flood control, water storage, irrigation and drainage, compilation of statewide data

[13] B. S. Alexander, C. H. Mendell, and George Davidson, *Report of the Board of Commissioners on the Irrigation of the San Joaquin, Tulare, and Sacramento Valleys of the State of California*, House Executive Document No. 290, 43rd Cong. 1st Sess. (serial no. 1615) (Washington, D.C.: Government Printing Office, 1874), 16-38; Pisani, *From the Family Farm to Agribusiness*, 102-128; W. Turrentine Jackson, Rand F. Herbert, and Stephen R. Wee, "Introduction," *Engineers and irrigation: Report of the Board of Commissioners on the Irrigation of the San Joaquin, Tulare, and Sacramento Valleys of the State of California, 1873: Engineer Historical Studies No. 5* (Fort Belvoir, Virginia: Office of History, U.S. Army Corps of Engineers, 1990), 1-36.

on rainfall and streamflow, public ownership and control of navigable waterways, and proposed regional and statewide water planning for development of water resources. In 1880, Hall published a report on the subject of irrigation that described the principal irrigation districts of the state and made recommendations on legislation to promote irrigation development in California, including recommendations for an "irrigation district bill." Hall also prepared the first detailed map of the Central Valley (like the later one shown in **Figure 1**) depicting every stream correctly located, the topography of adjacent foothills, and the slope and fall of the plains where irrigation would occur. He also prepared a more detailed map of the San Joaquin Valley in ten sheets displaying every ditch and irrigation canal in the San Joaquin Valley and the extent of actual irrigation.[14]

Hall was reappointed four times as State Engineer serving until his resignation in 1889 when he was appointed Supervising Engineer of the United States Irrigation Investigation (predecessor of Reclamation), within the U.S. Geological Survey. The U.S. Geological Survey carried on the vital work of stream gauging and topographic mapping in the Central Valley. Following Hall's departure, Robert B. Marshall, an experienced California geographer, became the chief champion of a statewide water program during the late nineteenth and early twentieth centuries. Marshall outlined a plan for the coordinated development of the Central Valley with a series of dams, canals, and aqueducts to bring water to twelve million acres of land. Marshall was determined to submit a plan that demonstrated its feasibility from an engineering perspective and spent twenty-five years perfecting his comprehensive state water development plan, gathering survey data and mapping proposed canals and reservoir locations.

Marshall arrived in California in 1891 and surveyed continuously in the state for the U.S. Geological Survey until 1903 when he was given administrative charge of topographic work in California. His duties spread to other arid western states working on proposed reclamation projects in Arizona, Oregon, Nevada, Washington, Idaho, and Utah. By 1908, at age 40, he had reached the pinnacle of his profession being appointed Chief Geographer in charge of the Topographic Branch of the U.S. Geological Survey with administrative charge of the entire United States. For years he directed the expenditures of the United States government in its geological surveys of California methodically putting together a plan of construction for his proposed system of canals and reservoir sites. Working co-operatively with the State of California, the U.S. Geological Survey, under Marshall's guidance, precisely mapped the Sacramento and San Joaquin valleys, co-operatively gauged streams, made profiles, and

[14] William Hammond Hall, "Statement of William H. Hall of the U.S. Geological Survey, Supervising Engineer for the Pacific Coast, U.S. Irrigation Survey," Report of the Special Committee of the U.S. Senate on the Irrigation and Reclamation of Arid Lands: Report of Committee and Views of the Minority, 51st Cong., 1st Sess., Senate Report No. 928 (Washington, D.C.: Government Printing Office, 1890), 208-220.

surveyed reservoir sites along the larger principal streams of the state, gathering all the field data necessary to begin the construction work. In the fall of 1919, he announced the main outlines of his one great comprehensive plan for statewide water development, including reclamation of the Central Valley of California:

> From a high dam to be built across the Sacramento River near Red Bluff water will be carried in large canals down each side of the Sacramento Valley and thence up each side of the San Joaquin Valley. These main canals will operate by gravity, siphons, or pumps, or through tunnels. . . . On the main West Side Canal . . . a large supply will be diverted for the use of the "San Francisco and Bay Cities Unit.". . . The main East Side Canal will be twice dropped and twice again started at new and higher levels on the east side of the San Joaquin Valley. . . . Separate in construction and operation from the two Valley of California Systems as above referred to, but necessarily co-operative in a State-wide sense, is a third system . . . "the Los Angeles unit." This system must always be dependent upon the Kern River, which will be diverted through a long tunnel for use in southern California. To offset the diversion of the Kern River waters from the San Joaquin Valley the Klamath River will be diverted below Klamath Falls and carried into the upper Sacramento River near Shasta Springs. Above all these grand canals the tributary streams will be drawn upon through reservoirs, to be built along their courses, and further flexibility of the total flow will be provided by additional storage below the canals.[15]

California and planning for irrigation therein changed greatly during the first decades of the twentieth century. Growing migration into the state brought increased tax revenue and an expanded political bureaucracy. Having suffered the effects of a succession of drought years from 1917-1920, California state government exhibited an interest in comprehensive water planning. In 1921, the governor directed the State Engineer to come up with a statewide water management proposal addressing conservation, flood control, storage, distribution, and uses for California water and an estimated cost for implementation of the plan. The legislature appropriated funds to investigate a statewide water resources development and management plan. While the initial report was completed in 1923, it was the more than a dozen detailed engineering reports on various aspects of water management and control made by State Engineer Edward Hyatt between 1920 and 1932 that formed the basis of what became known as "The State Water Plan." During this period, shifts in water use included increasing numbers of water storage and power projects in the Sacramento Valley and the northern portion of the San Joaquin Valley, while further south complex water rights issues and lack of surplus water available for storage led irrigators to substitute groundwater storage for on-stream surface storage in reservoirs.[16]

[15] Col. Robert Bradford Marshall, *Irrigation of Twelve Million Acres in the Valley of California* (Sacramento: California State Irrigation Association, 1919), 6-12.

[16] Paul Bailey, *Supplemental Report on Water Resources in California, Bulletin No. 9*, California Department of Public Works, Division of Engineering and Irrigation (Sacramento: California State Printing Office, 1925); Paul

The expansion of irrigated acreage in the early twentieth century was achieved by using surface water supplies and groundwater. By the mid-1920s water shortages had initiated several privately funded storage projects paid for by the irrigators themselves on irrigation projects in the San Joaquin Valley, such as in the Modesto, Turlock and Merced irrigation districts. As a by-product of storage, these districts were able to generate hydroelectric power to pay for construction costs and expansion of their distribution systems. Storage and power development in the 1920s, however, did not extend to the southern portion of the valley. From the San Joaquin River south, the water rights situation was more complicated as streams had been developed early by multiple diverters complicating adjustment of water rights and financing of storage facilities. Furthermore, there was less unused surplus surface water and more of the Sierra Nevada's runoff reached the irrigated lands on the valley floor as groundwater. Realization that productivity of agriculture could be greatly increased by utilization of groundwater, the US Geological Survey and Reclamation issued a preliminary report in 1908 on the quality, occurrence, accessibility, character, and proper use of groundwater in the San Joaquin River basin.[17]

In the early twentieth century, underground water sources were used for an increasing amount of irrigation in California. From 1909 to 1919, land irrigated by these sources increased from 32,539 acres to 299,841 acres in the state. Many of the farms in what later became the Friant Division of the CVP were irrigated using a combination of groundwater and the limited supplies from local rivers and creeks. From 1919 to 1929 groundwater use in the southeastern San Joaquin Valley nearly tripled, increasingly relying on the capacity of pumped wells. With the exception of the Kern River and its alluvial fan, from the Kaweah River south and in the area from Mendota to Kettleman City, available local surface water supplies were negligible. Water for irrigation was primarily achieved through drilling thousands of large and deep irrigation wells. By 1930 overdraft on groundwater supplies and major land subsidence had become widespread along the eastside of the valley. A bit later subsidence became an issue on the westside of the San Joaquin Valley as much of its agricultural land came to rely on groundwater or conjunctive use of surface water and groundwater to meet irrigation needs.[18]

Bailey, *Summary Report on the Water Resources in California and a Coordinated Plan for their Development, Bulletin No. 12*, California Department of Public Works, Division of Engineering and Irrigation (Sacramento: California State Printing Office, 1927).

[17] W. C. Mendenhall, *Preliminary Report on the Groundwater of the San Joaquin Valley, California: U.S. Geological Survey Water Supply Paper No. 222* (Washington, D.C.: Government Printing Office, 1908); W. C. Mendenhall, *Report on the Groundwater in the San Joaquin Valley, California: U.S. Geological Survey Water Supply Paper No. 398* (Washington, D.C.: Government Printing Office, 1916).

[18] Poland, J. F., and Evenson, R. E., "Hydrology and Land Subsidence, Great Central Valley, California," in Bailey, E. H., ed., *Geology of Northern California,* Vol. 2. (Sacramento: California Division of Mines and Geology, Bulletin 190, 1966), 239-247; Mitten, H. T., *Groundwater Pumpage in San Joaquin Valley, California* (U.S. Geological Survey, Open-file Report, 1967-68); N.P. Prokopovich and D.J. Hebert, "Land Subsidence Along the Delta-Mendota

The nearly complete use of natural streamflow and overdraft of groundwater in areas not replenished from streamflow, focused local interests on more comprehensive plans for importing additional water supplies. Water shortages in the San Joaquin and Sacramento valleys had caused the State of California to initiate planning for major reservoir projects on the Kings, Tuolumne, San Joaquin, Kern, Merced, and Sacramento rivers between 1917 and 1924.[19] Legislative investigations of the State Water Plan that had begun in 1921 aimed to obtain a comprehensive inventory of water resources and an estimation of probable future water requirements in the Central Valley. As noted, this plan was first completed in 1923, and after further financial studies, the plans were revised in 1925, 1927 and 1929. These investigations led the state to consider plans for a coordinated water management and development program that resulted in the adoption of the CVP in the 1930s.[20]

The story of the development, planning, political background, and construction of the CVP is well known and often told. The CVP is widely recognized as one of the greatest pieces of water planning, engineering, and conservation development ever undertaken and represents one of the most ambitious and successful water development projects ever built. It significantly altered California's natural hydrologic system in order to enhance water supplies for irrigated agriculture, municipalities, and hydroelectric power. Within the contexts of hydraulic engineering, the politics of public works, state-federal conflict over reclamation policy, and the

Canal, California," *Journal American Waterworks Association*, 60, n. 8 (Aug. 1968): 915-920. Water levels in wells within the future service area of the Friant Kern Canal declined from 1921 to 1951 but showed signs of substantial recovery over the next two decades as a reduction of pumping within the canal's service area through imported supplies delivered by the canal caused a reduction in groundwater pumping and increased recharge of the aquifer. A number of U.S.G.S. Professional Papers have been published on the land subsidence issue in the San Joaquin Valley. Two examples of investigations valley-wide in scope that address the early beneficial impacts of the Friant Kern Canal are: J. F. Poland, G. H. Davis, and B. E. Lofgren, "Progress Report on Land Subsidence Investigations in the San Joaquin Valley, California, through 1957," (U.S. Geological Survey, 1958) and J. F. Poland, B. E. Lofgren, R. L. Ireland, and R. G. Pugh, *Land Subsidence in the San Joaquin Valley, California, As of 1972. USGS Survey Professional Paper 137-11* (Washington, D.C., United States Printing Office, 1975). Other studies are narrower in scope focusing on specific regions within the valley such as B. E. Lofgren and R. L. Klausing, *Land Subsidence Due to Groundwater Withdrawal, Tulare-Wasco Area, California. USGS Survey Professional Paper 437-B* (Washington, D.C., United States Printing Office, 1969). This study notes that within the southeastern portion of the study area subsidence nearly stopped in the late 1950s, as water levels recovered some 130 feed in response to reduced pumping and groundwater recharge from imported water delivered by the Friant Kern Canal.

[19] William L. Kahrl, *The California Water Atlas* (Sacramento: California Office of Planning and Research, Department of Water Resources, 1979).

[20] California Department of Public Works, Division of Engineering and Irrigation, *Water Resources of California: A Report to the Legislature of 1923, Bulletin No. 4* (Sacramento: California State Printing Office, 1923); Bailey, *Supplemental Report on Water Resources of California: A Report to the Legislature of 1925, Bulletin No. 9*; Paul Bailey, State Engineer, *Summary Report on the Water Resources of California and a Coordinated Plan for their Development: A Report to the Legislature of 1927, Bulletin No. 12*, California Department of Public Works, Division of Engineering and Irrigation (Sacramento: California State Printing Office, 1927); Edward Hyatt, State Engineer, *Report to the Legislature of 1931 on State Water Plan, Bulletin No. 25,* California Department of Public Works (Sacramento: California State Printing Office, 1930).

economics of large-scale irrigation, the CVP is recognized as a great achievement on the national and even the international scale, although every component of the CVP is located within the boundaries of California.

The concept of a CVP was originally devised by the State of California to resolve chronic intra-state water shortage problems, but ultimately it was built by the federal government. The "State Water Plan" that resulted from the studies undertaken by State Engineers Edward Hyatt and Paul Bailey between 1927 and 1930 called for a vast system of canals, massive dams, and reservoirs throughout the state, and a massive north to south water transfer plan including most of what became the CVP. The essential units of the Central Valley portion of the plan included Shasta dam and reservoir (originally called Kennett Dam) on the Sacramento River, one of the highest overflow dams in the world with a storage capacity of 4.5 million acre feet; a 50-mile long industrial and irrigation conduit in the Delta diverting water to supply areas in Contra Costa County; a cross canal in the Sacramento-San Joaquin Delta; pumping plants and canals in the San Joaquin River and valley; Friant Reservoir on the San Joaquin River in the foothills north of Fresno and canals running north from the reservoir to supply lands in Madera County and south to irrigate lands between the reservoir and Kern River. To implement the plan the state needed to purchase the so-called "grass land" water rights of riparian owners on the lower San Joaquin River between Friant and the mouth of Merced River. With these water rights of early priority and large quantity satisfied, practically the whole flow of the San Joaquin River at Friant would become available for diversion to other water deficient areas of the valley. Thus, the implementation of the initial Central Valley unit of the State Water Plan entailed these fundamental requirements: regulation of stream flow by means of storage, exportation of water between watersheds, and exchanges of existing water supplies for imported water. Subsequent units of the ultimate State Water Plan would be adopted over time as demand for additional water warranted.[21]

In 1933, California voters approved the "Central Valley Project" portion of the State Water Plan, but the state needed the federal government to bring this project to life. With the depressed financial circumstances of the period, the state was unable to borrow money at a low enough interest rate to market the bonds necessary to fund the plan. California officials responded by lobbying the federal government to undertake the project as a federal reclamation project. Up until this point, federal reclamation had little impact on California

[21] Pisani, *From Family Farm to Agribusiness*, 381-439; Norris Hundley, Jr., *The Great Thirst: Californians and Water, 1770s-1990s* (Berkeley: University of California Press, 1992), 232-248; Hyatt, *Report to the Legislature of 1931 on State Water Plan, Bulletin No. 25*, 177-180; Edward Hyatt, State Engineer, *Sacramento River Basin, 1931, Bulletin No. 26*, California Department of Public Works, Division of Water Resources, Sacramento (Sacramento: California State Printing Office, 1931); Edward Hyatt, State Engineer, *San Joaquin Basin, 1931*, *Bulletin No. 29*, California Department of Public Works, Division of Water Resources (Sacramento: California State Printing Office, 1931).

agriculture or state water policies. Now after nearly three decades, Reclamation finally got the chance to build the largest integrated water and power project ever undertaken in California. This occurred just as the doctrine of multiple use emerged, wherein federal agencies were mandated to serve various interests simultaneously, which freed Reclamation to build and operate the project for a wide variety of water interests both urban and rural. By 1935, the state and federal governments reached an agreement and Reclamation was charged with construction of the CVP.[22]

3.1.2. Reclamation Initiates Construction of the Central Valley Project

President Franklin D. Roosevelt, amenable to almost any job creation proposal that would diminish the severity of the Great Depression, was responsive to California's appeal for assistance in funding the proposed CVP. In 1935 President Roosevelt approved the Secretary of the Interior's feasibility report and released federal emergency relief funds in order to initiate survey and investigations of proposed project works.[23] What had begun as a state project now became a federal undertaking under the auspices of the Secretary of the Interior and Reclamation. During 1936 Reclamation established its administrative headquarters at Sacramento and three field division offices at Redding (Kennett Division) covering works on the upper Sacramento River; at Antioch (Contra Costa / Delta Division) covering surveys for the Contra Costa Canal; and Friant (Friant Division), located 20 miles northeast of Fresno, covering the Friant dam/reservoir site and surveys for the Madera and Friant-Kern canals. A year later, Congress gave Reclamation final authority to take over control of the construction of the massive public works project. Construction of the federal project proceeded on a piecemeal basis.[24]

Reclamation designed the CVP with five fundamental units, operating as an integrated system: Shasta Dam, Delta-Mendota Canal, Friant Dam, the Madera and Friant-Kern Canals, and the Contra Costa Canal. The smallest of the canals, the Contra Costa Canal in eastern Contra Costa County, provided irrigation and industrial water for the area south of Suisun Bay between

[22] Erwin Cooper, *Aqueduct Empire: A Guide to Water in California, Its Turbulent History, and Its Management Today* (Glendale, California: A. H. Clark Co., 1968); Hundley, *The Great Thirst, 243-252*.

[23] The proposed construction project by the federal government stirred up controversies over the Reclamation's 160-acre limitation imposed under the 1902 Federal Reclamation Act, ownership of water rights, public vs. private hydroelectric power generation, as well as state vs. federal ownership and operation of the project. Given the early history of the Central Valley as an area dominated by large cattle ranches and bonanza wheat farms, the 160-acre limitation was deemed as particularly egregious where, as one landowner's attorney noted, "10 per cent of the ranches contain 80 per cent of the land," "Big Water 'Transfusion' Operation Taking Shape: World's Longest Canal to Carry Much Needed Moisture Through Central Valley," *Los Angeles Times," March 16, 1947;* and Bassett*,* "Water Limit Fight Stirs San Joaquin: Controversy Over How Much Land One Owner May Irrigate Features Valley Project Work," *Los Angeles Times*, March 17, 1947.

[24] Pisani, *From Family Farm to Agribusiness*, 416-438; Hundley, *The Great Thirst*, 252-262; "Active Construction Nears on Central Valley Project," *Western Construction News*, January 1937, 22.

Antioch and Martinez. In 1937, the canal was the first facility to be undertaken and the 48-mile canal was completed by Reclamation in 1939. The core of the system, however, involved the coordinated operation of the other four units for the purposes of delivering Sacramento River water to the arid San Joaquin Valley and to impound the flow of the upper San Joaquin River for distribution on the east side of the San Joaquin Valley.[25]

Reclamation designed the project's main four units to operate in two groups of works. Shasta Dam and Delta-Mendota Canal operated together to store and deliver Sacramento River water on the westside of the San Joaquin Valley as far south as Fresno County, to irrigate new areas and to supply water for San Joaquin River diverters with riparian and senior appropriative water rights. Friant Dam, located on the San Joaquin River 25 miles northeast of Fresno, conserved and stored flood flows in Millerton Lake for release and diversion into the Madera and Friant-Kern canals. These three water-storage and conveyance features operated together to store and divert San Joaquin River water as far as the southern extremes of the San Joaquin Valley near Bakersfield (through the Friant-Kern Canal) and north to Ash Slough near Chowchilla (through the Madera Canal). As noted, these units worked in conjunction with one another, the Shasta Dam/Delta-Mendota Canal system providing "replacement water" to west side "Exchange Contractors" (senior holders of water rights from the San Joaquin and Kings River Canal and Irrigation Company and Miller & Lux's corporate descendants) for that which was transported southward and northward on the east side of the San Joaquin Valley by the Friant Dam/Friant-Kern Canal/Madera Canal system. Reclamation completed these five major units of the CVP by the early 1950s.[26]

Groundwater issues quickly became part of the Delta Division's management. As noted, much of the agricultural land in western San Joaquin Valley had relied upon groundwater or conjunctive use of surface water and groundwater to meet their irrigation needs before the CVP was built. According to one U.S. Geological Survey study in the mid-1950s, about 4,500,000 acres of land in the San Joaquin Valley was irrigated, with 50% of that land supplied solely with groundwater from wells and land subsidence had been noted.[27] Thus, almost immediately after water was turned in the newly completed Delta-Mendota Canal, land

[25] U.S. Department of the Interior (USDI), Reclamation, Central Valley Projects: Issues and Legislation, October 15-2018 – June 21, 2019, https://www.everycrsreport.com/reports/R45342.html#_Toc12259578.
[26] L. B. Christiansen and R. W. Gaines, *Central Valley Project: Its Historical Background and Economic Impacts* (Sacramento, California: USDI, Reclamation, Mid-Pacific Region, 1981).
[27] G.H. Davis, J. H. Green, F.H. Olmstead, and D. W. Brown, *Groundwater Conditions and Storage Capacity in the San Joaquin Valley California.* Geological Survey Water Supply Paper 1469 (Washington, Government Water Supply Paper No. 1469, 1959), III, 4, 8-10, 114-124, 129-131.

subsidence began to impact the structure, especially the downstream 40 miles, causing the need for repairs and extensive modifications to raise the height of canal structures.[28]

3.1.3. Delta-Mendota Canal

Reclamation designed Delta-Mendota Canal to carry out one of the key features of the CVP, exchanging water from the Sacramento River basin to the San Joaquin River basin. Delta-Mendota Canal was built to convey water from the Sacramento-San Joaquin Delta in a southerly direction along the west side of the San Joaquin Valley, replacing flows in the San Joaquin River to permit diversion of San Joaquin River water at Friant Dam for delivery in Madera Canal and Friant-Kern Canal (**Figure 2**). It was designed to serve a total of approximately one million acres of irrigable land on the west side of the San Joaquin Valley in San Joaquin, San Benito, Stanislaus, Merced, and Fresno counties. Reclamation designed DMC to deliver water to Mendota Pool and the planned San Luis Reservoir, as well as to water users along its route. At the upstream end, the canal was designed with a maximum capacity of 4,600 cubic feet per second, diminishing as it traverses the valley to its southern terminus. Original plans called for a series of lifts to advance the water south up the valley; however, Reclamation modified the design to a single pumping plant that lifted the water approximately 200 feet before discharging it into DMC. The north portion of the canal is lined with concrete and the sound is compacted earth. DMC was built with repetitive structure types like concrete checks, concrete siphons, culverts and overchutes, drainage inlets, irrigation turnouts, canal crossings, wasteway turnouts, highway and farm bridges, and much smaller number of discrete, specialized structures. For most of the major structures like wasteways and siphons, Reclamation engineers prepared site-specific designs and drawings. For structures installed repetitively along the canal like culverts, inlet drains, and farm bridges, Reclamation prepared standardized drawings for multiple applications. Through the DMC, availability of a more reliable water supply to parts of the San Joaquin Valley contributed significantly to the success of agriculture and industry in the region.[29]

[28] N.P. Prokopovich and D.J. Hebert, "Land Subsidence Along the Delta-Mendota Canal, California," *Journal American Waterworks Association*, 60, n. 8 (Aug. 1968): 915-920.
[29] USDI, Bureau of Reclamation, *Delta-Mendota Canal,* Technical Record of Design and Construction (Denver: 1959), 1 and 13.

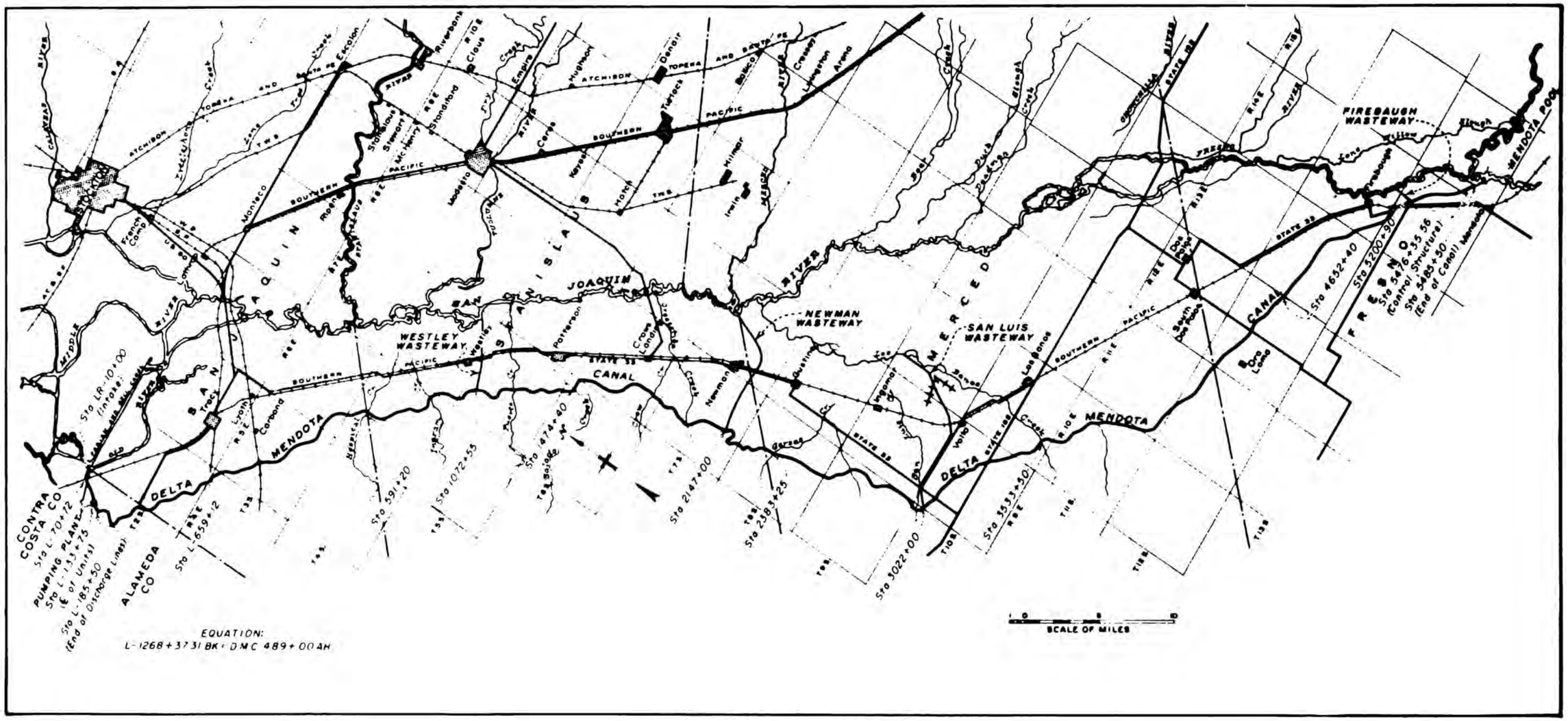


Figure 2: Location of Delta-Mendota Canal. Drawing 214-D-11164.

When completed, Delta-Mendota Canal was instrumental in accomplishing the goals of the CVP and it was second largest capacity canal in the state after the All-American Canal, which was an 80-mile-long aqueduct built in the 1930s conveying Colorado River water to Imperial Valley and several Southern California cities. Engineering and constructing Delta-Mendota Canal was a monumental task because of the natural and built features it had to traverse over a long distance: the alignment crossed multiple waterways, major roadways, and transmission lines; existing irrigation structures had to be tied in or crossed; and road and farm bridges, and major canal water control features like check structures and wasteways had to be built. In addition to the engineering challenges, Reclamation also had to negotiate the sale of project water delivered by Delta-Mendota Canal with various water users and address a complex right-of-way acquisition. Water first entered the canal for delivery to downstream users in 1951 but was not officially complete until April 9, 1952.[30]

One of the most renowned engineers employed by the Bureau of Reclamation, Oscar Boden spent sixteen years out of his forty-year-long tenure with the Bureau working in the Central Valley. Boden undertook the role of construction engineer for the Delta Division of the Central Valley Project (CVP) from 1935 until his death in June 1951. Born in 1885 in Kellogg, Iowa, Boden studied civil engineering at Iowa State University, graduating in 1910. Boden started at the Bureau of Reclamation in 1911 performing operation and maintenance work for the first five years of his career. From there, he moved on to survey work, lateral design, and lay-out of several irrigation projects in Wyoming and Nebraska. He also worked on projects in Idaho, Oregon, and Washington where he served as head of construction of various irrigation distribution systems. Dubbed "Mr. Canal" for his work supervising the construction of 76 miles of main canal and 200 miles of laterals for the Kittitas Project near Yakima, Washington in 1926, Boden's prowess as a team leader eventually led him to the Central Valley. At the request of the supervising engineer for the CVP, Boden relocated to California in 1935, serving as the project's first government construction engineer. Boden engineered surveys for the Friant-Kern and Contra Costa canals and led the construction of the Contra Costa Conduit. Boden's acclaim increased during his role as engineering administrator who oversaw the construction of Delta-Mendota Canal structures and the Tracy pumping plant. Additionally, Boden took charge of the investigations, planning, and lay-out necessary for Delta-Mendota Canal's features. Posthumously, Boden received nomination into the Reclamation's Hall of Fame. In total, Boden is credited with the construction of 1500 miles of canal.[31]

[30] "First Contract on Friant-Kern Canal," *Western Construction News* (Sept 1945): 112-113; US Department of the Interior, Bureau of Reclamation, *Delta-Mendota Canal,* Technical Record of Design and Construction (Denver: 1959), 5.

31 D. L. Goodman, "Oscar G. Boden – Builder of Lifelines," *Reclamation Er*a vol. 38 (February 1952), 30-31, 38; "'Mr. Canal' Builds Miles of Them in His Life Project," *Stockton Record* (California), May 15, 1951; "Pittsburg Ends

Delta-Mendota Canal's concrete lining extends down to Milepost 98.64. This portion of the canal has a 48-foot bottom width. The approximately 18 miles of canal between that point and the outfall at Mendota Pool are compacted earth-lined with bottom widths of 60, 62, and 84 feet at different reaches. After Tracy Pumping Plant lifts the water 200 feet, the water is moved down the canal at a gentle grade of 3 inches per mile, controlled by concrete check structures (**Figure 3**).[32] Specifications called for the concrete to be 4 inches thick and placed on the canal's 1 ½:1 side slopes. Check structures, placed an approximately 5-mile intervals along the canal, are composed of two standardized types. Three of the check structures are rectangular and the rest are trapezoidal in cross section.[33]

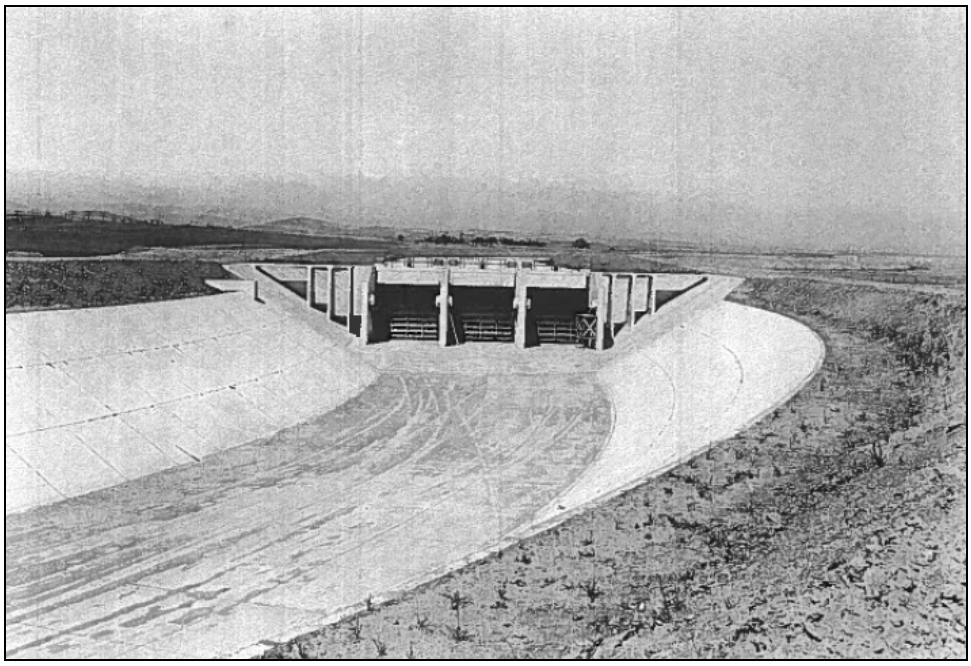


Figure 3: Complete check No. 1 (M.P. 11.35), camera facing upstream, April 18, 1949.[34]

Along its course, Delta-Mendota Canal is siphoned across streams, railroads, and irrigation canals. Siphons convey the water across seven streams, three railroad crossings, two highway crossings, one combined highway and railroad crossing, and one irrigation canal. The single siphon under an existing irrigation canal (Miller & Lux Outside Canal) was unique because all other existing irrigation ditches were siphoned under Delta-Mendota Canal. The Mountain

3 Dates of Fete," *Stockton Record* (California), October 15, 1940; "Boden Ranked High Among Canal Builders," *Tracy Press* (California), April 9, 1951.

[32] Martin H. Blote, "Water Runs Uphill," *Reclamation Era* (October 1947): 213.

[33] US Department of the Interior, Bureau of Reclamation, *Delta-Mendota Canal,* Technical Record of Design and Construction (Denver: 1959), 1.

[34] Morrison-Knudsen Company, Inc. and the M. H. Hasler Construction Company, *Final Report Contract No. I2r-16675 – Specifications No. 1435, Delta-Mendota Canal – Central Valley Project*, 1949, 22.

House Road Siphon carried Delta-Mendota Canal 1,200 feet through a monolithic concrete structure with an inside diameter of 24 feet 3 inches (**Figure 4**). Morrison-Knudsen and Hasler constructed the siphon under specifications No. 1435.



Figure 4: Construction of Mountain House Road Siphon showing concrete placement in progress, October 24, 1948. [130]

Wasteways to carry flood water out of Delta-Mendota Canal and to the San Joaquin River channel are among the largest appurtenant structures to the canal and were designed and constructed as part of the canal. Reclamation designed the canal's four wasteways to handle the full capacity of Delta-Mendota Canal at the turnouts into the wasteways in the event of flooding or canal failure. Studies of the topography and disposal of canal water informed the site selection of the wasteways. The wasteway turnouts were designed with radial gates to allow the flow of water into the channels. Westley Wasteway is a 3.9-mile long, mostly concrete-lined trapezoidal channel. Newman Wasteway is approximately 8.2 miles long, about 1.5 miles of which are concrete lined. Volta Wasteway (originally known as San Luis Wasteway) is 11.9 miles long and Firebaugh Wasteway is the shortest at 1.1 miles long.[35]

[35] USDI, Reclamation, *Friant-Kern Canal: Technical Record of Design and Construction*, 12; "Friant-Kern Canal – Myriad of Huge Structures Involved," *Western Construction News* (May 1948): 93.

3.1.4. Construction

Delta-Mendota Canal and all of its appurtenant structures were constructed by five contractors under 10 major construction specifications, starting in 1946 and completed in 1951. Hubert Everist, Sr. won the first contract and began work in June 1946. Each of the major contractors engaged many subcontractors to supplement their own work forces.

On April 30, 1946, bids opened for Specifications No. 1183, which comprised of two schedules including earthwork, concrete lining and structures (schedule one) and the construction of the Westley wasteway (schedule two). Everist placed the lowest bid, winning the contract for both schedules on June 14, 1946. His firm also served as the contractor for Specification 2460, the earthwork, concrete lining and structures from M.P. 25.88 to M.P. 40.72, and the timber operating bridge at M.P. 23.28. Educated as an engineer at Purdue Univeristy, Everist came from a family of leaders in the construction industry. Born in Beardstown, Illinois but raised in Sioux City, Iowa, Everist played an instrumental role in the growth of his family's company, L.G. Everist, Inc., as well as the establishment of two other businesses: Western Contracting Corp. based in Sioux City and Intercontinental Engineering and Manufacturing Corp. of Parkville, MO. Branches of all three businesses existed in the West. At the time of the bidding for Delta-Mendota Canal, Everist lived in San Francisco.[36]

On December 30, 1946, Morrison-Knudsen Company, Inc., partnering with the Los Angeles-based M.H. Hasler Construction Company, won the first of its four contracts for "earthwork, canal lining, and structures" along Delta-Mendota Canal. This first contract included a segment measuring approximately 11.15 miles, completed on April 18, 1949. Between October 1949 and April 1951, Morrison-Knudsen Co. and M.H. Hasler engaged in three other contracts pertaining to Delta-Mendota Canal. All the work involved earthwork, concrete lining and structures (**Figure 5**). The Morrison-Knudsen Company, headquartered in Boise, Idaho, specialized in construction of large civil and military projects. Founded in 1912 by Harry W. Morrison and Morris H. Knudsen, the firm had become the preeminent dam-building company after its successful contribution to the construction of Hoover Dam, contracted in 1931. In the ensuing decades, Morrison-Knudsen emerged as one of America's largest civil engineering contractors. The company's portfolio of work went on to include some of the world's biggest dams and bridges. During World War II, the company was in prime position to take on large contracts for construction of military bases and airfields. After the war, the company embraced opportunities created by the expansion of the American military presence overseas, as well as the push to rebuild and expand American infrastructure at home. By the end of the

[36] US Department of the Interior, Bureau of Reclamation, *Delta-Mendota Canal,* Technical Record of Design and Construction (Denver: 1959), 103; "Hubert H. Everist Sr Obituary," *Sioux City Journal,* July 20, 1990; L.G. Everist, Inc., "Company Overview," https://www.lgeverist.com/companies.php.

1950s, the company had diversified and expanded to various worldwide locations. Morrison-Knudsen's work along Delta-Mendota Canal is illustrative of the company's participation in domestic infrastructure expansion in the post-war period.[37]

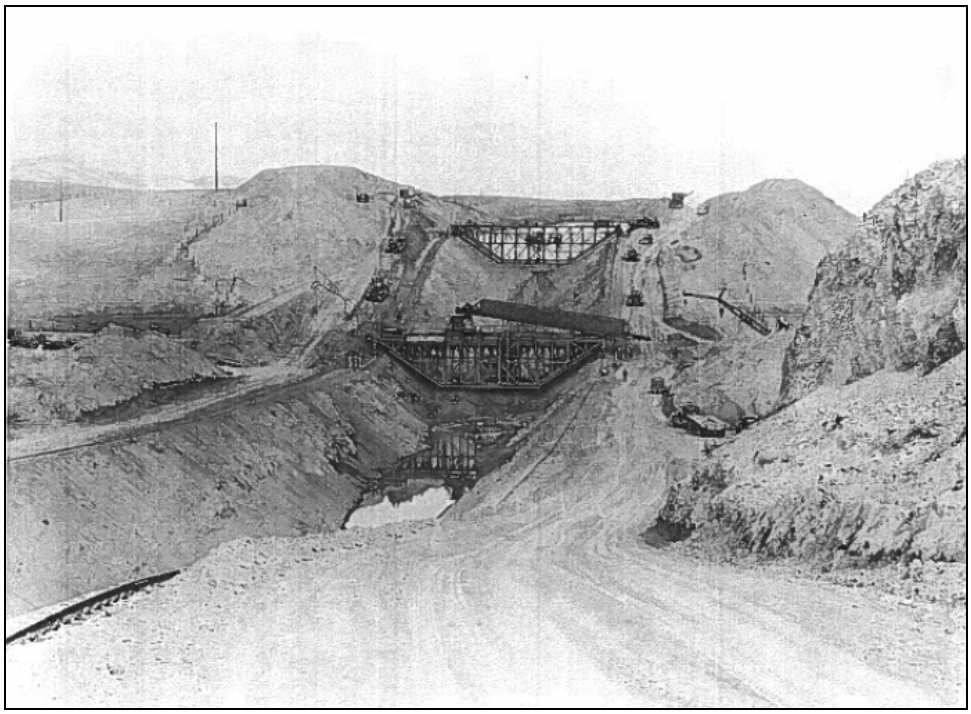


Figure 5: Morrison-Knudsen Company, Inc. and the M. H. Hasler Construction Company operating canal trimmer and slip form at Mountain House Road Siphon excavation, June 10, 1948.[38]

In addition to constructing four segments of Delta-Mendota Canal under Specifications 1435, 2197, 2732, and 2799, the Morrison-Knudsen Company, Inc. and the M.H. Hasler Construction Company also collaborated on multiple segments of the Central Valley Project's Friant-Kern Canal. In the late 1930s, M.H. Hasler also assisted Morrison-Knudsen in the construction of the All-American Canal and its branch Coachella Canal. Morrison-Knudsen and Hasler built over 75 miles of the 122-mile-long Coachella Canal between 1939 and 1941, including construction of 14 siphons, 31 double siphon boxes, one round barrel siphon, five checks, four automatic

[37] Donald E. Wolf, *Big Dams and Other Dreams: The Six Companies Story* (Norman: University of Oklahoma Press, 1996), 204, 254-265; "Earth Mover," *Time* (May 3, 1954): 86, 90-93; "Morrison Knudsen Corporation," Jay P. Pedersen, ed., *International Directory of Company Histories*, vol. 28 (Detroit, Michigan: St. James Press, 1999); "Morrison-Knudsen Company, Inc.," Harvard Business School Baker Library Historical Collections, Lehman Brothers Collection, Twentieth-Century Business Archives; "Top Twelve Hit Over $100 Million," *Engineering News-Record*, July 2, 1964, 53; "Construction's Man of the Year," *Engineering News-Record*, February 17, 1966, 99-106; David P. Billington and Donald C. Jackson, *Big Dams of the New Deal Era: A Confluence of Engineering and Politics* (Norman: University of Oklahoma Press. 2006).

[38] Morrison-Knudsen Company, Inc. and the M. H. Hasler Construction Company, *Final Report Contract No. I2r-16675 – Specifications No. 1435, Delta-Mendota Canal – Central Valley Project*, 1949, 12.

spillways, and five drainage inlets. During World War II, Hasler worked with the U.S. Army Corps of Engineers in building air bases at Blythe, Reno, and Kingman. The company's collaborative work on four segments of Delta-Mendota Canal between 1946 and 1951 appears to be illustrative of the general work performed by the M. H. Hasler Construction Company during this period.[39]

Another of Hubert Everist Sr.'s companies, Western Contracting Corporation, won the contract for earthwork, concrete lining, and structures for a 15.61-mile-long segment of Delta-Mendota Canal on June 22, 1949. The company completed the work on June 1, 1951. Additionally, on June 29, 1950, Western Contracting Corporation bid on and received Contract No. I2r-19060, for construction of the San Luis Wasteway and holding reservoir dike, split into two schedules (**Figure 6**). Western Contracting Corporation completed the work on April 9, 1952, and June 14, 1951, respectively. Everist established Western Contracting in 1917, headquartered in Sioux City, Iowa. For the work on Delta Mendota, the corporation operated out of an office in Westley, California. Today, the company predominantly constructs Army Corps of Engineer flood control, and wetland and river mitigation projects in the Midwest.[40]

In 1946, Reclamation Commissioner Straus authorized a contract of $5,888,000 for the two and a half mile long Delta-Mendota Intake Canal, which included the Tracy Pumping Plant (later renamed C.W. Bill Jones Pumping Plant) (**Figure 7** - **Figure 8**). Located nine miles northwest of Tracy, California, the pumping plant was to "lift water from the Delta-Mendota Intake Canal to a height of 200 feet and send it flowing for a distance of 120 miles" through the DMC to the west side of the San Joaquin Valley utilizing six 22,500 horsepower motors (**Figure 9**). With these motors, the plant had the capacity to lift 4,600 cubic feet of water per second. Construction of the pumping plant began September 2, 1947, through a joint venture between Stolte Inc., United Concrete Pipe Corporation, Duncanson-Harrelson Company, and Ralph A. Bell. The companies, all of which consolidated and operated under S.U.H.B. Company, completed the work on December 30, 1949. Construction engineers included Bureau of Reclamation's Oscar Boden and C.H. Spencer, both of whom spent a considerable portion of their careers working on the Central Valley Project. However, the location of the Tracy Pumping Plant created a unique problem for Reclamation; it aligned with the route that young salmon and bass are swept along by the early spring runoff in their migration towards the ocean. To prevent a detrimental loss in fish population, the Bureau of Reclamation and the

[39] Eric A. Stone (edited by Brit Storey), *All-American Canal: Boulder Canyon Project,* (Denver: United States Bureau of Reclamation, December 2009), 6-28; USDI, Reclamation, *Technical Record of Design and Construction, Delta-Mendota Canal: Constructed 1946-1952, Central Valley Project – California* (Denver, June 1959), 103; "M. H. Haslers of Laguna Buy Walter Botthof Home," *Desert Sun (Palm Springs)*, May 19, 1950, 5.

[40] US Department of the Interior, *Delta-Mendota Canal:* Technical Report*,* 104; Associated General Contractors of Iowa, "Western Contracting Corporation," http://www.agcia.org/memberDetails.asp?memberID=19795.

U.S. Fish and Wildlife Service experimented to find the most promising solution. This experimentation resulted in a diversion using a series of vertical louver structures, which transferred the young fish to holding tanks and then onto tank trucks to be hauled "about 50 miles to waters destined for the ocean" (**Figure 10**). By 1959, the Tracy Pumping Plant operators collected and transported upwards of 250,000 fish a day, and a record 12 million for the entire year.[41]

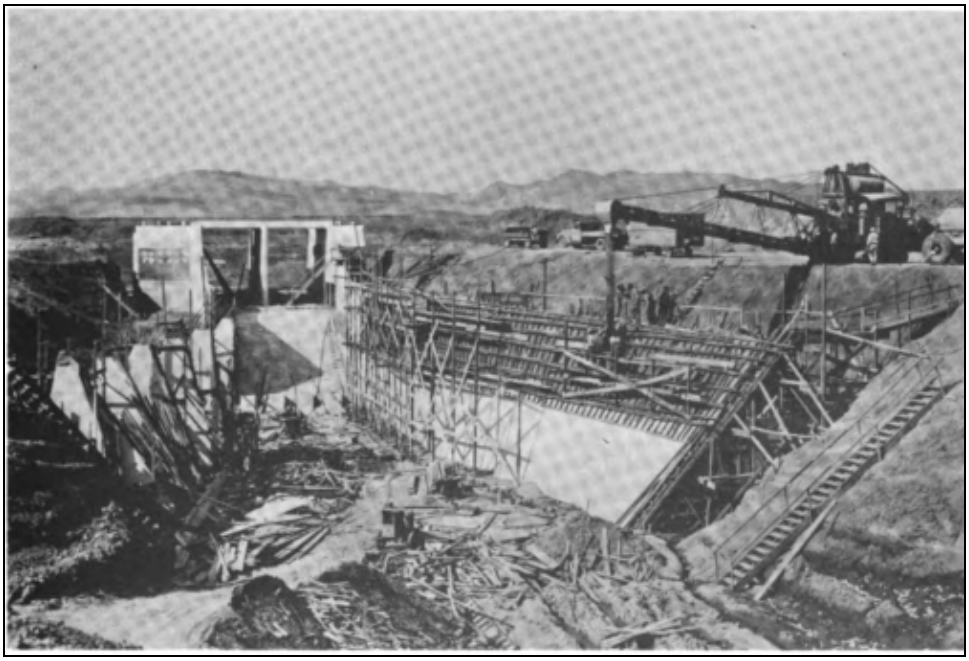


Figure 6: Placing concrete in transition walls of San Luis wasteway turnout, July 26, 1950.[42]

[41] USDI, Bureau of Reclamation, "Final Construction Report on Delta-Mendota Canal Intake and Tracy Pumping Plant and Discharge Lines," *Specifications No. 1810* – Central Valley Project (Denver: March 1952); USDI, Reclamation, "Commissioner Authorized to Award Top Value Contracts," *Reclamation Era* vol. 33, January 1947; USDI, Reclamation, "Fish and the Tracy Pumping Plant," *Reclamation Era* vol. 36, January 1950; USDI, Reclamation, "Well Worth Celebrating," *Reclamation Era* vol. 37, January 1951; USDI, Reclamation, "Reclamation Pioneers in Fish Conservation Techniques," *Reclamation Era* vol. 42, January 1956; USDI, Reclamation, "C.H. Spencer Succeeded by B.P. Bellport," *Reclamation Era* vol. 43, January 1957; USDI, Reclamation, "A Story about the USBR and Millions of Fish," *Reclamation Era* vol. 46, January 1960; "Construction Begins on Huge Central Valley Pump Plant," *Western Construction* vol. 22, no. 11, November 1947.

[42] [Photograph], DM-889-CV in USDI, Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal,* 123; At left are counterforts which were placed independently of the warped walls.

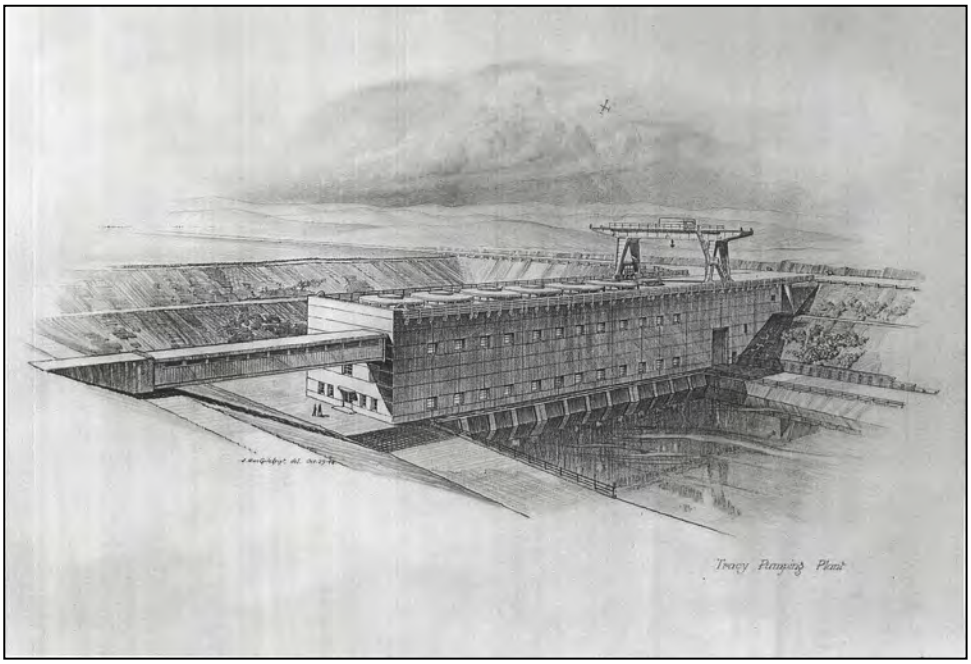


Figure 7: Artist rendering of Tracy Pumping Plant, 1948.



Figure 8: Tracy Pumping Plant, January 1951.[43]

[43] [Photograph] USDI, Reclamation, "Well Worth Celebrating," *Reclamation Era* vol. 37, January 1951.



Figure 9: One of six 84-in. vertical shaft bottom suction twin volute centrifugal pumps.[44]

On January 18, 1950, United Concrete Pipe Corporation and Vinnell Co. entered a joint contract to construct the earthwork and structures along Delta-Mendota Canal from M.P. 85.89 to M.P. 109.89, which spanned approximately 17.95 miles, and the Firebaugh wasteway, located at M.P. 98.50 (**Figure 11**). The government accepted the completed work on November 30, 1951. The two companies also worked together on the earthwork, concrete lining and structures, and service lateral, and part of the Newman Wasteway. They won this second contract on May 16, 1950 and finished the work on April 4, 1852. United Concrete Pipe Corporation can trace its origins to 1919 in Ventura, California. Serbia native Tom Polich started the company, first naming it Polich Construction Company until 1924, when he partnered with Steve Krai and B.J. Ukropina. Polich came to the United States in 1905 at the age of 17, and first entered the concrete business under the employ of Bent Brothers. Polich's first self-employed contract involved the installation of an irrigation system for the California Packing Corporation at their orchard at Tuttle. United Concrete Pipe Corporation went on to complete projects in Merced County such as the John Muir school building, concrete bridges and highways, sanitary sewers, and irrigation for the Merced Irrigation District. For this project, the Vinnell Company operated from a plant in Baldwin Park. Originally founded in 1931 by Allan S. Vinnell in Alhambra, the company began as a hauling and excavating contractor. The Vinnell Co. also constructed roads, buildings, portions of the Pan-American

[44] [Photograph] "A Pictorial Review of Tracy Pumping Plant Construction," *Western Construction News* vol. 26, no. 5, May 1951.

Highway and the Grand Coulee Dam. By the 1960s, the United States government employed Vinnell as contractors in Vietnam.[45]

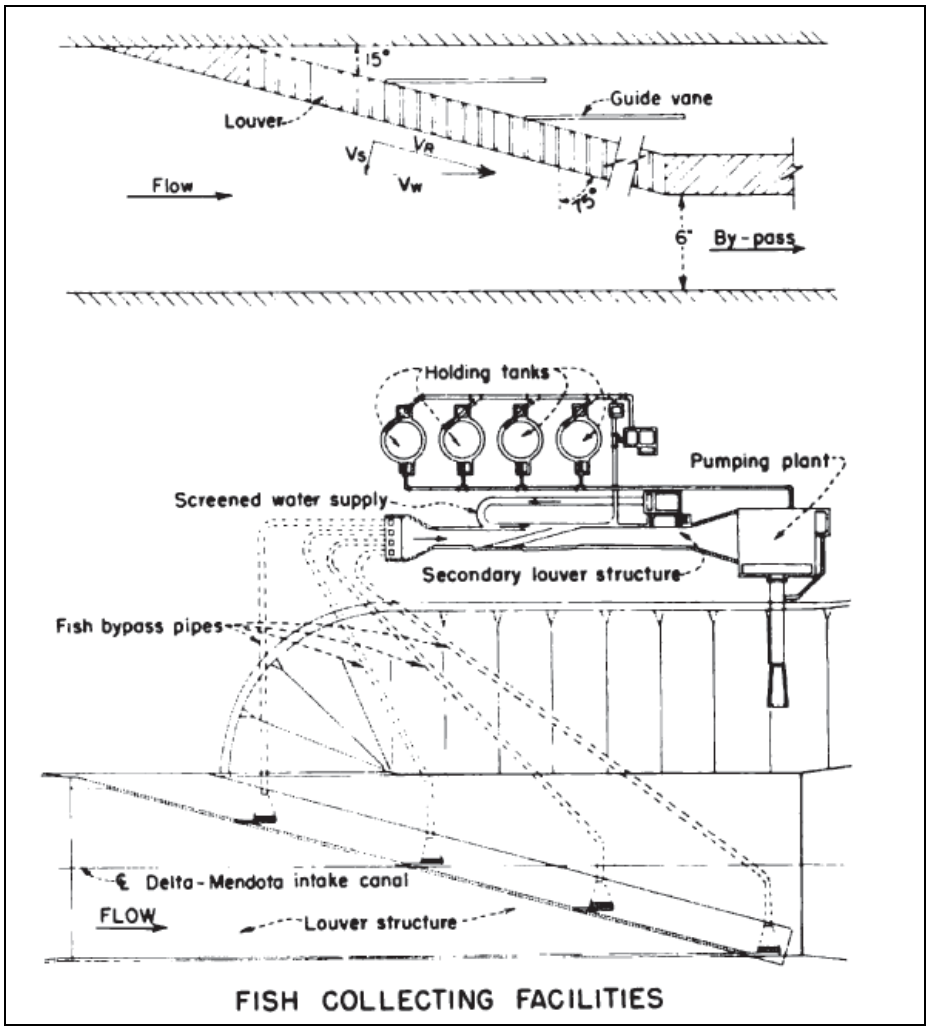


Figure 10: Fish Collecting Facilities at Tracy Pumping Plant, January 1956.[46]

[45]*Delta-Mendota Canal:* Technical Report, 105; John Outcalt, "Merced-Ventura-Los Angeles County CA Archives Biographies: Polich, Tom (Merced: 1925); "Dirt Lined Section of Delta-Mendota Canal Progresses," *Fresno Bee,* November 27, 1950.

[46] [Photograph] USDI, Reclamation, "Reclamation Pioneers in Fish Conservation Techniques," *Reclamation Era* vol. 42, January 1956; drawing at the top shows plan arrangement of louvers or slats; drawing at the bottom shows layout of permanent structure.

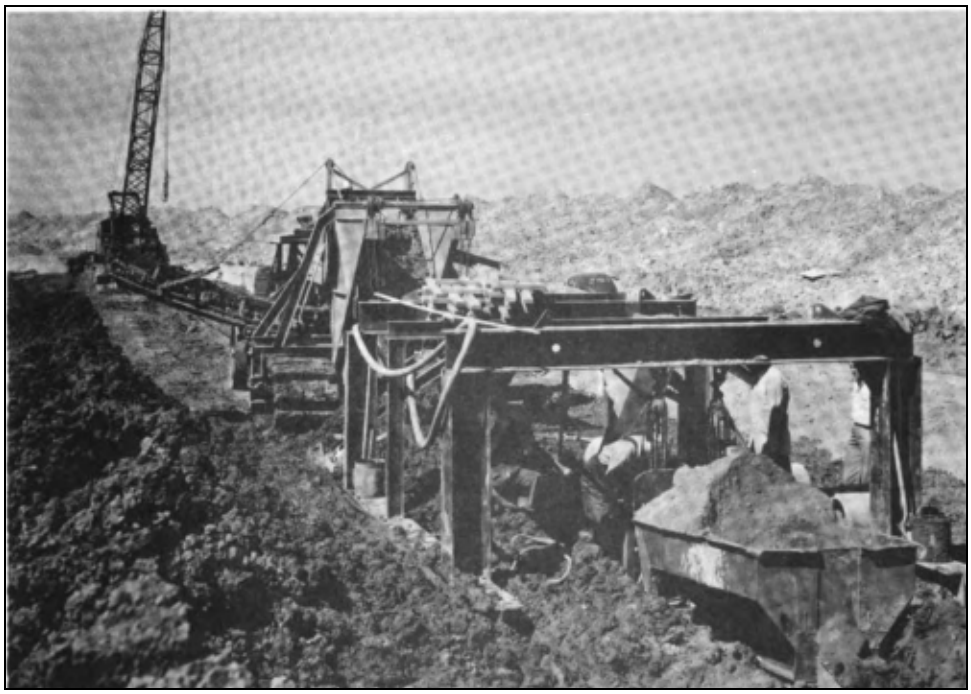


Figure 11: Converted ditcher and pipe laying machine used by United-Vinnell Co., March 1951.[47]

Construction of another small part of Newman wasteway and its service lateral went to A. Teichert and Sons, Inc., of Sacramento, California. The government awarded the contract on May 16, 1950, and Teichert completed the work on June 29, 1951. Both Teichert and United Concrete Pipe Corporation and Vinnell Company's portions of the Newman Wasteway fell under Specification 2951, albeit separate schedules. Teichert lined the wasteway by hand methods given the small size of the job (**Figure 12**). The company's founder, Adolph Teichert, immigrated to the United States in 1866 from Germany, finding success as a craftsman in San Francisco. He started his own business, Artificial Stone: Adolph Teichert, in 1887 in Sacramento. In 1912, Adolph Teichert Jr. joined his father as a partner in the concrete paving business under the name, A. Teichert and Son. The company played an integral role in the development of the road and highway system in Northern California, employed by the likes of the State of California Highway Department (later Caltrans) and the cities of Sacramento, Davis, Woodland, Placerville, and Fresno. In addition to paving roads, Teichert expanded its repertoire to include the production of rock product and ready-mixed concrete and the construction of dams, beginning with the North Fork Dam on the American River in 1938. A. Teichert and Son also partook in joint ventures with companies like United Concrete Pipe and Ralph A. Bell. In 1939, the companies worked together to construct tunnels and relocate

[47] [Photograph,] DM-1471-CV in USDI, Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal,* 115; Machine used for laying drains in the lower reaches of canal. The machine digs a trench and men working inside shield lay the drain pipe which is covered by gravel from the hopper.

telephone and railroad lines around the Shasta Dam. During World War II, A. Teichert and Son supported the war effort through the construction of airports; ammunition storage facilities; runways; and water, light, and fuel systems. By the early 1950s, the company's growth spurred the establishment of district offices in the Woodland/Davis area and in Stockton.[48]



Figure 12: Placing alternate panels of reinforced concrete in Newman wasteway, April 1951.[49]

On November 8, 1951, Johnson Western Constructors won the bid for construction of structures for distribution to water agencies along the canal rouate. The firm built the Columbia Pumping Plant No. 1, Mowry Pumping Plant, and their respective delivery systems. The work was broken into two schedules under Specification DC-3989. Headquartered in San Pedro, Johnson Western had additional offices in San Diego and Oakland. The company specialized in heavy engineering construction, waterfront construction, and gunite construction. Born in 1885, William Arthur began his career at age 21 at a small pipe company, working on construction projects there until he became president of the National Bank of Riverside. Johnson stayed at the National Bank from 1918 to 1923, at which time he established the Hall Johnson Company. Throughout his career, Johnson started numerous firms, including American Pipe, Johnson, Inc., and Johnson Western Constructors. His companies helped construct the Shasta Dam from 1938 to 1944. At the time of the

[48] *Delta-Mendota Canal:* Technical Report, 105; "Our History," *Teichert Way,* file:///J:/22-015%20Delta-Mendota%20Canal%20Subsidence/Research/Contractors/A.%20Teichert%20&%20Sons/Our%20History%20-%20Teichert.html.

[49] [Photograph], DM-1496-CV in USDI, Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal,* 128.

construction of Delta-Mendota Canal, Larry Sullivan of San Pedro served as president of Johnson Western.[50]

The government awarded Plainview Water District and Stolte Inc. Contract No. 14-06-D-542 which "covered construction of earthwork, pipelines, and structures, including pumping plants, laterals 8.7 to 20.0 inclusive, and sublaterals" on September 1, 1953. Divided into three schedules, the contract with Stolte, Inc. allocated $441, 893.11 for the work, but only "a portion of the costs [$81, 686.99] was chargeable to Delta-Mendota Canal." Plainview Mutual Water Company is based in Strathmore, California, and had been one of the first companies formed with the aim of negotiating with the Central Valley Project for irrigation water. At the time of the bidding, Plainview Water District fell under the Delta-Mendota Canal distribution system. The company formed in 1950, with an irrigation request of about 4,200 acres. Stolte Inc. can trace its origins to Ferdinand Charles Stolte, whose dreams of becoming a gentleman farmer were foiled by the stock market crash of 1929. Based in Alameda, Stolte Inc. began with specializing in homebuilding, but expanded to include work on hotels, medical facilities, high-rise commercial construction, and heavy construction like dams and tunnels. In 1932, engineer George Loorz joined Stolte Inc. as a partner, and the company went on to build Hearst Castle for William Randolph Hearst. In 1976, National Medical Enterprises purchased Stole Inc.[51]

Crest Contracting Company won the contract for construction of pump turnouts from mile 58.18 to mile 96.62 on May 2, 1958. Floyd Hardwick, a former Rio Vista city administrator, owned the company. While working on the Dela-Mendota Canal, Crest Contracting also undertook projects constructing culverts for Merced County.[52]

Contracts for "furnishing, hauling, and placing gravel" from various stations along Delta-Mendota Canal and the Westley wasteway were awarded to H. Sykes Construction Company. Under Specification R2-32, Sykes's company performed work along M.P. 12.99 to M.P. 25.88 and the start of the Westley wasteway to M.P. 0.37. The company specialized in road oiling, paving, and ready-mix concrete. Hubert Sykes headquartered his company in Patterson,

[50] Technical Report, 106; "Johnson, Shasta Dam Builder, Dies," *News Pilot,* San Pedro: May 11, 1956; "William A. Johnson, 71, Industrialist, Succumbs," *San Bernadino County Sun* May 11, 1956; "San Pedran Elected President of Johnson Western Company," *News Pilot,* December 2, 1950.

[51] Technical Report, 106; "County Ok's Tax Rate for New Plainview District," *Tracy Press,* May 4, 1951; "More Acreage Wanted in New Water District," *Tracy Press* October 2, 1950; Evelyn De Wolfe, "San Simeon Builder's Forgotten Notes : Cache Enriches Castle Lore," *LA Times,* January 25, 1985; "Carol Louise Stolte Paden," *Alameda Sun*, May 14, 2020.

[52] Technical Report, 106; "New Southbay Business Licenses," *The Redondo Reflex,* April 16, 1948; "Gasoline, TV Thefts Reported," *Merced Express,* January 29, 1959.

California. Born in England in 1895, Sykes came to Patterson in 1919, having become a naturalized US citizen in 1918.[53]

E.A. Pollard won the contract for the "erection of right-of-way fence," which cost the government $5,407. Prior to his work on the Delta Mendota Canal, Pollard and his employees worked in Martinez, constructing a bridge across Marsh Creek on County Road E-44 and in Mendocino, grading and improving roads in Wages Creek. Born in 1897 in Oregon, it is not clear when Pollard came to California and established a home in Richmond. He operated his business out of Fairfax.[54]

To aid in the furnishing, processing, hauling, and placing of gravel along stations, the government also developed contracts with M.J. Ruddy and Son of Modesto, California (**Figure 13**). The company emphasized the "prompt delivery" of sand and gravel, including washed concrete sand and crushed rock. Though the company's establishment dates to the 1930s, it did not file as a stock corporation until October 15, 1954. Other work done by M.J. Ruddy and Son involved highway bridges and overpasses from Firebaugh throughout the San Joaquin Valley, and paving on the Tuolumne-Sonora Road. At the time the government accepted the bid for the Delta Mendota Canal, M.J. Ruddy and Son's managers included M.J. Ruddy, Jr, project manager; Fred Sattler, chief engineer; Warren Shields, project superintendent; and Paul Snyder, office manager.[55]

The Claude C. Wood Company also won a bid for "furnishing or processing, hauling and placing gravel" for Delta-Mendota Canal. Based in Lodi, California, Claude C. Wood Co. operated a gravel plant which manufactured rock, sand, and gravel and offered ready-mix concrete for purchase. The company also provided asphalt road oils to eliminate dust on driveways along farmland. During World War II, the Claude C. Wood Co. supported the war effort by assembling parts for floating drydocks, operating under a sub-contract for the United States Navy. Wood himself led an active role in his community; he served as secretary-treasurer for the Turlock Exchange Club in the 1920s and served on the board of trustees for Galt High

[53] Technical Report, 147; "Advertisement," *West Side Index,* June 2, 1960; United States Federal Census, "Hubert Sykes," 1940 and 1950.
[54] Technical Report, 146; United States Federal Census, "E A Pollard," 1940; "Official Report of the Board of Supervisors," *Contra Costa Gazette,* May 6, 1949; "Mendocino Beacon Files," *Mendocino Coast Beacon,* January 2, 1959.
[55] Technical Report, 146; "Modestan's Bid On Road Work is Low," *Modesto Bee,* February 24, 1939; "Advertisement," *Modesto Bee,* February 26, 1947; "Supervising the Jobs," *Western Construction,* vol. 32 (Cornell: King Publications, Jan. 1957); Gene Phillips, "Obituary- Cirgus H. Rumbaugh," *Rogers County Archives,* November 28, 2006.

School in the 1940s. Trained as an engineer, Wood came to California from Wisconsin in 1905 at the age of 20.[56]

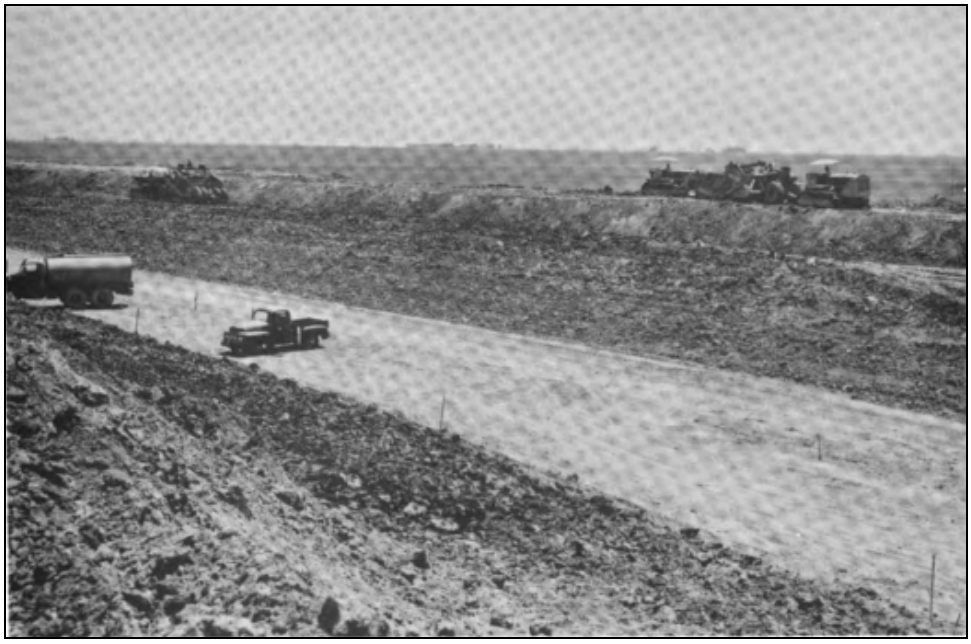


Figure 13: Placing and compacting lining material on side slope of canal, July 26, 1950.[57]

The high groundwater level, some large storms, and labor issues were among the biggest obstacles during construction. The high groundwater table caused water intrusion into the canal excavations and required contractors to de-watered those areas moving the water into a pilot ditch or other drain structures. Heavy storms in November and December 1950 also slowed progress when the deluge caused high water in Los Banos and San Luis creeks, which both breached constructed portions of Delta-Mendota Canal, causing damage to the canal and to some of the siphons. The storms also caused excess water in Garzas Creek to undermine an overchute pier and damaged some of the canal lining. After the delays caused by the storms and the subsequent repairs, a series of labor strikes in May 1951 halted constructed for about two weeks. Once the workforce returned the main branch of the canal was completed in

[56] Technical Report, 146; "Neel Re-elected Club President," *Modesto Bee,* July 2, 1926; "Farmers and Grape Growers Attention," *Lodi News-Sentinel,* April 27, 1943; "Wood Given Contract to Assist Navy," *Lodi News-Sentinel,* June 18, 1943; United States Federal Census, "Claude C. Wood," 1940; US City Directories, 1822-1995, "Claude C. Wood," 1905.

[57] [Photograph], DM-895-CV, in USDI, Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal,* 141.

summer 1951, but Delta-Mendota Canal was not considered complete until April 1952 when the San Luis Wasteway was completed (later renamed Volta Wasteway).[58]

3.1.5. Post-construction

Completion of the CVP was an economic boon to the Central Valley. In 1953, two years after the major canals of the project were complete, the project provided 1,500,000 acre-feet to irrigate nearly 720,000 acres of land. That year, the project delivered 134,000 acre-feet of irrigation water along Delta-Mendota Canal to districts composed of almost 120,000 acres. Reclamation planned for ultimate development of 225,000 acres in the Delta-Mendota service areas to be achieved upon the completion of Folsom Dam (1956) on the American River in Sacramento County and the Trinity Division in Trinity County (1959-1967), which transfers water from the Klamath River Basin into the Sacramento River Basin.[59]

Completion of the CVP also came with controversy. The century or so after California's Gold Rush witnessed exploitation of the Delta not only for irrigation purposes, but for other water resources, including chinook salmon. Canneries appeared in Sacramento as early as 1864, but the California Fish Commission noted a severe decline in fish populations by 1880 – attributed to overfishing and the prevalence of sediment in spawning beds from hydraulic mining. As detrimental as overfishing and mining were to the salmon runs, the most adverse effects came from the changes in the Delta landscape and ecosystem from the Central Valley Project and the State Water Project. Delta-Mendota Canal provided water to the west side of the San Joaquin Valley, but left "the 59-mile stretch of the river from Mendota upstream to Friant Dam with little water, and within this reach, the 23 miles directly above Mendota were completely dewatered." The dry river channel and the 319-foot-high concrete dam rendered the salmon helpless, with no way to continue their traditional migration and spawning runs. Not until 2009 did legislation pass to provide "substantial river channel improvements and sufficient releases from Friant Dam" to sustain the fish population from downstream to the Merced River, allowing water to flow freely through the San Joaquin River. The impacts of this San Joaquin River Restoration Settlement Act are still being observed.[60]

Further negative effects on the fish populations of the San Joaquin River system have been caused by altered hydrology, recirculation of water, and poor water quality caused by polluted runoff and dissolved oxygen. Though fish are entrained at the C.W. Bill Jones Pumping Plant

[58] USDI, Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal,* 142-144.
[59] USDI, Reclamation, "The Contribution of Irrigation and the Central Valley Project to the Economy of the Area and the Nation," (Government Printing Office: Washington, 1956), XIII, 21.
[60] Philip Garone, "Managing the Garden: Agriculture, Reclamation, and Restoration in the Sacramento-San Joaquin Delta," in in Delta Protection Commission, Delta Narratives: Saving the Historical and Cultural Heritage of the Sacramento-San Joaquin Delta, prepared by the Center for California Studies, California State University, Sacramento (West Sacramento: Delta Protection Commission, 2015), 77-86.

(formerly Tracy Pumping Plant) to mitigate impact on the fish population, increased pumping alters the hydrodynamic conditions of the water, creating problems for fish who rely on habitat condition indicators to make their run. The Central Valley Project Improvement Act of 1992 allocated 800,000 acre-feet per year of CVP water "dedicated for anadromous fish enhancement and wildlife purposes," managed by the Sacramento division of the U.S. Fish and Wildlife department. A portion of this water is reserved to reduce pumping from the Jones plant, as efficient fish diversion via entrainment continues to decrease.[61]

By 1959 when Reclamation published its final report on Delta-Mendota Canal's construction, entitled *Delta-Mendota Canal Technical Record of Design and Construction*, most of the turnouts supplying water to individual water districts had been completed, nearly all according to Reclamation's standardized specifications. A few more, also designed according to specifications, were over the next several decades.[62] Individual water districts are responsible for maintaining turnouts into their own distribution systems and adding turnouts from Delta-Mendota Canal as needed and approved by Reclamation. Most of the physical changes made to Delta-Mendota Canal since its completion fall into five categories 1) maintenance, 2) capacity correction, 3) water district turnout additions and changes, 4) drainage / erosion control, 5) automation. Since October 1992 San Luis & Delta-Mendota Water Authority (Authority) has been responsible for maintenance of Delta-Mendota Canal.

The Authority is responsible for maintaining the concrete lining of the canal. Natural processes including land subsidence and soil characteristics cause deterioration of the concrete panels that line the canal. As noted, land subsidence and the damage it caused to Delta-Mendota Canal became apparent almost as soon as Reclamation turned water into the canal. Writing retrospectively about subsidence in 1968, geologist N.P. Prokopovich, and engineer D.J. Hebert noted that the most widespread soil bed in the upper part of the San Joaquin Valley was an "ancient lake bed known as the Corcoran or Blue Clay," in which a substantial storage of artesian groundwater lays. This groundwater reserve constituted a large portion of the irrigation supply before the CVP and continued to be a source even after the canal was built. Since 1960, the Bureau of Reclamation recognized a phase of subsidence caused by well-developed ground water overdraft, denoting it as "prominent and publicized." However, a

[61] USDI, Bureau of Reclamation, "Delta-Mendota Canal Recirculation Feasibility Study – Plan Formulation Report," (Sacramento: September 2010), 58-62; USDI, Reclamation, "Delta-Mendota Canal/California Aqueduct Interie – Final Environmental Impact Statement, vol 1: Main Report," (Sacramento: November 2009), 99-102.
[62] USDI, Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction;* USDI, Reclamation, "Milepost at Structure Sites Delta-Mendota Canal," 1985.

different phase of subsidence called "lag," which occurs even when the area experiences little or no pumping of groundwater, and despite a decrease or disappearance of overdraft.[63]

Prokopovich and Hebert explained that the last 30-40 miles of Delta-Mendota Canal offer a remarkable example of lag subsidence (**Figure 14**). Preconstruction and construction surveys had not recognized any land subsidence in the lower reaches of the DMC, and any changes in elevation were attributed to earthquakes. By 1952, however, professionals identified subsidence as responsible for past changes in elevation. At the time of article, Prokopovich and Hebert noted that 22 miles of the concrete-lined section and all 18 miles of earth-lined section were affected by subsidence, causing the linings to become submerged below the water. Bridges and pipe crossings showed extensive effects of subsidence, where their clearance to the water was reduced sometimes to within inches or none at all. In some cases, the subsidence caused timber bridges and pipe crossings to flood (**Figure 15**). Prokopovich and Hebert stated that subsidence had not negatively affect the capacity of the canal, nor was there damage to either canal linings or structures. Despite the lack of impacts to the canal's capacity and its linings and structures, subsidence caused enough of a maintenance and operations problem to warrant a plan to rehabilitate the canal that was proposed for the 1968-1969 fiscal year. Reclamation staff estimated that the lag subsidence would increase up to two feet a year.[64]

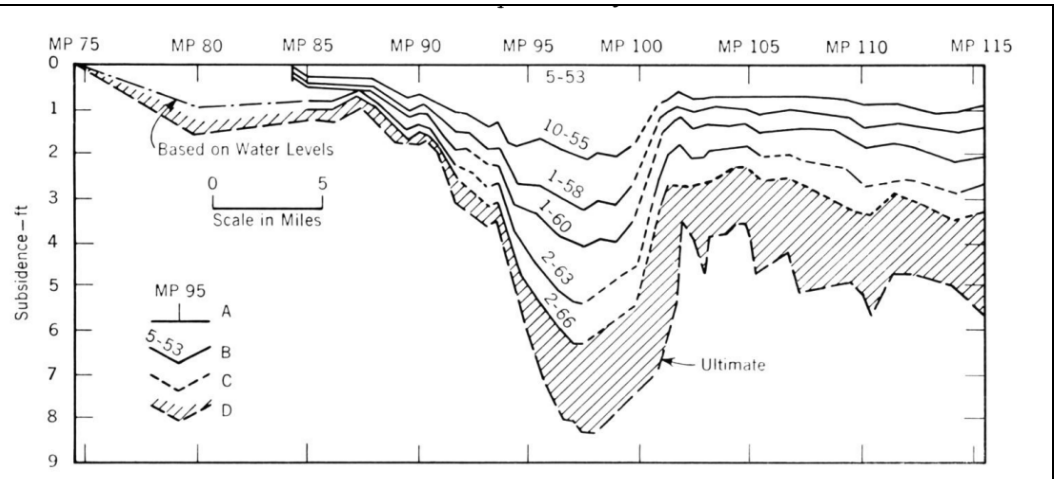


Fig. 5. Past and Future Land Subsidence in Downstream Reaches of the Delta-Mendota Canal

A is mile post (distance from intake); B is date of survey data; C is interpolations to bridge data gaps; D is predicted ultimate subsidence.

[63] N.P. Prokopovich and D.J. Hebert, "Land Subsidence Along the Delta-Mendota Canal, California," *Journal (American Water Works Association)* vol. 60, no. 8, August 1968.
[64] N.P. Prokopovich and D.J. Hebert, "Land Subsidence Along the Delta-Mendota Canal, California," *Journal (American Water Works Association)* vol. 60, no. 8, August 1968.

Figure 14: From Prokopovich and Hebert, graph showing past and future subsidence, 1968.[65]

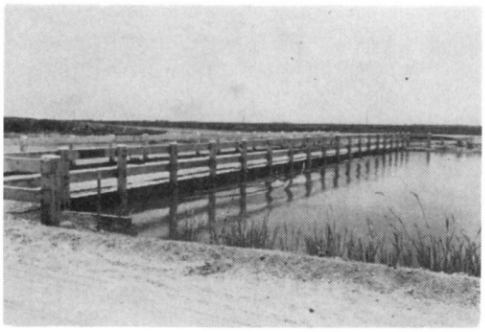


Fig. 7. Effect of Subsidence on Bridge at Near Capacity Flow

This is a partially submerged timber bridge at Mile Post 98.21, in an area affected by deep subsidence. Concrete lining of the canal is completely flooded.

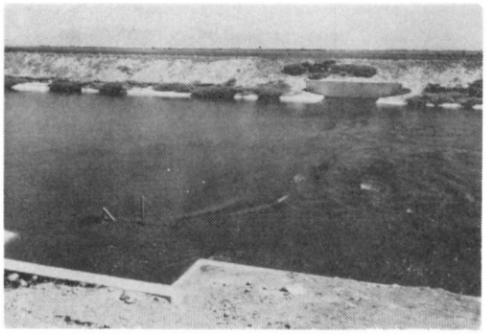


Fig. 9. Effect of Subsidence on Pipe Crossing at Near Capacity Flow

This is a submerged pipe crossing at Mile Post 91.71 in an area affected by deep subsidence.

Figure 15: Effects of subsidence on DMC, 1968.[66]

In December 1952, members of the canal's Central Valley Project Operations and Tracy Operations divisions conducted a biennial inspection of Delta-Mendota Canal, the first of which took place in October 1951, just a few months after the canal first delivered water. The report contained comments on the intake structure and intake canal; concrete and earth lining; and structures. It also provided recommendations and a general remark noting that "this was the first time the upper 100 miles of canal has been [dewatered] since water was turned in the canal in July 1951." The inspectors noted minor bank erosion and beaching on a curve of the canal near M.P. 0.5, no leakage in the discharge lines, and concrete and earth linings in good condition aside from "minor trouble spots" such as bulging and cracking and settlement of berms (**Figure 16**). Concerning the structures, the inspectors observed problems like leakage in the Mountain House Road siphon, canal silting at M.P. 42, drain pumps out of service, and inaccurate measurements from sparling meters.[67]

[65] [Photograph] in Prokopovich and Hebert, "Land Subsidence Along the Delta-Mendota Canal, California," 917.
[66] [Photograph] in Prokopovich and Hebert, "Land Subsidence Along the Delta-Mendota Canal, California," 918.
[67] United States Department of the Interior, Bureau of Reclamation, Divisions of Design and Construction Operation and Maintenance, *Report on Inspection of Friant-Kern, Madera, Contra Costa, and Delta-Mendota Canals, 1-5.*

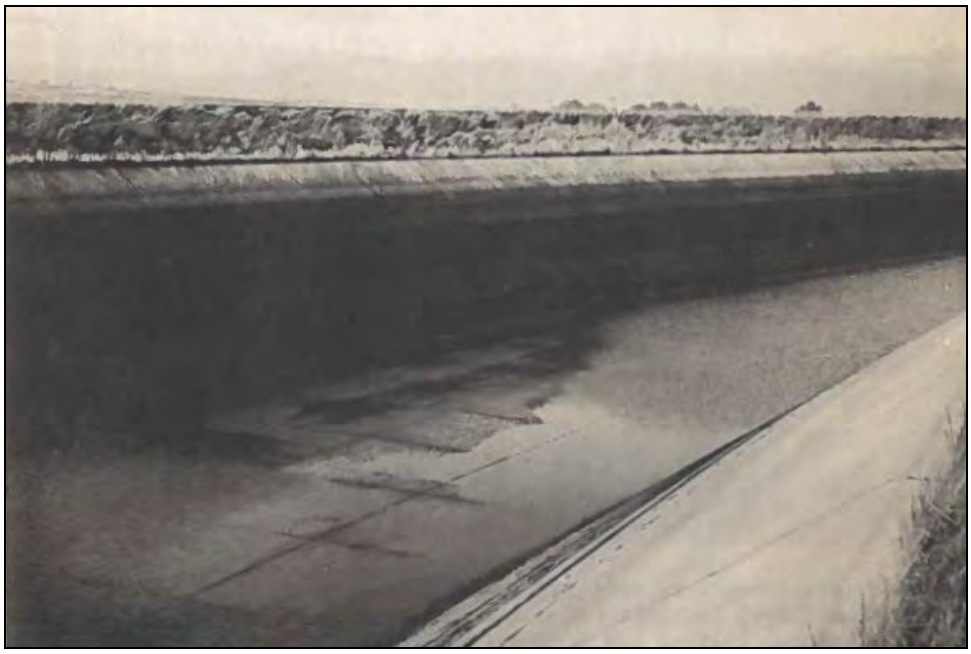


Figure 16: M.P. 11.15, concrete lining and heaving of bottom slab.[68]

In June 1965, the Bureau of Reclamation Chief of Engineers received a report on the condition of Delta-Mendota Canal, including Tracy Fish Collecting Facilities and Tracy Pumping Plant. Overall, the canal appeared to be in excellent condition at the time, including its structures, gates, and operating roads. Subsidence was described as "slow and not yet stabilized." At the time of the inspection, no maintenance issues caused by the subsidence presented themselves; therefore, no corrective action occurred. The report also mentioned that several bridges had been replaced, with others needing replacement as well, such as the bridge at M.P. 90.56 (**Figure 17**). The turnouts and gates and wasteways looked to be in good condition, only requiring minor aesthetic maintenance. The inspectors observed the Tracy Pumping Plant to be well-maintained and in excellent condition, but did note a horizontal crack in the wall along the construction joint on the discharge side of the motor room. However, the inspectors found no evidence of leakage. Regarding cross drainage siphons and channels, the examination team noticed some leakage that seems to decrease as the weather and water warm. To mitigate this leakage and degradation, baffled-apron drops were under construction (**Figure 18**). The report concluded with the recommendation that the unwatered canal be watched during the winter of 1965-1966 to determine the necessity of repairing the flap-valve underdrain outlets because that winter would likely be the last year of the "normal operating

[68] [Photograph], DM 2294 in USDI, Divisions of Design and Construction Operation and Maintenance, *Report on Inspection of Friant-Kern, Madera, Contra Costa, and Delta-Mendota Canals.*

procedure" because once the San Luis Unit began operations (built in the early 1960s), the canal would be in continuous use. [69]



Figure 17: Bridge, Mile 90.56, scheduled for replacement. May 14, 1965.[70]

[69] United States Department of the Interior, Bureau of Reclamation, *Condition of Major Irrigation Carriage Systems and Appurtenant Features – Central Valley Project* (Denver: June 21, 1965), 3-8.
[70] [Photograph], Photo No. 5, P214-D-48741 NA, in USDI, Reclamation *Condition of Major Irrigation Carriage Systems and Appurtenant Features,* 20.



Figure 18: Baffled apron drop under construction, May 12, 1965.[71]

The Bureau of Reclamation authored a similar report on June 5, 1970, examining "major irrigation structures and facilities operated and maintained by Tracy Field Division, Central Valley Project." Overall, the structures were found to be in good condition. The most pressing concern was the prevalence of people and expanding use of the canals for recreational activities like fishing. On Delta-Mendota Canal, the inspectors noted some erosion in the earth-lined section, but the concrete-lined sections appeared to be in excellent condition. As stated in previous inspection reports, some cracking in the lining on Mile 75 was evident but did not seem to be increasing. The examination team commented on the disruption of the canal by the public, including agricultural pipe crossings on the canal or farmers who discharged barnyard waste into the canal (**Figure 19**). The report recommended fencing around the checks to prevent fishing and any risk of people falling into the canal and drowning. The team found the overall condition of the canal's radial gates and turnouts and drain inlets to be

[71] [Photograph], Photo No. 9, P214-D-48732 NA, in USDI, Reclamation *Condition of Major Irrigation Carriage Systems and Appurtenant Features,* 21; baffled apron drop under construction to control retrogression at Coral Hollow Creek Siphon.

satisfactory and without need for repair but recommended the removal of cottonwood trees growing in the San Luis wasteway channel.

The 1970 inspection report did, however, note some issues concerning subsidence, seepage, and silt deposits. The team noticed subsidence in the lower reaches of the canal, below M.P. 70. At the time of the inspection, the reach was already scheduled for a lining raise, to alleviate the effects of future subsidence. The team also witnessed significant seepage at two locations along the canal, with the most detrimental between M.P. 56 and 57. According to the report, a prior inspection observed seepage; thus, the maintenance division added a layer of butyl rubber over the concrete lining sometime in 1966. This remedy proved to be insufficient and a plan to completely replace the concrete lining was in development. Silt deposits became more prevalent after the construction of the O'Neill Pumping Plant (at B.F. Sisk Dam and part of the San Luis Unit) and with the "increased operation of the check gates" downstream of the Tracy Pumping Plant (**Figure 20**). Due to a lack of funding for studies, no sufficient method of removing sediment existed in 1970 for the Tracy Field Division.[72]



Figure 19: Discharge of barnyard manure into the canal, May 16, 1970.[73]

[72] United States Department of the Interior, Bureau of Reclamation, *Condition of Major Irrigation Structures and Facilities – Central Valley Project – Report of Examination* (Denver 1970).
[73] [Photograph], 5-70-49D in USDI, Reclamation, *Condition of Major Irrigation Structures and Facilities – Central Valley Project – Report of Examination*, 14; government is starting legal action if this is not stopped by July.



Figure 20: Note rough silty water below gates at Check No. 19, May 16, 1970.[74]

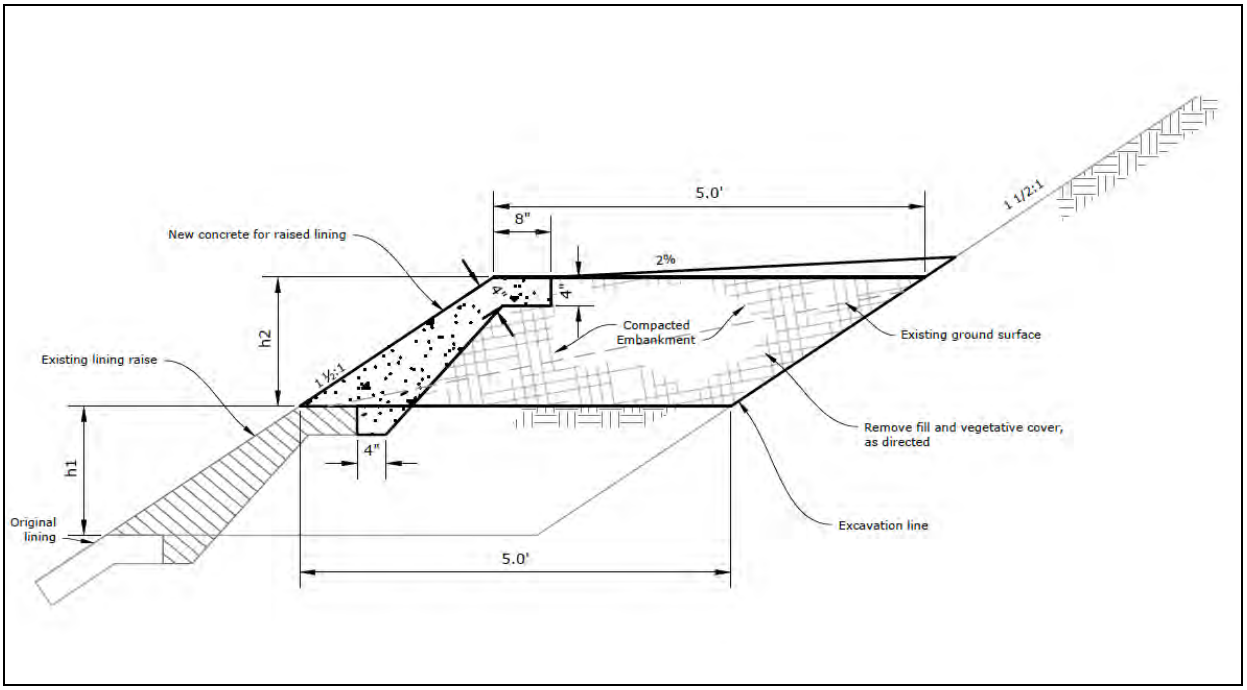


Figure 21: DMC typical cross section showing placement of original concrete lining, previous lining raise, and proposed lining raise.

[74] [Photograph] 214-D-67155 in USDI, Reclamation, *Condition of Major Irrigation Structures and Facilities – Central Valley Project – Report of Examination*, 16; gate pins partially submerged.

Over time various points along the canal have required modifications to correct the carrying capacity of the canal. Reclamation undertook one of the earliest, and most extensive capacity corrections in 1969, raising approximately 70 miles of the concrete-lined canal 18 inches and 24 inches.[75]

Wet conditions and soil characteristics make drainage and erosion control a perpetual issue that requires maintenance, the placement of drains where needed, and abandonment of drains that have become obsolete. As farming intensified around the canal following its completion, drainage water diminished as it was captured by surrounding farmlands. Many original concrete inlet drains have either become obsolete or have deteriorated.

Other changes have taken place to structures that span the canal like bridges and pipe crossings / overchutes since completion of Delta-Mendota Canal. In the 1960s, Reclamation undertook a bridge rehabilitation project that converted timber farm bridges piers from wood to concrete. Pipe crossings are changed frequently, and Reclamation maintains separate license agreements with utility companies for each crossing of water, oil, gas, transmission lines etc. Pipelines are removed, replaced with a new type of pipe, and added at new locations as dictated by local demand.

The massive length and capacity of Delta-Mendota Canal has largely been an obstacle to execution of a comprehensive modernization or upgrade plan because the cost would be prohibitive. Instead, the original design specifications have continued to serve as the basis for maintaining the canal, which has resulted in a high retention of many of the features and the overall character of Delta-Mendota Canal.

3.2. San Luis Drain

The San Luis Drain segment recorded for this report was constructed in sections between 1969 and 1973 as part of the San Luis Unit addition to the Central Valley Project, which expanded the federal water-distribution network to irrigators in the western San Joaquin Valley. The following provides a broad historical overview of the San Luis Unit, chronicles the development of the San Luis Drain, and discusses the significance and lasting impact of the Kesterson Reservoir ecological disaster in the early to mid-1980s.

Central Valley Project – San Luis Unit

The San Luis Drain was constructed as a critical element of the San Luis Unit, a joint state-federal expansion of the Central Valley Project (CVP) to distribute irrigation water to farmers on the west side of the San Joaquin Valley in the 1960s.

[75] USDI, Reclamation, *Designer's Operating Criteria*, 1971: 4-5, 26; Grimsley, J. O. and M. L. Barmettlor, *Condition of Major Irrigation Structures and Facilities*, Region 2, 1970, Appendix I – 3, 6.

As compared to the east side of the valley, agricultural development arrived comparably late to the arid west side of Merced, Fresno, and Kings counties. Through the turn of the twentieth century, the regional economy revolved around ranching—primarily sheepherding—with an economic boom period of oil and coal strikes, which attracted railroads and light municipal development to the area. Irrigation efforts were modest during this period, with farmers digging small canals from the San Joaquin River and repurposing abandoned mining ditches. But, beginning in the 1910s, an influx of local farmers, aided by advances in turbine pump technology, began to extract increasing quantities of high-quality groundwater, converting acres of former pasturage to irrigable lands and progressively pushing ranchers west into the Coast Range foothills. By 1922, 33,000 acres had been irrigated, and by 1948, following the introduction of cotton, hay, grain, alfalfa, and sugar beet crops to the region and boosted by wartime demand, that total had exponentially increased to 484,000 acres. At this time, regional irrigation farmers primarily discharged drainage wastewater into the San Joaquin River and/or its tributaries. However, this growing dependence on underground water resources severely depleted the groundwater table, leading to a 10-foot-per-year drop in the 1930s, with farmers drilling wells as deep as 2,000 feet below the surface. By the early 1950s, the aquifer overdraft reached 500,000 acre-feet per year, an increase from 100,000 annual acre-feet in 1929. In 1942, in response to the growing threat of water scarcity, landowners in western Fresno and Kings counties—among whom several owned over 1,000 acres each in the San Joaquin Valley—established the Westside Landowners Association and began petitioning the US Bureau of Reclamation (Reclamation) to divert surface water from the CVP to the west side of the valley. In response, Reclamation determined that water resources at existing facilities at Shasta Dam on the Sacramento River and Friant Dam on the San Joaquin River would be insufficient to meet the permanent needs of westside farmers and that the CVP would require expansion to meet this growing demand.[76]

To raise political support for transferring water resources to the western San Joaquin Valley, the Westside Landowners Association was reorganized in 1952 as the Westlands Water District (WWD). The new irrigation district was comprised of various incorporated interests—including the Southern Pacific Railroad Company, Standard Oil, and the J. G. Boswell Company, one of the largest agricultural entities in the world—with a service area stretching almost 70 miles between Mendota in Fresno County to Kettleman City in Kings County encompassing 399,000 acres, which was ultimately expanded to 600,000 acres in 1965 following a merger with the Westplains Water Storage District. In 1955, Reclamation released a feasibility study for

[76] Robert Autobee, "San Luis Unit, West San Joaquin Division, Central Valley Project" (Denver, Colorado: Bureau of Reclamation History Program, unpublished manuscript, 1995), 5-7, available at https://www.usbr.gov/projects/pdf.php?id=109 (accessed July 2022); Philip Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley* (Berkeley: University of California Press, 2011), 200-202.

delivering water to the westside, which it named the "San Luis Unit," and detailed an elaborate expansion of the existing CVP, whereby surplus water from the Sacramento-San Joaquin Delta would be delivered south via Delta-Mendota Canal and pumped into a new storage reservoir: the San Luis Reservoir, with a one-million-acre-foot storage capacity, to be located in the inner Coast Range foothills roughly due west from Los Banos in Merced County. The study likewise identified the need for drainage facilities, as the west side experienced poor drainage conditions resulting from the impermeable Corcoran clay layer. To meet increased drainage needs attendant with the expansion of the water-delivery system, Reclamation envisioned an intricate system of underground drains for roughly 96,000 acres of the San Luis service area that would drain saline subsurface groundwater away from low-lying croplands into an open surface interceptor drain (that became the San Luis Drain, recorded on this form), which would convey the water north for release into the Sacramento-San Joaquin Delta. During this same period, the California Department of Water Resources (DWR) produced the California Water Plan as part of the State Water Project (SWP). The water plan included the Feather River Project, which proposed erecting the Oroville Dam on the Feather River; developing a statewide aqueduct system to convey water to the San Francisco Bay Area, the west side of the San Joaquin Valley, and south to Southern California; and constructing a storage reservoir at the San Luis site. In addition to conflict between state and federal authorities concerning their overlapping systems, opposition to the westside expansion of the CVP arose from other contingents as well, namely: groups that argued that the project would serve an area dominated by large landowners in defiance of the 1902 Reclamation Act, which stipulated a 160-acre limit on all lands served by federal irrigation; and water agencies located downstream from the San Luis Unit's service areathat would receive the west side's drainage flows. Following years of negotiations, which included an explicit 160-acre limitation for all lands served by the San Luis Unit along with the inclusion of a drainage provision for affected water agencies, the U.S. Congress passed and U.S. President Dwight Eisenhower signed into law the San Luis Act in 1960, which authorized the annual export of about 1.25 million acre-feet of water to the western San Joaquin Valley to irrigate approximately 500,000 acres in Merced, Fresno, and Kings counties. The act likewise provided for the return of said irrigation water to the Sacramento-San Joaquin Delta as drainage wastewater via proposed interceptor drain (ultimately constructed as the drain recorded on this form).[77]

In 1961, Reclamation and the State of California, which had authorized the SWP with the passage of the Burns-Porter Act of 1959 and narrowly passed bond measures to fund its

[77] Autobee, "San Luis Unit," 7; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 202-205; U.S. Bureau of Reclamation (Reclamation), "San Luis Unit, Central Valley Project, California: A Report on the Feasibility of Water Supply Development" (Sacramento, California: Reclamation Region 2, 1955); Philip Garone, "The Tragedy at Kesterson Reservoir: A Case Study in Environmental History and a Lesson in Ecological Complexity," *Environs* 22, no. 2 (Spring 1999): 114-15.

construction in November 1960, officially resolved the overlapping areas of the CVP and SWP by entering into an agreement to jointly operate the San Luis Unit (**Figure 22**). Reclamation would construct and DWR would operate and maintain the San Luis Dam and Reservoir, now to be enlarged to over two million acre-feet—the largest off-stream reservoir in the United States—to accommodate both projects. In 1963, Morrison-Knudsen Company, Inc., Utah Construction and Mining Company, and Brown and Root, Inc. won the joint contract to build the dam and reservoir, which they completed in August 1967. Transporting SWP water from the Sacramento-San Joaquin Delta to the reservoir, the California Aqueduct would be known as the San Luis Canal where it delivered federal water to the San Luis Unit service area between the reservoir and Kettleman City, south of which it would resume its SWP designation and function: to supply irrigation water to farmers in Kings and Kern counties and in Southern California. Under Reclamation in the San Luis Unit, the San Luis Canal was constructed in five reaches between 1963 and 1968, when water released near Los Banos was finally received in Kettleman City. The San Luis facilities continue to serve the SWP and CVP, and presently comprise of the Governor Edmund G. Brown California Aqueduct / San Luis Canal; B. F. Sisk San Luis Dam; San Luis Reservoir; O'Neill Forebay and Dam, where CVP water from Delta-Mendota Canal is impounded for distribution; the William R. Gianelli Pumping-Generating Plant, which pumps water from O'Neill Forebay into San Luis Reservoir for distribution via the San Luis Canal; the Dos Amigos Pumping Plant, a secondary pumping facility on the San Luis Canal; and the Los Banos and Little Panoche detention dams and reservoirs, which provide flood protection for the San Luis Canal, Delta-Mendota Canal, and various populated areas. Federal-only facilities include the O'Neill Pumping Plant and Intake Canal; Coalinga Canal, a distribution structure erected to sustain the local mining industry, encourage local agriculture, and provide clean drinking water to the city of Coalinga; Pleasant Valley Pumping Plant, which pumps CVP water into the Coalinga Canal; and the San Luis Drain, discussed below.[78]

[78] Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 208-209; Autobee, "San Luis Unit," 9, 14-17; California Department of Water Resources, "San Luis," 2022, https://water.ca.gov/Programs/State-Water-Project/SWP-Facilities/San-Luis (accessed August 2022).

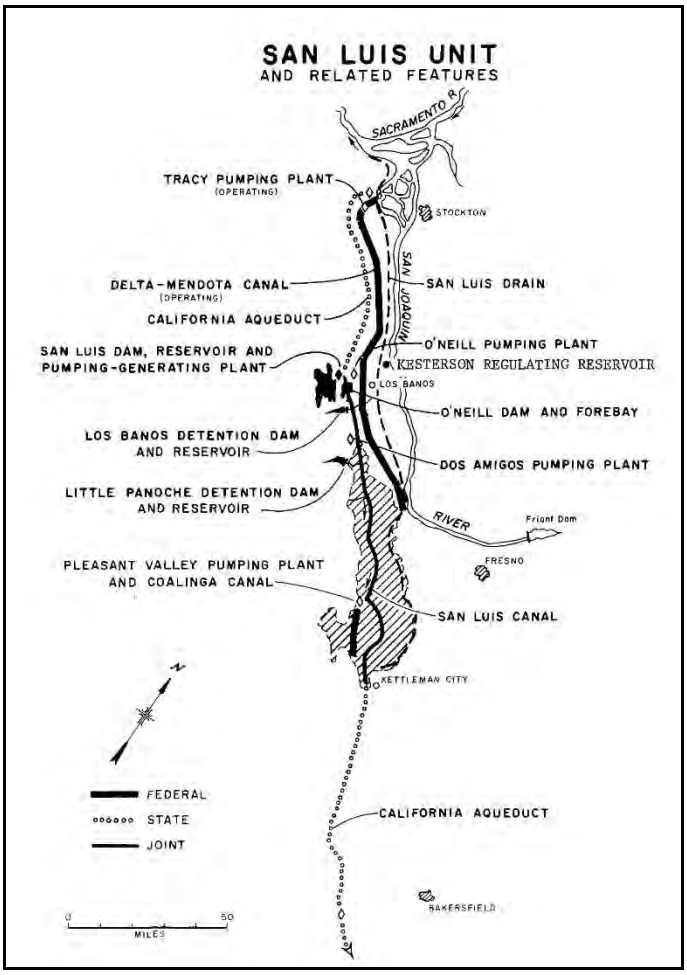


Figure 22: Map of "San Luis Unit and Related Features," ca. 1972.[79]

San Luis Drain

While construction forged ahead on the water storage and distribution elements of the joint state-federal San Luis Unit, the development of drainage facilities lagged. According to the San Luis Act of 1960, drainage infrastructure would either be built by DWR as a "master drain" for the entire San Joaquin Valley or by Reclamation as a smaller interceptor drain for those lands in the San Luis service area. Initially opting out of constructing the master drain, DWR reversed its position in 1964, proposing an approximately 280-mile, concrete-lined structure to extend north from Bakersfield in Kern County to a discharge point near the city of Antioch in Contra Costa County in the Sacramento-San Joaquin Delta, thereby serving the entire western San Joaquin Valley. Construction was stalled, however, when the Contra Costa County Water Agency objected to the plan because it would discharge nitrogen-rich saline drainage that may

[79] U.S. Bureau of Reclamation, "San Luis Unit and Related Features" (March 1972), dwg. no. 805-208-1947, reprinted in W. Turrentine Jackson and Alan M. Paterson, "The Sacramento-San Joaquin Delta: The Evolution and Implementation of Water Policy, an Historical Perspective" (Davis: California Water Resources Center, University of California, Davis, Contribution No. 163, June 1977), 137.

also contain pesticide residues into its freshwater resources. State and federal officials drafted several alternatives to the Antioch outfall, which included diluting discharge flows in natural streams like the San Joaquin River and Salt Slough or storing drainage in evaporation ponds. Reclamation and other supporters of the drain in the San Joaquin Valley did not accept these alternatives, however, because they failed to remove salt from the region, or they continued to utilize the San Joaquin River as a drain. Meanwhile, opposition to the Antioch outfall spread throughout the San Francisco Bay / Sacramento-San Joaquin Delta region, where congressional representatives called for investigations into the drain's pollution potential. In response, in early 1965 U.S. President Lyndon Johnson removed the San Luis Drain from the federal budget while requesting a $300,000 appropriation to fund an environmental investigation into a joint state-federal master drain by the U.S. Public Health Service. Two years later, the Federal Water Pollution Control Administration, subsequently tasked with the investigation, issued a comprehensive report that conditionally endorsed the drain, identifying fertilizer-derived nitrogen as the most dangerous pollutant and discounting subsurface drainage as a source of toxic pesticide residue. While nitrogen treatment and removal studies continued, the report advised partial construction of the San Luis Drain to enable drainage storage, which continued to threaten groundwater resources and agricultural output. In 1967, following the election of Ronald Reagan as California governor, DWR again reversed its position on the drain, finding no political support among San Joaquin Valley farmers for repayment rates at $18 per acre-foot and lacking even 25 percent of the upfront capital drainage construction costs. Responsibility for maintaining compliance with the San Luis Act of 1960 was retained by Reclamation alone, which was then being sued by the Central California Irrigation District for failing to provide drainage in accordance with the act; meanwhile, water deliveries were slated to begin as early as 1968.[80]

Following DWR's abandonment of the regionwide master drain, Reclamation set about designing and constructing an interceptor drain, initially conceived as a 188-mile structure to serve the area between Kettleman City in Kings County to the south and an undetermined discharge point in the Sacramento-San Joaquin Delta to the north. Until a final outfall location was made available, the drain was to empty into Kesterson Reservoir— a proposed complex of 12 interim storage ponds outside of Gustine in Merced County used to store and partially evaporate drainage flows (discussed below). This drainage network was to be developed alongside a drainage collection system constructed by Reclamation for the WWD, which would be comprised of underground concrete pipelines that gathered irrigation drainage from buried drainage pipes installed on private farms. In 1968, Reclamation began SLD's first phase of construction between Tranquility in Fresno County and Kesterson Reservoir. That March, the

[80] Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 209-212; Jackson and Paterson, "The Sacramento-San Joaquin Delta," 139-143.

Sacramento-based Darkenwald Construction Company, Inc. won the first contract for a seven-mile stretch of drain excavation along with 11 irrigation crossings, five road crossings, and two encasement pipes between Highway 180 and Adams Avenue in Fresno County (south of the study area). That October, Menlo Park-based firms, Oscar C. Holmes, Inc. and Holmes-Clair, Inc., won the joint contract to construct precast concrete pipe portions of siphons below the Laguna, Main, Outside, and Bass Avenue / Intake canals, and—in the study area described above—Delta-Mendota Canal (M.P. 121.50). In January 1969, San Mateo-based contracting company, Carl W. Olson & Sons, Inc., was awarded the contract to construct roughly 15 miles of earthwork, concrete lining, and structures between Dos Palos in Merced County and Firebaugh—including Check 37 recorded herein (M.P. 119.31). Work was slated to begin that April and involved a unique construction method to accommodate for the groundwater level located above the drain floor.[81] As explained by journalist Joe Thome, "Although several excavation techniques were tried and varying ones are being used, the best method has proven to be a sled system developed and built right on the job. It is called a 'pre-trimmer [(Error! Reference source not found.)].'" Thome continues:

> The 'pre-trimmer' is pulled along the drain alignment as it excavates the drain to within six inches of the final cut. It also simultaneously excavates three trenches, each 14 inches wide, extending below the rough cut [sic] drain bottom. The center trench, extending about 30 inches below the drain bottom, is used by the contractor to 'de-water' the immediate drain route to allow further excavation and placing of the lining. The two trenches, which run along each edge of the eight-foot wide [sic] bottom, will function to collect and hold water and keep it from lifting the lining out of the ground. In the center trench the contractor lays a 4-inch perforated plastic pipe, which is covered with gravel, and ground water is pumped out at points 1,000 feet apart. The outer trenches, similarly built but only 15 inches deep, will be connected to the canal portion by weep valves, spaced 10 feet apart. This will allow water to seep into the canal through these valves, when it builds up in the trench, and will thus relieve uplift

[81] Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 210; Jackson and Paterson, "The Sacramento-San Joaquin Delta," 144; "Major Recent Contract Awards," *Reclamation Era* 54, no. 2 (May 1968): 54; U.S. Bureau of Reclamation, "San Luis Unit, Central Valley Project: Plan for Disposal of Subsurface Agricultural Drainage" (Sacramento, California: USBR Region 2, June 1969), 17-21, on file at USBR Library, Sacramento, California; U.S. Bureau of Reclamation, Office of Design and Construction, "Designers' Operating Criteria: San Luis Drain, San Luis Unit, West San Joaquin Division, Central Valley Project, California" (Denver, Colorado: USBR, January 1975), 4; Memo Re: Field Inspection for Transfer from Construction to O&M Status for: Stage 1 Kesterson Reservoir and the Three Completed Reaches of the San Luis Drain—Specification Nos. DC-6611, DC-6681, DC-6703, DC-6823—San Luis Unit, CVP, California (December 17, 1973), ff. San Luis Drain (Spec. No. DC-6611), on file at USBR Library, Sacramento, California; "Major Recent Contract Awards," *Reclamation Era* 55, no. 1 (February 1969): n.p.; "Bureau Awards Contract for San Luis Drain," *The Fresno Bee* (January 17, 1969): 12A; "Reservoir Job Contract Due Danville Firm," *Salinas Californian* (March 7, 1969): 13; "Work on First Section of San Luis Drain Begins," *The Modesto Bee* (April 6, 1969): C4.

pressure which could 'float' the concrete lining. The action of the valve will, however, prevent drain water from going from the drain canal back into the trench.[82]

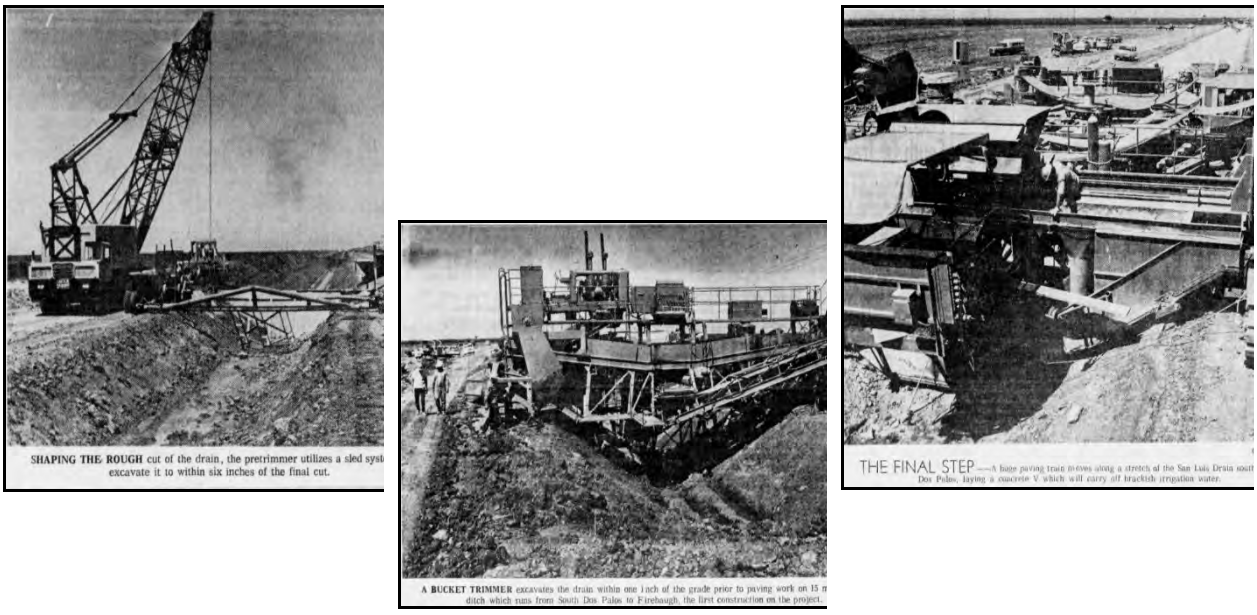


Figure 23: Published photographs of San Luis Drain construction between Dos Palos and Firebaugh, 1969.[83]

Progress on the construction of San Luis Drain, however, was stalled by budget cuts. In April 1969, U.S. President Richard Nixon slashed $2 million from the San Luis Drain budget (among other cuts to the CVP), pushing the timeline back one year, with Carl Olson & Sons (discussed above) completing construction of their section in January 1970. That July, Gordon H. Ball, Inc., based in Danville, Contra Costa County, won the contract for the northernmost 26-mile stretch of earthwork, concrete lining, and structures between Gustine and Dos Palos, along with the 1,283-acre, 12-pond, Kesterson Reservoir, all outside the study area. As mentioned, while the drain's discharge point in the Delta was debated, Kesterson continued to function as a drainage detention and evaporation facility.[84] Aided by advanced technology, Ball reportedly streamlined the canal excavation method employed by Carl Olson & Sons, Inc. (described above), as reported in *Construction Methods & Equipment*, "By mounting a specially-designed digging unit on a canal trimmer, [Gordon H. Ball, Inc.] gained a one-pass machine that

[82] Joe Thome, "San Luis Drain Paving Begins Near South Dos Palos," *The Modesto Bee* (August 18, 1969): B2.
[83] Bee Photos, published in Thome, "San Luis Drain Paving Begins Near South Dos Palos."
[84] Memo Re: Field Inspection for Transfer from Construction to O&M Status for: Stage 1 Kesterson Reservoir and the Three Completed Reaches of the San Luis Drain—Specification Nos. DC-6611, DC-6681, DC-6703, DC-6823—San Luis Unit, CVP, California (December 17, 1973), ff. San Luis Drain (Spec. No. DC-6611), on file at USBR Library, Sacramento, California; Michael Green, "Budget Cut Costs CVP $11.7 Million," *The Modesto Bee* (April 16, 1969): A2; "San Luis Drain May be Finished in 6 or 7 Years," *The Fresno Bee* (April 4, 1970): 6B; "San Luis Drain is Year Ahead," *The Modesto Bee* (October 1, 1970): C1.

simultaneously excavates canal finger drains, trims slopes and bottom, lays continuous plastic pipe, backfills, and screeds drains level with the slopes. Any area passed over by the machine is immediately ready for concreting."[85] In June 1972, Ball, Ball & Brosamer of Danville won construction contracts for an approximately 18-mile stretch of earthwork, concrete lining, and structures comprising the bulk of the study area (M.P. 119.33 – 137.77), along with the southernmost segment terminating at Five Points, outside the study area. For much of the segment in the study area, Reclamation adapted a preexisting earth-lined drainage canal originally dug by the Firebaugh Canal Company around the same time that Delta-Mendota Canal was built, rerouting the earth-lined drain (Drain U-121.2, recorded and evaluated on a separate DPR 523 form attached to this report in **Appendix B**) immediately adjacent to the San Luis Drain segment (**Figure 24**). Ball, Ball & Brosamer completed all work the following year, when construction on the San Luis Drain was halted altogether (**Figure 25**).[86]

Collectively, Gordon H. Ball, Inc., and Ball, Ball & Brosamer constructed 69.51 miles of the extant San Luis Drain, nearly 80 percent of the completed structure, along with the Kesterson Reservoir evaporation ponds. Hailing from a contracting family, Gordon H. Ball began his career working for his father, N. M. Ball, an early proponent of underground concrete irrigation construction who branched out into highway building in the 1920s. Following his father's death in 1935, Gordon Ball partnered with his two brothers forming N. M. Ball Sons, which took on numerous military projects during World War II, including 200 miles of roads for the Hanford Atomic Energy Plant in Hanford, Washington. In the early 1950s, Gordon split off from his brothers, ultimately incorporating as Gordon H. Ball, Inc., in 1957, and was active throughout California, Oregon, Washington, and Hawaii, specializing in concrete paving, as well as highway and bridge construction. In addition to the company's work on the San Luis Drain and Kesterson Reservoir, other CVP work included the Tehama-Colusa Canal and preliminary work for the proposed but never built Auburn Dam (the contract for which issued to Auburn Constructors, a joint venture between Gordon H. Ball, Inc., Guy F. Atkinson

[85] David C. Etheridge, "Hybrid Rig is Versatile Canal Builder," *Construction Methods & Equipment* (October 1972): 61.

[86] Memo Re: Field Inspection for Transfer from Construction to O&M Status for: Stage 1 Kesterson Reservoir and the Three Completed Reaches of the San Luis Drain—Specification Nos. DC-6611, DC-6681, DC-6703, DC-6823—San Luis Unit, CVP, California (December 17, 1973), ff. San Luis Drain (Spec. No. DC-6611), on file at USBR Library, Sacramento, California; Michael Green, "Budget Cut Costs CVP $11.7 Million," *The Modesto Bee* (April 16, 1969): A2; "San Luis Drain May be Finished in 6 or 7 Years," *The Fresno Bee* (April 4, 1970): 6B; Declaration of Taking, United States of America vs. Redfern Ranches, No. F-232, October 4, 1968, 5629 O.R. 444, Fresno County Recorder, Fresno, California; Aero Exploration Co., Flight ABI, Frame ABI-18G-51, February 13, 1950, 1:20,000, flown for U.S. Department of Agriculture (USDA) – Production and Marketing, available at http://malt.lib.csufresno.edu/MALT/ (accessed July 2022); Cartwright and Company, Flight ABI-1957, Frame ABI-29T-138, June 22, 1957, 1:20,000, flown for USDA – Commodity Stabilization Service, available at https://mil.library.ucsb.edu/ap_indexes/FrameFinder/ (UCSB; accessed July 2022); "San Luis Drain Takes Shape in Fresno County," *The Fresno Bee* (September 16, 1973): C1.

Company, and the Arundel Corporation). By 1975, the company had been purchased and operated as a subsidiary of Dillingham Corporation. Some later projects included: the Woodburn-Hayesville Interchange on Interstate 5 between Salem and Portland, Oregon; the Stapleton International Airport runway in Denver, Colorado; runways at Mather and McLellan air force bases in Sacramento; a cofferdam and forebay for a powerhouse at Grand Coulee Dam in Washington; a subway tunnel for the Washington Metropolitan Area Transit Authority (jointly built with the J. F. Shea Company, Inc., and Norair Engineering); and numerous sections of highway throughout California and Oregon, including California State Route 99 in Bakersfield, and Interstate 5 north of Los Angeles.[87] Ball, Ball & Brosamer was formed as joint venture between Gordon H. Ball's two sons, Gordon N. Ball and Dennis W. Ball, and Robert G. Brosamer. In addition to its work on the San Luis Drain, other CVP work includes rehabilitation of a portion of the Friant-Kern Canal, with other works for Reclamation including installation of the Gallegos Canyon Siphons as part of the Navajo Indian Irrigation Project in New Mexico and the Sonoqui Dike in Arizona. As with Gordon H. Ball, Inc., Ball, Ball & Brosamer was most actively involved in heavy highway construction. Gordon N. Ball went on to form Gordon N. Ball, Inc., and Robert Brosamer formed R & L Brosamer, Inc, both active firms based in the San Francisco Bay Area.[88]

[87] "Small Staff Takes on Big Highway Program," *Contractors and Engineers* (January 1965): 35; "Major Recent Contract Awards," *Reclamation Era* 58, no. 2 (May 1972): 33; "Scrapers are Modified to Haul 26-yd Payloads," *Construction Methods & Equipment* 43, no. 9 (September 1961): 86; "Slip-form Machine Paves Three Lanes in One Pass," *Contractors and Engineers* 60, no. 7 (July 1963): 64; "80-ton Bottom-dump Trains Clock Million Yards Monthly," *Roads and Streets* 112, no. 8 (August 1969): 40; "How Ball Handles Maintenance on Oregon's Biggest Highway Job," *Western Construction* 50, no. 10 (October 1975): 24; "Slipform Lanes 50 Feet Wide and 18 Inches Deep," *Western Construction* 50, no. 12 (December 1975): 26; "Aggregate Base and CTB Mixed in Pugmill Plant," *Contractors and Engineers Magazine* 69, no. 5 (May 1972): 16; "Auburn Dam," *Compressed Air Magazine* 80, no. 11 (November 1975): 18; "Blaw-Knox Road and Airport Duo-forms Speed Air Base Paving," *Construction Methods & Equipment* 41, no. 5 (May 1959): 241; "Loaders, Trucks, and Scrapers Move Million Yards a Month," *Contractors & Engineers Magazine* 67, no. 11 (November 1970): 11; "Subway Contractors Overcome Poor Soil Conditions," *Contractors & Engineers Magazine* 68, no. 1 (January 1971): 18;

[88] "Irrigation Trickles," *Irrigation Journal* 27, no. 3 (May-June 1977): 34; "Contractors," *Western Construction* 50, no. 7 (July 1975): 127; U.S. Department of Interior, *Decisions of the United States Department of the Interior Vol. 93, January-December 1986* (Washington, D.C.: U.S. Government Printing Office, 1987), 144; "County Repays FAA $480,000 for False Billing," Los Angeles Times (June 29, 2000): B1; "Gordon N. Ball, Inc.," NewBayBridge.org, n.d. https://www.newbaybridge.org/the_builders/gordon_ball/ (accessed August 2022); "Featured Projects," Gordon N. Ball Inc., 2017, http://ballconco.com/featured-projects/ (accessed August 2022); Robert L. "Bob" Brosamer, "Message from Bob Brosamer," R & L. Brosamer, Inc. [newsletter] (Spring 2001): 2, available at https://www.thenewsletterguy.com/samples/CustomerNewsletters/RLBrosamer.pdf (accessed August 2022).



Figure 24: Excerpt of 1957 aerial photograph, with Firebaugh Canal Company drain (indicated by arrows) in same alignment as San Luis Drain, adjacent to Delta Mendota Canal.[89]



Figure 25: Archival photograph of Ball, Ball & Brosamer constructing outlet transition at UPRR / SR 33 siphon undercrossing, September 20, 1973. San Luis Drain indicated by arrows. Note Delta-Mendota Canal next to the SLD in the middle ground.[90]

[89] Cartwright and Company, Frame ABI-29T-138, 1957, UCSB.

[90] F. A. Shrader, Photograph No. CN805-243-9106NA: San Luis Drain, San Luis Unit, Bureau of Reclamation, Central Valley Project, California (August 20, 1973), available at U.S. Bureau of Reclamation, California-Great Basin Digital Library, https://usbr.contentdm.oclc.org/digital/collection/p15911coll7/id/3074/rec/7 (accessed August 2022).

The San Luis Drain was ultimately built out to about half of its proposed alignment, extending from a point near Five Points in Fresno County north to Kesterson Reservoir, when construction was halted in 1973 (**Figure 26**). Construction of the southernmost 29 miles of canal between Five Points and Kettleman City was impeded by a federal spending freeze that year and funding was never reinstated for its completion. The northernmost 75 miles between Kesterson Reservoir and the proposed Delta discharge outfall faced mounting opposition, not only from environmentalists in the San Francisco Bay Area, who claimed that nitrate-rich drainage water would cause algal blooms and compromise regional ecology, but also over half of all landowners along the proposed canal route between Kesterson and Antioch, most of whom saw the open canal as a loss to their property for the benefit of farmers further south. As a result, the San Luis Drain remained unfinished, and the 12 evaporation ponds at Kesterson Reservoir functioned as the ultimate discharge terminus through 1986, when use of the reservoir and drain was ultimately discontinued following the ecological disaster at Kesterson, discussed below.[91]

As discussed above, the ultimate build-out of the San Luis drainage system terminated at Kesterson Reservoir, a roughly 1,283-acre complex of 12, roughly 100-acre evaporation and seepage ponds separated by earthen berms with a combined storage capacity of 4,330 acre-feet (**Figure 27**). Completed in 1971, Kesterson Reservoir was contained within the larger Kesterson National Wildlife Management Area, created via joint agreement in 1970 between Reclamation and the U.S. Fish and Wildlife Service (USFWS), which would manage the area as a wildlife refuge. Historically, the area contained within Kesterson had been used for cattle ranching and waterfowl hunting, a popular area among local duck clubs. With about half of the fall and winter marsh acreage comprised of seasonally flooded grasslands and other copious food sources, Kesterson was a key stopping point on the Pacific Flyway for migratory birds and other grazing animals. As a partial remediation for summer water scarcity, the Grasslands Water District, under contract with Reclamation, was to furnish several thousand acre-feet of water per year. At the same time, surface agricultural drainage water began flowing into the Kesterson Reservoir via the San Luis Drain in 1972—one year prior to the completion of construction of the reaches further south. Diluted with irrigation-quality water supplied by the Grasslands Water District, the discharge initially produced high-quality wetland habitat between 1972 and 1978, fostering breeding activities among various duck species that nested there in the spring. In 1975, Reclamation officially changed the status of Kesterson from a regulating reservoir to a terminal holding reservoir for storing and concentrating drainage water for release into the San Joaquin River during sufficiently high flows. Meanwhile, in

[91] Jackson and Paterson, "The Sacramento-San Joaquin Delta," 144; William Schiffman, "San Luis Project is Dwindling," Merced *Sun-Star* (October 29, 1973): 2; "Landowners Oppose San Luis Interceptor Drain as Proposed," Newman *Index* (December 14, 1972): 8.

compliance with the San Luis Act of 1960, Reclamation developed the WWD Drainage Collector System, comprised of a network of plastic drains lain six-to-eight feet below the ground surface, between 1976 and 1980. In 1978, for the first time, Reclamation began conveying subsurface irrigation drainage water to Kesterson Reservoir, and by 1981, virtually all the inflow that the SLD conveyed to Kesterson consisted of subsurface water, which contained higher concentrations of trace elements, saline, and other contaminants leached into the soil than surface drainage.[92]

For about a decade prior to the development of the San Luis drainage facilities, state and federal agencies had warned against reusing drainage water. As early as 1960, DWR had identified irrigated agricultural drainage as a key source of water quality degradation in the lower San Joaquin Valley, specifically regarding drainage waters in the Panoche Fan area of the WWD (located in the vicinity west of Firebaugh and Mendota) as "unusable for beneficial purposes" (**Figure 28**).[93] Four years later, DWR discovered selenium in water sampled from this area. As discussed below, selenium is the natural mineral trace element that later caused the ecological disaster at Kesterson Reservoir. In 1961, scientists with the U.S. Department of Agriculture reported on the high probability of selenium in alkali soils, such as those prevalent in the arid San Joaquin Valley. The USFWS warned Reclamation the following year about the risks of toxins bioaccumulating in various organisms exposed to agricultural drainage, as well as the potential harms posed to humans that consumed them. In 1963, the USFWS likewise warned that agricultural contaminants rendered irrigation drainage water unsuitable for wetlands habitat restoration. That same year, the agency further warned that impounded agricultural irrigation drainage water would likely contaminate groundwater, a warning reissued in 1977 by the California State Water Resources Control Board (SWRCB), which determined that the groundwater below Kesterson would ultimately be contaminated should the area continue to serve as the terminus of the San Luis Drain.[94]

[92] Reclamation, "Designers' Operating Criteria: San Luis Drain," 7; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 212-213; S. M. Benson, M. Delamore, and S. Hoffman, "Kesterson Crisis: Sorting Out the Facts" (prepared for the U.S. Department of Energy under Contract Number DE-AC03-76SF00098, July 1990), 2; U.S. Department of the Interior, "Kesterson Reservoir Closure and Cleanup Plan: State Water Resources Control Board Order No. WQ 85-1 for Cleanup and Abatement of Kesterson Reservoir" (July 5, 1985), 2-3; Arnold Schultz, "Background and Recent History," in *Selenium and Agricultural Drainage: Implications for San Francisco Bay and the California Environment, Proceedings of the Second Selenium Symposium, March 23, 1985, Berkeley, California* (Berkeley, California: Bay Institute of San Francisco, 1986), 6.

[93] DWR, "Lower San Joaquin Valley Water Quality Investigation: Bulletin No. 89" (Sacramento: California Department of Water Resources, 1960), 95, qtd. in Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 215.

[94] H. W. Lakin, "Geochemistry of Selenium in Relation to Agriculture," in Selenium in Agriculture" (Washington, D.C.: U.S. Department of Agriculture, Agricultural Research Service, Agriculture Handbook No. 200, 1961), 12; S. B. Moore, "Fish and Wildlife Resources and Agricultural Drainage in the San Joaquin Valley, California: Vol. 1"

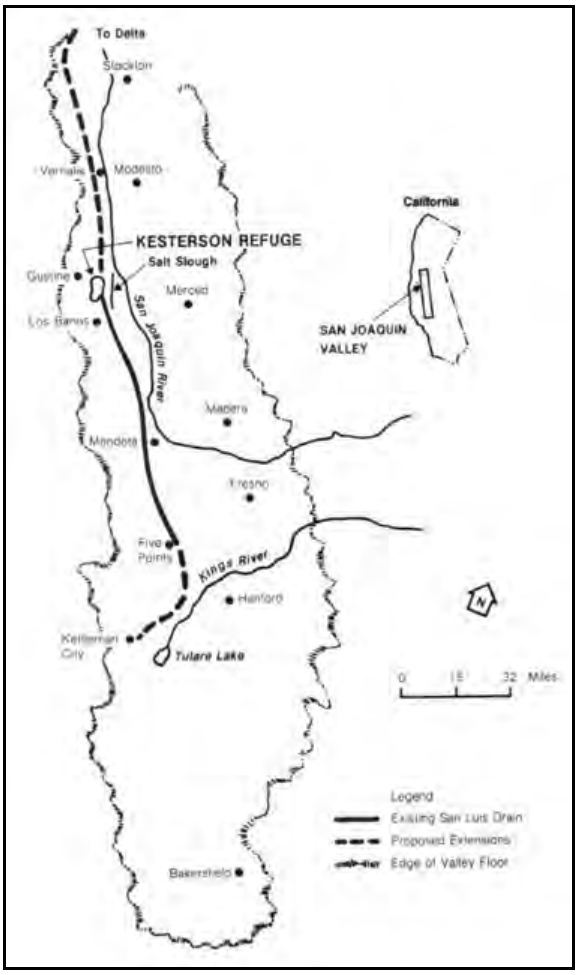


Figure 26: Location of the completed San Luis Drain, from Five Points to Kesterson Reservoir, with proposed segments at north and south ends, no date.[95]

(Sacramento: San Joaquin Valley Drainage Program, 1990), 3-6; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 215.

[95] U.S. Bureau of Reclamation, untitled map of San Luis Drain, no date, reprinted in Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 211.

Ecological Disaster at Kesterson Reservoir[96]

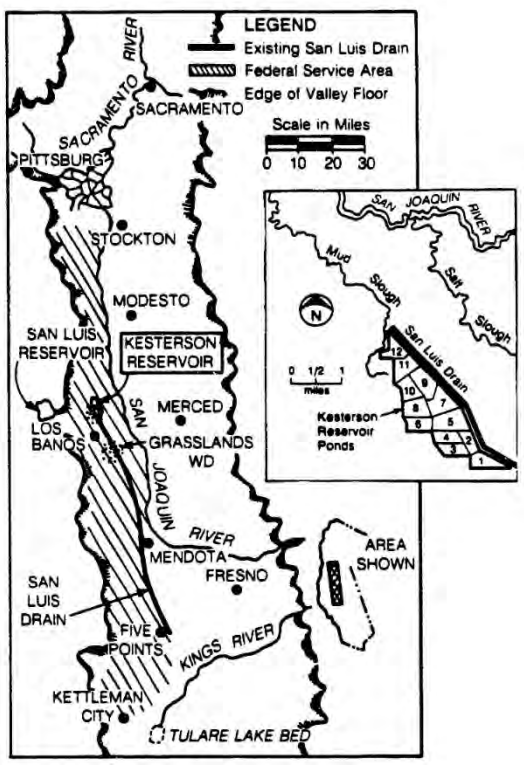


Figure 27: Location map of Kesterson Reservoir, Merced County, showing 12 evaporation ponds in inset, ca. 1990.[97]

[96] The following provides an overview of the ecological disaster at Kesterson Reservoir in the mid-1980s. For a detailed scholarly account, see: Philip Garone, "The Tragedy at Kesterson Reservoir: A Case Study in Environmental History and a Lesson in Ecological Complexity," *Environs* 22, no. 2 (Spring 1999): 107-144; and the expanded chapter, "Tragedy at Kesterson Reservoir" in Philip Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley* (Berkeley: University of California Press, 2011). For a journalistic account, see: Russell Clemings, *Mirage: The False Promise of Desert Agriculture* (San Francisco: Sierra Club Books, 1996); and Tom Harris, *Death in the Marsh* (Washington, D.C.: Island Press, 1991). Since the closure of the Kesterson Reservoir, Reclamation and recipients of CVP irrigation water in the western San Joaquin Valley have struggled with the issue of drainage up to the present. However, this study does not discuss this ongoing aspect of the history of the San Luis Drain. For more information on the evolution of Reclamation's drainage policies in the twenty-first century, see: Kathleen Nitta, "A Tale of Two Water Districts: The Future of Agriculture in California's San Joaquin Valley Lies in Compromise Over Drainage," *Golden Gate University Environmental Law Journal* 5, no. 2 (May 2012): 439-480; and Nigel W. T. Quinn, "Policy Innovation and Governance for Irrigation Sustainability in the Arid, Saline San Joaquin River Basin," *Sustainability* (2020), available at https://escholarship.org/uc/item/7dn0w5g2 (accessed July 2022).

[97] Benson, Delamore, and Hoffman, "Kesterson Crisis," 2.

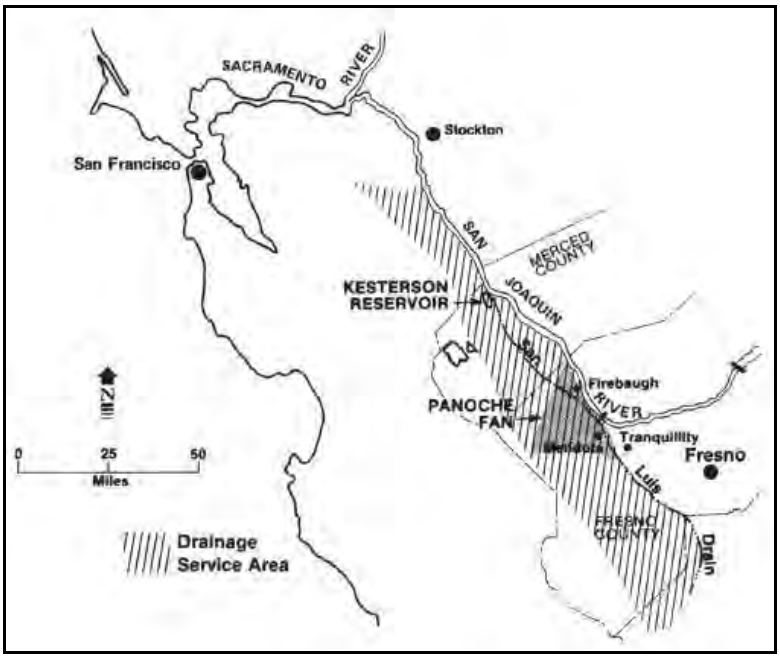


Figure 28: Map of San Luis drainage service area, showing Panoche Fan area—source of high quantities of selenium that contaminated Kesterson Reservoir.[98]

As various agencies had warned, discharging subsurface irrigation drainage via the SLD for indefinite storage in the wetland habitat at Kesterson had disastrous consequences. In 1982 following four years of receiving WWD wastewater in the SLD that was sent to Kesterson Reservoir, perennial cattails were dying off, algal blooms were present throughout the pond complex, the migratory bird population had decreased substantially, and all but one fish species—the mosquitofish—had completely died off. Scientists found the highest recorded selenium concentrations of any living fish among Kesterson mosquitofish. The following summer, USFWS biologists reported that roughly 10 percent of all nests among Kesterson's resident waterfowl breeding populations contained one or more chicks with various developmental deformities. Noting multiple similarities between these deformities and those reported among chicken populations in South Dakota raised on seleniferous soils in the 1930s, the USFWS issued a series of memoranda calling attention to the growing crisis at Kesterson and expressing concern over using agricultural wastewater for habitat management. Around this time, the USFWS closed the Kesterson wildlife refuge to the public and began a hazing program to ward off migrating waterfowl. The following year, scientists also found adult birds dead from selenium poisoning, with one final estimate of at least 1,000 migratory birds, including adults, chicks, and embryos having died of selenium toxicosis from bioaccumulation between 1983 and 1985; scientists have since come to refer to these symptoms of selenium poisoning as the "Kesterson Syndrome." In August 1983, U.S. Geological Survey (USGS) scientists conducted tests in the Kesterson collection ponds, the San Luis Drain, drainage

[98] U.S. Bureau of Reclamation, untitled map of San Luis drainage service area, no date, reprinted in Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 207.

effluents, and shallow groundwater, finding dangerous levels of selenium—140-1,400 micrograms per liter (µ/L), as opposed to that found in typical freshwater, 0.2-0.4 µ/L. Additional testing by the USGS found elevated levels of selenium throughout the WWD service area, from Los Banos to Kettleman City. In September, regional media picked up the Kesterson story and followed the unfolding saga for the next few years—the story even featured on CBS' *60 Minutes*, which fueled public outrage with graphic images of deformed birds and reports of bureaucratic negligence. In March 1984, adjoining landowners, discovering sick and deformed birds on their property, petitioned the Central Valley Regional Water Quality Control Board and ultimately, the SWRCB to take enforcement action against Reclamation.[99]

Compelled by state authorities, Reclamation finally addressed the crisis at Kesterson. Following two hearings in December 1984 and February 1985, and under the authority of the state Porter-Cologne Water Quality Control Act and the Toxic Pits Cleanup Act of 1984, the SWRCB issued Cleanup and Abatement Order No. WQ 85-1, which required the U.S. Department of Interior to resolve the problems at Kesterson and ordered Reclamation to submit a cleanup and abatement plan within five months. The following month, at a House Subcommittee on Water and Power Resources congressional hearing in Los Banos, the Department of Interior dramatically announced its decision to close Kesterson Reservoir and the San Luis Drain and to immediately cease all irrigation water deliveries to the WWD service area that drained into Kesterson for fear of violating the Migratory Bird Treaty Act. Shortly thereafter, Department of Interior amended this arrangement with WWD, which pledged to reduce the export of drainage wastewater by 20 percent every two months beginning in September 1985, plugging all subsurface drains by July 1986. In October 1986, Reclamation, in cooperation with the USFWS and the U.S. Army Corps of Engineers, submitted its environmental impact statement for the Kesterson cleanup project, which offered four solutions, ordered least to most expensive: a flexible response plan; an immobilization plan; a wetland restoration / onsite disposal plan; and an offsite disposal plan.[100] Reclamation proposed a phased approach, graduating from the flexible response plan to the onsite disposal plan as necessary. The SWRCB rejected the phased approach and ordered Reclamation to implement the onsite disposal plan, which called for the excavation, disposal, and replacement of the uppermost six-inch soil layer, including vegetation. However, subsequent studies showed that selenium had

[99] Michael K. Saiki, "Concentrations of Selenium in Aquatic Food Chain Organisms and Fish Exposed to Agricultural Tile Drainage Water," in *Selenium and Agricultural Drainage: Implications for San Francisco Bay and the California Environment, Proceedings of the Second Selenium Symposium, March 23, 1985, Berkeley, California* (Berkeley, California: Bay Institute of San Francisco, 1986), 6; Theresa S. Presser and Ivan Barnes, "Selenium Content in Waters Tributary to and in the Vicinity of Kesterson NWR" (Menlo Park, California: U.S. Geological Survey, 1984), 16; Deborah Blum, "Mineral is Linked to Bird Deformities," *The Fresno Bee* (September 21, 1983): 1; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 217-231.

[100] U.S. Bureau of Reclamation, "Final Environmental Impact Statement, Kesterson Program, Merced and Fresno Counties, California" (Sacramento: U.S. Department of the Interior, Bureau of Reclamation, 1986).

concentrated in shallow groundwater at comparable levels to the drainage ponds, indicating that their release into the wetland would render the ponds as toxic as before. Therefore, in July 1988 the SWRCB ordered Reclamation to fill all low-lying areas where ephemeral pools formed six inches above the expected seasonal groundwater level by January 1, 1989. By November 1988, Reclamation contractors had filled about 710 low-lying acres of the former reservoir with 1,050,437 cubic yards of imported earth, converting the former wetland to an upland habitat and attracting a variety of terrestrial bird species. By the early 1990s, selenium concentrations among plants and animals at Kesterson had stabilized.[101]

The Kesterson disaster fundamentally transformed scientific understanding of selenium-contaminated irrigation drainage, spurring advances in environmental research, wetlands preservation, and governmental policy. Prior to Kesterson, selenium contamination research was largely confined to problems at the individual farm scale, such as how the trace element contaminates crops and impairs livestock. However, following the demonstrated dangers of high selenium concentrations in irrigation drainage at Kesterson, environmental scientists better understood the problem to be an environmental protection issue at the watershed scale with major consequences for irrigation management throughout the western United States. California emerged (and remains) as a global center for selenium contamination research and environmental management. As early as 1985, government scientists began proactively testing for selenium concentrations throughout the Central Valley, with USFWS biologists detecting high rates of selenium poisoning among plants, insects, birds, and fish in the Tulare Basin. Around that same time, as part of the Department of Interior's National Irrigation Water Quality Program, scientists investigated all federal irrigation and drainage facilities for concentrated toxins, finding Kesterson-level rates of selenium toxicosis at five sites in the western United States. By the early 1990s, scientists had established firm links between human activity and high selenium concentrations, identifying sites of irrigated agriculture, mining, and fossil fuel refinement as areas of particular concern. Researchers likewise noted intensified rates of bioaccumulation and biomagnification in aquatic ecosystems, particularly wetland habitats like Kesterson, where selenite—one of the element's primary dissolved forms—was observed to readily concentrate in stagnant areas among various invertebrates and fish species before spreading up the food chain and throughout the ecosystem.[102]

[101] Garone, "The Tragedy at Kesterson Reservoir," 122-123; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 229.

[102] Matteo Francesco Kausch, "From Soil Aggregate to Watershed, from California's Central Valley to the Salton Sea – Agricultural Selenium Contamination Across Ecosystems, Scales, and Disciplines" (PhD. diss., University of California, Berkeley, Spring 2013), 9-13; Arnold Schultz, "Highlights Since Selenium II," in *Selenium and Agricultural Drainage: Implications for San Francisco Bay and the California Environment, Proceedings of the Third*

In response to heightened awareness and a more refined understanding of aquatic selenium contamination, environmental managers in California and elsewhere developed new water quality regulations and environmental management strategies. In 1987, the U.S. Environmental Protection Agency (EPA) established new criteria for imposing maximum limits for selenium concentrations in freshwater and saltwater environments, based partly on observed laboratory results and partly on field studies—including those conducted at Kesterson Reservoir. These standards were made legally binding for 14 states, including California, with the promulgation of the 1992 Water Quality Standards. Noting excessive selenium concentrations in the area surrounding Kesterson, between 1988 and 1990 the California Legislature added 8,224 acres of grasslands watershed marshes, a section of the lower San Joaquin River downstream from subsurface drainage, Salt Slough, and Mud Slough to California's Clean Water Act section 303(d) list of impaired waters. In 1996, Reclamation and the San Luis & Delta-Mendota Water Authority developed the Grasslands Bypass Project to rectify this problem in accordance with total maximum daily load limits for selenium and best management practices introduced that same year by the Central Valley Regional Water Quality Control Board. The Grasslands Bypass Project incorporates the northernmost 28 miles of the San Luis Drain in Merced County to discharge drainage water into Mud Slough for release into the San Joaquin River. Discharges are closely and regularly monitored for selenium, salinity, boron, molybdenum and various nutrients by the USFWS, California EPA, the Central Valley Regional Water Quality Control Board, and California Department of Fish and Wildlife.[103] According to Reclamation, "Since the implementation of the [Grasslands Bypass Project], all discharges of drainage water from the Grassland Drainage Area into wetlands and refuges have been eliminated. The Project has reduced the load of selenium discharged from the Grassland Drainage Area by 61 percent (from 9,600 lbs. to 3,000 lbs.)."[104] Perhaps most importantly, the disaster at Kesterson illustrated an urgent ecological need to reform the CVP—which had historically served the interests of agribusinesses—to incorporate environmental stewardship among its mandates. In 1992, the U.S. Congress passed the Central Valley Project Improvement Act (CVPIA) into law, which mandated reform of the CVP to better

Selenium Symposium, March 15, 1986, Berkeley, California, ed. Alice Q. Howard (Berkeley, California: Bay Institute of San Francisco, 1989), 5, 7; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 231-235.

[103] Kausch, "From Soil Aggregate to Watershed, from California's Central Valley to the Salton Sea," 9-13; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 231-235; U.S. Environmental Protection Agency, "Ambient Water Quality Criteria for Selenium – 1987" (EPA-440/5-87-006, September 1987), 25, available at https://www.epa.gov/sites/default/files/2019-03/documents/ambient-wqc-selenium-1987.pdf (accessed August 2022); U.S. EPA, "Section 319: Nonpoint Source Program Success Story – California Grasslands Bypass Project Reduces Selenium in the San Joaquin Basin" (September 2011), https://www.epa.gov/sites/default/files/2015-10/documents/ca_sanjoaquin.pdf (accessed August 2022).

[104] U.S. Bureau of Reclamation, "Grassland Bypass Project," July 29, 2020, https://www.usbr.gov/mp/grassland/ (accessed August 2022).

protect, restore, and enhance fish and wildlife habitat by placing environmental goals on par with irrigation and domestic water usage. Some environmental policy changes implemented under the Act include: the dedication of 800,000 acre-feet of water per year to fish and wildlife along with firm water commitments to Central Valley wildlife refuges; the restoration of anadromous fish populations; the establishment of a habitat restoration fund financed by water and power users; and the installation of mitigative technology at various sites, including temperature control devices and fish passage infrastructure. The Act also stipulates that the CVP would establish no new contracts until it had achieved its environmental goals. Since the passage of the CVPIA, Reclamation, in partnership with various federal, state, and local agencies, has implemented aquatic habitat improvement projects on the American, Stanislaus, Yuba, and Upper Sacramento rivers and Clear, Mill, and Deer creeks; provided annual water allotments and upgraded or built conveyance facilities to 19 federal, state, and private managed wetlands; and funded independent restoration programs on the San Joaquin and Trinity rivers through the habitat restoration fund.[105]

[105] U.S. Bureau of Reclamation, " Central Valley Project Improvement Act (CVPIA)," April 27, 2022, https://www.usbr.gov/mp/cvpia/ (accessed August 2022); U.S. Bureau of Reclamation, "Central Valley Project Improvement Act: Fact Sheet," October 2021, https://www.usbr.gov/mp/mpr-news/docs/factsheets/cvpia.pdf (accessed August 2022); U.S. Bureau of Reclamation, "CVP Habitat Restoration," February 2022, https://www.usbr.gov/mp/mpr-news/docs/factsheets/habitat-restoration.pdf (accessed August 2022); California Department of Fish and Wildlife, "Refuge Water Supply Program," n.d., https://wildlife.ca.gov/Conservation/Watersheds/Refuge-Water (accessed August 2022).

4. NRHP / CRHR Evaluation

4.1. Criteria for Evaluation

The eligibility criteria for designating historic properties under federal and state criteria are essentially the same. The criteria for listing properties in the National Register of Historic Places (NRHP) are codified in 36 CFR 60 and expanded upon in numerous guidelines published by the National Park Service. Buildings, structures, objects, sites, and districts listed in, eligible for listing in, or that appear eligible for listing in the NRHP are considered historic properties under the regulations for Section 106 of the National Historic Preservation Act (NHPA) (36 CFR Part 800). Eligibility for listing buildings, structures, objects, sites, and districts (i.e., historic properties) in the NRHP rests on twin factors of *historic significance* and *integrity*. A resource must have both significance and integrity to be considered eligible. Loss of integrity, if sufficiently great, will overwhelm the historic significance a property may possess and render it ineligible. Likewise, a property can have complete integrity, but if it lacks significance, it must also be considered ineligible. Historic significance is judged by applying the NRHP criteria, identified as Criteria A through D. The NRHP guidelines state that a historic property's "quality of significance in American history, architecture, archeology, engineering, and culture" must be determined by meeting at least one of the four main criteria. Properties may be significant at the local, state, or national level. The NRHP criteria are:

Criterion A: association with "events that have made a significant contribution to the broad patterns of our history;"

Criterion B: association with "the lives of persons significant in our past;"

Criterion C: resources "that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values;"

Criterion D: resources "that have yielded, or may be likely to yield, information important to history or prehistory."[106]

Integrity is determined through applying seven factors to the historic resource: location, setting, design, workmanship, materials, feeling, and association. These seven can be roughly grouped into three types of integrity considerations. Location and setting relate to the relationship between the property and its environment. Design, materials, and workmanship, as they apply to historic buildings, relate to construction methods and architectural /

[106] USDI, National Park Service, *Guidelines for Applying the National Register Criteria for Evaluation, National Register Bulletin 15* (Washington, D.C.: USDI, National Park Service, 1990, rev. 1997).

engineering details. Feeling and association are the least objective of the seven criteria and pertain to the overall ability of the property to convey a sense of the historical time and place in which it was constructed.

4.2. Central Valley Project Draft Multiple Property Listing

In 2009 Reclamation prepared a *Draft National Register of Historic Places Multiple Property Documentation Form: Central Valley Project* (CVP MPL); Reclamation updated the draft in 2018.[107] The CVP MPL identifies the period of significance for the CVP as 1935 when the project received its first authorizations to 1956 when the last of the major project components was completed. The document provides registration criteria regarding NRHP significance and integrity. The subsections of the registration requirements relied upon for this evaluation of Delta-Mendota Canal for individual eligibility for listing in the NRHP are the subsection for "Main Canals," and for "Appurtenant Canal Features," as quoted below. The NRHP and CRHR evaluation of Delta-Mendota Canal contained in this report utilizes the framework provided in the CVP MPL.

The following is excerpted from the CVP MPL:

Main Canals

Construction on the first main canal of the CVP, the Contra Costa Canal of the Delta Division, commenced in 1937 and was completed in 1948. In 1940, construction began on the Madera Canal of the Friant Division, with construction completed in 1945. In 1945, construction on the Friant-Kern Canal began. The following year, construction on Delta-Mendota Canal commenced. Finally, in 1950, construction on the Delta Cross Channel began. The Friant-Kern Canal, Delta-Mendota Canal, and Delta Cross Channel were all completed in 1951-1952. The longest main canal is the Friant-Kern Canal at 151.8 miles, while the shortest is the Delta Cross Channel at 1.2 miles. All main canals are located on Reclamation fee title or easement land.[108]

Significance

In conjunction with the storage and diversion dams, canals form the CVP's backbone. They provide the means to transfer, transport, and deliver water through the system and ultimately to the water users. Traversing across hundreds of miles, the canals form a significant feature of the physical landscape and define the geographical limits of the project. In keeping with the original CVP plan of large-scale water transfers, canals are the primary means behind the

[107] Jim Bailey, "National Register of Historic Places Multiple Property Documentation Form, Central Valley Project: Planning and Construction of the First Four Divisions, 1935-1956," draft prepared for Reclamation, 2009, updated 2018.
[108] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 106.

geographical redistribution of fresh water from the valley's wetter northern reaches to the drier southern stretches.[109]

Registration Requirements for CVP Canals

The period of significance for historic CVP water conveyance structures begins in 1937 with the initial construction of the first CVP canal, the Contra Costa Canal, and ends in 1951 with the completion of the Friant-Kern, Delta-Mendota, and Delta Cross Channel canals. Like the CVP's dams (Shasta, Friant, Folsom, Keswick, and Nimbus dams), these canals are part of the initial CVP authorizations. The main canals within the period of significance for this historic context are all considered individually eligible (if they retain sufficient historic integrity) because of their primary role in operating the CVP. The main canals can be individually eligible for the National Register under one or more of the criteria, as follows:[110]

Criterion A: They have had a significant impact on the settlement, agricultural economy, or development patterns of the project area; they have been defining elements in the evolution of the cultural landscape; they are directly associated with important events.

Criterion B: They are the result of the direct efforts of a prominent individual associated with the CVP and are the most prominent feature associated with that individual.

Criterion C: They represent the distinctive characteristics of Reclamation canal design and/or methods of construction used on the CVP; they involved challenging engineering design problems due to topography, grade, length, natural obstacles, and resulted in complex or innovative solutions; they are among the best or a rare surviving example of a distinctive type of water conveyance structure; they represent the evolving technology in the engineering, design, and construction of water conveyance structures; they were identified during the construction period as an individually significant feature; or they embody the work of a significant engineer or builder.

Criterion D: They have the ability to yield information important to understanding the history of the CVP.[111]

Integrity

The need for continual maintenance and repairs to canals requires special consideration of integrity. Irrigation systems are constantly evolving as features are upgraded, repaired, or replaced. Alterations made to canals during the period of significance, and even subsequent to

[109] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 106.
[110] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 107.
[111] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 108.

that may not nullify eligibility if a canal retains certain key qualities. Most important are integrity of location, association, and overall design configuration of the conveyance prism (i.e., depth and width) and water control features. A canal which has retained its original form and associated appurtenant features has a high degree of integrity. It is not uncommon for canal lining to be replaced, or for previously unlined segments to be lined. Such changes may not preclude a canal's eligibility if replacement features are in-kind, or they do not significantly damage the canal's historic association or its overall design. If in addition to integrity of association, location, and overall design, the historical setting and feeling of a canal are maintained, then the likelihood is even higher that an altered canal could remain eligible. On the other hand, if an entire canal is piped, it would no longer convey any of its original design, workmanship, materials, or historical association and would not be contributing. Conversely, partial piping of a significant canal may not preclude eligibility if a majority of a canal is still open and intact.[112]

Appurtenant Canal Features

Although appurtenant canal features are all operationally and thematically related to canals, each feature type serves a specific purpose. These features can be divided into five categories of structures: conveyance, regulating, protective, water measurement, and bridges. The first four of these types were built to function as part of the canal, while the bridges were built to function independently of the canal.[113]

1. *Conveyance Structures*

Conveyance structures are features such as inverted siphons, drops, chutes, flumes, tunnels, and pipelines that are used to safely transport water from one location to another traversing various existing natural and manmade topographic features along the way. There are two types of pipelines, those that carry water below ground and those that transport water above ground.[114]

2. *Regulating Structures*

Regulating structures are used to raise, lower, or control the release and volume of the water flow. Regulating structures that are located at the source of the water supply include headworks and turnouts. Headworks control the release of water into the canal and are often located downstream from a major diversion or storage facility. Regulating structures located along the course of a canal include turnouts, checks, check-drops, radial gates, reservoirs, and

[112] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 108-109.
[113] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 109.
[114] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 109.

diversion structures. The smaller regulating structures like checks and turnouts are basic components of an irrigation system.[115]

3. *Protective Structures*

Protective structures protect the canal system and adjacent property from damage which would result from uncontrolled storm runoff or drainage water, or an uncontrolled excess of flow within the canal. Several different types of structures perform this function, including overchutes, drainage inlets, siphon spillways, and wasteways.[116]

4. *Water Measurement Structures and Objects*

Water measurement structures are used to gauge water flow and ensure its equitable distribution. Many different types of water measurement structures are used in irrigation systems. The type most commonly used in Reclamation's systems are Parshall flumes, weirs, open-flow meters, and constant head orifices.[117]

5. *Miscellaneous Structures*

a. Bridges

Bridges crossing CVP canals include single lane bridges, multi-lane highway bridges, farm bridges, pedestrian bridges, and maintenance bridges. Most of the bridges constructed within the period of significance were built by Reclamation according to standard designs. Ownership of the bridges were turned over upon their completion to other entities, including city, county, or state transportation agencies. There are also many bridges not constructed by Reclamation that have been added over CVP canals and were built outside the period of significance for this historic context. Additionally, some original bridges built by Reclamation have been replaced.[118]

b. Gauging or Recording Stations

Several types of small structures were built in association with gauging or recording stations to measure canal flows. The most common are small circular plan, sheet metal structures called "tin whistles" or "silver bullets" that provide enclosure for recording devices. A second type of shelter is small reinforced concrete "houses." When gauging or recording stations are located over the canal, simple wooden footbridges with wood handrails were constructed to permit the taking of measurements. In some cases, the original bridges have been replaced with

[115] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 109-110.
[116] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 110.
[117] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 111.
[118] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 111.

concrete or metal ones, which are easier to maintain. Many of the gauging or recording structures are built on concrete pads, adjacent to the canal, on the canal berm.[119]

Drains

Drains are water conveyance structures (either open channels or buried pipes) that carry excess water away from irrigated agricultural fields to prevent rising water tables. A drain classification was instituted by Reclamation in 1920 that categorized drains into three classes according to their size and relative importance. Class I or "deep drains" are the largest and most significant, with Class III being the smallest and least significant.[120]

Significance Methodology

Secondary to the canals in distributing water are the thousands of appurtenant features. With the exception of bridges, these appurtenant features are important to the overall operation of the main canals, yet are too small in size and repetitive in design to merit individual eligibility.

Even though bridges cross canals and can be physically tied to the canal prism, bridges have no connection to the operation of the CVP and therefore merit separate evaluation from other appurtenant features. In addition, most of the bridges were either constructed by Reclamation and ownership was turned over to a different entity or they were constructed by a different entity. Because of these reasons, bridges would rarely be individually eligible for the National Register in association with this historic context.[121]

Registration Requirements

The period of significance for historic appurtenant canal features begins in 1937 with the initial construction of the first CVP canal, the Contra Costa Canal, and ends in 1951 with the completion of the Friant-Kern, Delta-Mendota, and Delta Cross Channel canals. CVP appurtenant canal features can be eligible for the National Register for the following reasons:[122]

Criterion A: They are directly associated with important events that occurred along canals;

Criterion B: not applicable;

Criterion C: They are among the best or a rare surviving example of a distinctive type of appurtenant canal feature; they represent the evolving technology in the design of appurtenant canal features; they represent a unique design solution developed in response to

[119] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 111.
[120] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 124.
[121] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 112.
[122] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 112.

a difficult engineering challenge; they were identified during the construction period as an individually significant feature;

Criterion D: They have the ability to yield information important to understanding the history of the CVP.[123]

Integrity

As with canals, many appurtenant features are upgraded, altered, or even replaced over time due to the constant ongoing maintenance needs. Integrity of a structure's historic materials, workmanship and design is essential for National Register eligibility under any criterion. Because location is of primary importance under Criterion A, a structure will rarely qualify under this criterion if it does not remain on its historic site along its associated canal. Location can also have importance under Criterion C, but this association is less vital.[124]

4.3. Evaluation of Delta-Mendota Canal

Portions of Delta-Mendota Canal and some of its appurtenant features have been subject to previous NRHP evaluations. In 2009, Reclamation historian Jim Bailey prepared a draft NRHP nomination form that concluded that Delta-Mendota Canal meets NRHP Criterion A with a period of significance from 1946-1951. Bailey also evaluated Tracy Pumping Plant in 2009, concluding that it meets NRHP Criterion A and C with a period of significance of 1951. Other appurtenant features of the canal that have been previously evaluated are listed in **Table 4** below with the updated status codes provided by this evaluation.[125]

Table 4: Previously evaluated segments and appurtenant features of Delta-Mendota Canal.

Primary String	Resource Name	Status Code – Previous	Status Code – Updated by this evaluation	County
P-10-005165	Delta-Mendota Canal Bridge	3D	6Z	Fresno
P-10-006215	Sierra Avenue Bridge (42C0281); Sierra Avenue Bridge over Delta-Mendota Canal	3D	6Z	Fresno
P-10-006649	Bridge 42C0074; Nees Avenue Bridge over Delta-Mendota Canal	3D	6Z	Fresno

[123] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 112-113.
[124] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 113.
[125] California Historical Resource Status Codes.
2S2: Individual Property determined eligible determined eligible for NR by a consensus through Section 106 process. Listed in the CR.
3D: Appears eligible for NR as a contributor to a NR eligible district through survey evaluation.
3S: Appears eligible for NR as an individual property through survey evaluation.
6Z: Found ineligible for NR, CR, or Local designation through survey evaluation.

Primary String	Resource Name	Status Code – Previous	Status Code – Updated by this evaluation	County
P-24-001703	Delta Mendota Canal	2S2	2S2	Merced
P-24-001848	San Luis Wasteway (part of Delta-Mendota Canal)	2S2	2S2	Merced
P-39-000089	Delta Mendota Canal	3D	2S2	San Joaquin
P-50-001904	Delta Mendota Canal	2S2	2S2	Stanislaus
P-01-010442	Tracy Pumping Station (No. 11a)	3S	2S2	Alameda
P-07-002983	Tracy Fish Collection Facility	6Z	6Z	Contra Costa

The following presents the evaluation of Delta-Mendota Canal for individual eligibility for listing in the NRHP and CRHR under the theme presented in the draft CVP MPL.

Criteria A and 1

The CVP fundamentally altered California's landscape and economy by moving water over a long distance from basin to basin and providing more reliable irrigation water to regions previously prone to scarcity of both surface water and groundwater. Delta-Mendota Canal, an integral component of the Delta Division of the CVP, allowed continued delivery of water to irrigators on the San Joaquin River so that water could be diverted further south to areas with a lower water supply. While its benefits to agriculture cannot be overstated, Delta-Mendota Canal is also at the center of the controversy over replacing impounded and re-routed San Joaquin River water that no longer flows through historic salmon and steelhead spawning grounds.

Whether viewed as beneficial or harmful, Delta-Mendota Canal is an instrumental component in accomplishing the objective of the CVP, bringing irrigation water from the wetter northern state to the arid regions of the San Joaquin Valley. At 116 miles long, stretching from C.W. Bill Jones Pumping Plant (Tracy Pumping Plant) in the Delta to Mendota Pool on the San Joaquin River, Delta-Mendota Canal demonstrates the purpose of the CVP, and the scale of the transformation it generated. The canal has had a lasting legacy on California agriculture, providing a reliable water source to support immensely successful agricultural enterprises. Delta-Mendota Canal meets NRHP Criterion A and CRHR Criterion 1 at the state level because of its primary role in accomplishing the visionary goals of the CVP to transfer a substantial

portion of the San Joaquin River water supply from its historical route to the arid lands of the southern San Joaquin Valley. Delivery of San Joaquin River water away from its historical water users was not a tenable proposition without the provision for replacement water delivered by Delta-Mendota Canal. The period of significance under these criteria is from the awarding of the first construction contract in 1946 to 1951 when water was first turned down the canal to provide a replacement supply of water.

Criteria B and 2

The CVP was the result of the efforts of many individuals and agencies over many years and no one person or group of people rises in the historical record as playing a direct role in its implementation in a way that would be best demonstrated by Delta-Mendota Canal; therefore, Delta-Mendota Canal is not individually eligible for listing in the NRHP under Criterion B or in the CRHR under Criterion 2.

Criteria C and 3

Delta-Mendota is individually eligible for listing in the NRHP and CRHR under Criterion C and Criterion 3 because its size, scale, and purpose demonstrate the magnitude of the CVP's engineering and construction accomplishment. The largesse of the vision required an outsized engineering effort and no other component part of the CVP better demonstrates the vision than Delta-Mendota Canal, designed to provide water to replace the flow of the San Joaquin River. Construction of any long-distance linear infrastructure requires extensive planning and engineering, large-scale construction, and coordination among jurisdictions and agencies. As one contemporary observer noted, the "quantity of earth moved is equivalent in mass to more than three times that of Grand Coulee Dam – world's largest concrete structure – and the quantity [*sic.*] of concrete placed for the 97-mi. concrete-lined portion of the canal is more than sufficient to build a sidewalk 3 ft. wide and 4in. thick between San Francisco and New York City."[126] The scale of the project and the sheer number of obstacles present along the 116-mile alignment made its design and construction a monumental undertaking. The canal's significance, however, is not tied to the engineering or construction of any of its individual components or appurtenant parts, but rather to its ability to demonstrate the scale of the project by the long-distance conveyance of water for the purpose of transferring water between watersheds. Delta-Mendota Canal is individually eligible at the state level under NRHP Criterion C and CRHR Criterion 3 because it demonstrates the visionary engineering achievement that redistributed the flows of major rivers between basins in California. The period of significance under these criteria is the period of construction of Delta-Mendota Canal, 1945-1951.

[126] "Concrete Lining Complete for Delta-Mendota Canal," *Western Construction* 25, n. 12 (Dec. 1950), 81.

Morrison-Knudsen Company, Inc., who won four construction contracts for Delta-Mendota Canal in partnership with M.H. Hasler Construction Company, built the largest share of the canal. Morrison-Knudsen should be considered a master builder for their large body of work and extensive experience with large infrastructural construction projects both in the United States and worldwide since the 1930s that included among other civil and military works, very large dam projects like Hoover Dam on the Colorado River. While construction of Delta-Mendota Canal was a large undertaking for the company, it does not best represent their body of work. They were most known during the pre- and post-World War II period for construction of military installations, bridges, and large dams. Delta-Mendota Canal would not best represent the work of any of the other contractors who won contracts for the canal because their contributions to the project were only to a small fraction of the overall project.

Delta-Mendota Canal also meets NRHP Criterion C and CRHR Criterion 3 because of its direct association with the contributions of renowned Reclamation engineer Oscar Boden who headed the investigation, planning, and siting of the Delta Division of the CVP, including Delta-Mendota Canal. Delta-Mendota Canal, a principal element of the CVP, is an historically important example of this master engineer's work. The period of significance for this canal is its period of construction, 1946-1951.

Criteria D and 4

Delta-Mendota Canal is not eligible under NRHP Criterion D or CRHR Criterion 4 for information potential because it was designed and built according to well-documented practices, and the project is well documented through drawings, textual records, and photographs.

4.3.1. Character-defining Features and Integrity of Delta-Mendota Canal

In general, the character-defining features of Delta-Mendota Canal are its location, its relationship to C.W. Bill Jones Pumping Plant (Tracy Pumping Plant), the size, shape, and dimensions of the canal prism, its lining material (approximately 95 miles of concrete and 18 earthen miles), and the direction of water flow from C.W. Bill Jones Pumping Plant downstream to Mendota Pool. Individual elements that contribute to the significance of Delta-Mendota Canal along its 116.4 miles are those structures that are directly related to its significance under NRHP Criterion A / CRHR Criterion 1 and NRHP Criterion C / CRHR Criterion 3, i.e., structures that directly relate to the conveyance of CVP water from the pumping plant to Mendota Pool. Structures like C.W. Bill Jones Pumping Plant, check structures and siphons that convey and control the water's southerly flow from the pumping plant, and structures like turnouts that direct the water to users along its route and wasteways the control excess flows all relate directly to the canal's significance and purpose and therefore contribute to the significance of the historic property. Structures that accommodate pre-existing uses or

conditions like pipe crossings, siphon undercrossings, culverts, drains, overchutes, and most bridges do not contribute to the historic significance of this linear historic property because they are not directly related to the conveyance of CVP water, and instead serve ancillary purposes. Similarly, ancillary features like gauging stations or salinity stations do not relate to the historic significance and are not character defining. Operating bridges that are used specifically for the operation of the canal, as opposed to farm bridges or county road bridges that simply cross the canal and have no relationship to its functioning as a CVP water conveyance, have potential to contribute to Delta-Mendota Canal's significance; however, none of this category of bridges crossing Delta-Mendota Canal retain historic integrity. See **Table 2** below and **Appendix C** for contributing status of component elements of Delta-Mendota Canal.

Table 5: Contributing Status of Component Parts of Delta-Mendota Canal.

Structure Type	Contributing Status
Farm Bridges	Non-Contributing
Railroad Bridge	Non-Contributing
Pipe Crossings	Non-Contributing
County Highway Bridges	Non-Contributing
Overchutes	Non-Contributing
Inlet Drains	Non-Contributing
Road Drains	Non-Contributing
Culverts	Non-Contributing
Cattle Guards	Non-Contributing
Pumps	Non-Contributing
Ladders	Non-Contributing
Gauging Stations	Non-Contributing
Gates	Non-Contributing
Check Structures	All are Contributing
Siphons	All are Contributing
Wasteways	4 are Contributing, 1 is not – see Master Table in **App. D**
CVP Signs	All are Contributing
Lining / Prism	Lining to original specifications is Contributing
O&M Roads	Contributing (roads on canal embankments)
Operating Bridges	Non-contributing; integrity loss
Turnouts	Some are contributing – see Master Table in **App. D**
Pumping Plants	C.W. Bill Jones Pumping Plant is Contributing

The character-defining features and integrity of contributing elements are discussed below, followed by a discussion of the overall integrity of Delta-Mendota Canal. See **Appendix C** for the contributing status of individual components of the historic property.

Canal Prism, Embankments, Maintenance Roads

The character-defining features of Delta-Mendota Canal prism are its original material composition, and original design. Specifically, this includes: its concrete- and earth-lined construction; its original dimensions – height, width, and shape, side slopes, embankments, and O&M roads; and its alignment (**Figure 29**- **Figure 32**).

Those sections of Delta-Mendota Canal prism that have a high degree of integrity and, therefore, contribute to the significance of the historic property are those that retain all or most of their character-defining features. While some concrete-lined stretches of the canal have been altered by the raising of the lining, this modification only constitutes a minor loss of integrity of design, as the work included appropriate materials (concrete) and the elevated extensions were clearly differentiated from the original by a concrete seam above the original lining. As such, these alterations were made in accordance with standards set forth by the *Secretary of the Interior's Standards for the Treatment of Historic Properties* and do not disqualify those sections with raised concrete lining from contributing to the significance of Delta-Mendota Canal.[127] Similarly, those originally earth-lined sections that have been altered by the addition of rip-rap only suffer slightly diminished loss of integrity of designs or materials; however, the rip-rap itself is considered a non-contributing element.[128] While the majority of the surrounding setting remains rural in nature as it was at the time of Delta-Mendota Canal's period of significance, 1946-1951, suburban development radiating out from Mountain House, Tracy, and Patterson have started to alter the characteristic setting. The canal itself in these areas retains its other character-defining features and thus contributes to the significance of Delta-Mendota Canal as a whole. As Delta-Mendota Canal has remained in its original alignment, it retains a high degree of integrity of location throughout the entirety of its alignment.

[127] Kay D. Weeks and Anne E. Grimmer, *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings*, revised by Anne E. Grimmer (Washington D.C.: USDI, National Park Service, Technical Preservation Services, 2017).
[128] The *Secretary of the Interior's Standards for the Treatment of Historic Properties* favor protecting historic properties with temporary materials while planning for repairs that meet the standards.



Figure 29: View of concrete-lined section of canal from approximately M.P. 91.36; camera facing upstream from left bank, June 14, 2022.



Figure 30: View of earth-lined section of canal from approximately M.P. 104.22; camera facing downstream from left bank, June 14, 2022.



Figure 31: View of embankment and concrete-lined section of canal; camera facing downstream from left bank, June 14, 2022.



Figure 32: View of embankment and maintenance road along earth-lined section; camera facing downstream from left bank, June 15, 2022.

C.W. Bill Jones Pumping Plant (Tracy Pumping Plant)

The Tracy Pumping Plant complex is made up of the Delta-Mendota Intake Canal (M.P. 0.0-2.52), the Tracy Pumping Plant facility (now called "C.W. Bill Jones Pumping Station") (M.P. 2.53), three (3) 15-foot (inside) diameter, 4,822-foot long concrete discharge pipes, a concrete-block siphon breaker house with a flat, overhanging roof at the end of the discharge lines (M.P. 3.49), and a concrete inlet structure that releases the water from the Plant into the concrete-lined section of the DMC, at M.P. 3.50. Each of these features is character defining of the Tracy Pumping Plant.

The Delta-Mendota Intake Canal contains fish collection facilities (M.P. 0.09) and a three-barrel siphon under Byron-Bethany Road and a single track for Union Pacific Railroad (formerly Southern Pacific Railroad) (M.P. 1.36/ M.P. 1.41). The character-defining features of the Intake Canal include: the fish collection facilities; the three-barrel siphon; and its loose-earth construction.

The Pumping Plant is a semi-outdoor facility. The building has a two-story rectangular plan, made of concrete, with a flat, parapet roof with inset handrails. The treatment of the concrete walls creates a rectangular pattern on the north, south, and east façades and the windows and doors of the north and south façades are symmetrically arranged and centered on their respective sides. The character-defining features of the Pumping Plant include: the aforementioned form and massing; concrete construction; the windows on the north façade; the accordion doors on the south façade; the inset handrails on the roof and north façade; the six circular, removable hatches on the roof; the six vertical-shaft pumping units symmetrically arranged in pairs within the three eastern sections of the building; and the inlet transition walls.



Figure 33: Tracy Pumping Plant; camera facing southwest, May 9, 2022.



Figure 34: Tracy Pumping Plant; camera facing east, May 9, 2022.

Siphons

The population of Delta-Mendota Canal siphons comprises 13 concrete structures (see **Appendix C** for a listing of all appurtenant DMC structures). Siphons are defined by their concrete construction, with sloped-to-vertical transitional wingwalls, concrete box inlets and

outlets, and one-, two-, three, or four-barrel underground concrete channels that transport Delta-Mendota flows beneath waterways, railroads, highways, and an irrigation canal.

The Delta-Mendota Canal siphons retain historic integrity to their period of significance, 1946-1951, and therefore appear eligible for inclusion in the NRHP and CRHR as contributing features of Delta-Mendota Canal. In terms of integrity of design and setting, the Delta-Mendota Canal siphons all remain in their original locations—at the sites of waterways, roadways, railroad crossings, and an irrigation canal. These locations and settings appear largely unaltered. In terms of design, materials, and workmanship, research did not reveal that any substantial modifications have been made to any of the character-defining features of the siphons that would reduce their integrity. The siphons all retain their basic concrete construction, single- and multiple-barrel conveyance structure, and transitional wingwalls, and they all continue to transport Delta-Mendota Canal flows beneath major appurtenant crossings.



Figure 35: Three-barrel siphon inlet headwall at M.P. 13.67; camera facing downstream from left bank, May 10, 2022.



Figure 36: Four-barrel siphon outlet headwall at M.P. 16.34; camera facing upstream from left bank, May, 10, 2022.

Check Structures

The population of Delta-Mendota Canal check structures consists of 21 concrete structures composed of two types (see **Table 1** in DMC DPR 523 form in **Appendix B** for list of DMC check structures, and **Appendix C** for listing for all appurtenant DMC structures). Check structures are characterized by their predominately poured-in-place concrete construction, with sloped transitional wingwalls that contract and expand as Delta-Mendota Canal leads into and away from the check. All checks feature narrow equipment platforms with mechanical gate-hoisting equipment in metal encasements; the concrete platforms are framed with metal pipe railing and most have metal lampposts with umbrella shades. Concrete block check structure houses are later additions after the period of significance and are not character defining of the historic-era canal.

The character-defining features of the Delta-Mendota Canal check structure population retain historic integrity to their period of significance, 1946-1951, and therefore appear eligible for inclusion in the NRHP and CRHR as contributing features of Delta-Mendota Canal. In terms of integrity of design and setting, the Delta-Mendota Canal check structures all remain in their original locations in a setting characterized by adjacent San Joaquin Valley farmlands. Moreover, those check structures constructed near siphon inlets and wasteway turnouts retain their spatial relationships with other components of the canal. In terms of design, materials, and workmanship, research and field observations did not reveal that substantial

modifications have been made to any of the character-defining features that would reduce the integrity of these structures. The later addition of the concrete block check houses does not constitute a loss of historic integrity because the structures are small and unobtrusive into the setting of the canal. Moreover, the historic-period population of Delta-Mendota Canal check structures continues to regulate Delta-Mendota Canal flows throughout the span of the canal.



Figure 37: Check No. 16 at M.P. 85.09; camera facing downstream from left bank, June 14, 2022.



Figure 38: Check No. 11 at M.P. 58.28; camera facing downstream from left bank, June 13, 2022.

Wasteways

Wasteways function as escape structures to protect the canal system by diverting water out of the canal and preventing it from overtopping the banks of the canal, minimize the damage resulting from a break in the canal, or by preventing additional damage from a washout or failure of the canal. This class of structures requires an accompanying waste channel from the canal to a point of discharge into a natural drainage channel. The wasteway channels are not in the APE for this project; however, the turnouts into the wasteways are integrated into Delta-Mendota Canal and are within the APE.

There are four primary wasteways and associated wasteway turnout structures along Delta-Mendota Canal and one overspill apron wasteway on the right bank of the canal (see **Appendix C** for a listing of all appurtenant DMC structures). Wasteways turnouts are defined by poured-in-place concrete construction, two rectangular gate sections, two equally sized radial gates, and narrow equipment platforms with mechanical gate-hoisting equipment in metal encasements. The size of the gates is dictated by the capacity of the canal at the turnout. The concrete platforms are framed with metal pipe railing and feature metal lampposts with umbrella shades, though some umbrella shades are missing.

The four wasteway channels – Westley, Newman, Volta, and Firebaugh – are defined by their locations, size and shape of the excavation, concrete and earth lining, and outfalls into the San

Joaquin River channel. Culverts and bridges along the wasteway are not directly related to the historical significance of Delta-Mendota Canal and are not character-defining features.

The Delta-Mendota Canal wasteway turnouts and turnout channels retain a good degree of historic integrity of design, materials, workmanship, setting, location, association, and feeling.

The character-defining features of the Delta-Mendota Canal wasteway turnouts and wasteway channels retain historic integrity to their period of significance, 1946-1951, and therefore are contributing features of Delta-Mendota Canal. In terms of integrity of design and setting, the Delta-Mendota Canal wasteways all remain in their original locations, the setting of which remains defined by adjacent San Joaquin Valley farmlands. Moreover, all wasteway turnouts retain their spatial relationships with other components of the canal, which include the canal lining, and the wasteway channels. In terms of design, materials, and workmanship, research and field observations did not reveal that any substantial modifications have been made to the character-defining features that would reduce the integrity of these structures. The population of Delta-Mendota Canal wasteways continues to function as it did historically to regulate Delta-Mendota Canal flows into natural waterways.



Figure 39: Radial gates at Firebaugh Wasteway's inlet structure; camera facing upstream from wasteway's right bank, June 14, 2022.



Figure 40: View of Newman Wasteway; camera facing upstream from right bank, June 13, 2022.

Turnouts

Turnouts function to deliver water into the local distribution systems of water users along the canal and those that have a high degree of integrity and, therefore, contribute to the significance of Delta-Mendota Canal are those that retain all or most of their character-defining features (**Figure 41**). Minor alterations to some of these turnouts such as conveyor-type debris screens across the channel openings, replacement gear mechanisms, and modern railing or fencing do not prevent the turnouts from conveying significance and they contribute to the canal's historical significance. Those turnouts added to the DMC after the initial period of construction that were designed in accordance with Reclamation's original design specifics and possess those character-defining features enumerated above may also be considered contributors to the DMC's significance. However, those turnouts that have been so heavily altered from their original design that they no longer have sufficient integrity to convey their significance are those that have had the original pedestal and geared hoist mechanism removed and replaced, or the concrete equipment decks raised or entirely replaced. These substantial alterations have diminished the integrity of design, materials, workmanship, and feeling to such a degree that these structures no longer convey the significance of the canal. Additionally, those turnouts that have been added that were designed divergently from Reclamation's original design specifications—such as steel-pipe turnouts and turnouts with automated electronic gate-hoisting equipment—are likewise not considered contributors to the DMC's significance (**Figure 42**).

The character-defining features of the turnouts are those materials, equipment, and design aspects that are part of the original construction of these structures, built according to the original design specifications. Specifically, this includes the concrete construction of the structure; shape and size of the water channels or barrels; metal grate debris screens over the openings; original gate hoisting mechanism; gates; concrete deck, railing, and steps; and the position of the turnout deck just above the canal lining.



Figure 41: Turnout at M.P. 45.35; camera facing downstream from left bank, May 12, 2022.



Figure 42: Two turnouts at M.P. 38.14; camera facing downstream from left bank, May 12, 2022.

Because the vast majority of the contributing elements of Delta-Mendota Canal retain historic integrity of the character-defining features, overall Delta-Mendota Canal retains integrity to its period of significance, 1946-1951, and is eligible for listing in the NRHP and CRHR under Criteria A / C and 1 / 3. The boundary of the historic property is from outside toe to outside toe from the inlet canal at M.P. 0.09 to the outlet at Mendota Pool at M.P. 116.61 because this encompasses all of the features of Delta-Mendota Canal that contribute to its significance.

4.4. Evaluation of San Luis Drain

The following evaluates two point-observations and one linear segment of the San Luis Drain together for individual eligibility for listing in the NRHP and CRHR under the themes and within the framework presented above. This evaluation concludes that the San Luis Drain is historically significant under NRHP / CRHR Criterion A / 1 at the national level for its important association with the ecological disaster at Kesterson Reservoir, an historically significant event that profoundly impacted subsequent governmental policies toward drainage and wildlife habitat management. While this evaluation concludes that the San Luis Drain meets NRHP and CRHR criteria, it does not conclude that the entire multi-component resource is eligible for listing in the NRHP and CRHR because assessing the integrity of any part of the San Luis Drain beyond the APE for the project is outside the scope of this project. This evaluation assesses the historic integrity of one linear segment and two point-observations of the San Luis Drain in and adjacent to the APE and concludes that they retain historic integrity to their period of

significance, 1982-1988, and would be contributing elements of the overall San Luis drainage system if the entire linear resource is found to possess sufficient integrity to be listed.

Criteria A and 1

The San Luis Drain does not possess significance under these criteria for its involvement with the CVP. The San Luis Drain, an integral but short-lived component of the San Luis Unit of the CVP, returned subsurface irrigation drainage water from irrigation districts within the San Luis service area between 1972 and 1986. Following decades of lobbying by agricultural interests in the region, Reclamation was authorized in 1960 to deliver irrigation water to the western San Joaquin Valley with the formation of the San Luis Unit, a first in federal-state joint-use facilities. In addition to rallying support for supplementing their depleted groundwater sources with CVP surface water, local irrigators also lobbied for the addition of critical drainage facilities, as the rising groundwater table of highly saline subsurface irrigation wastewater threatened to drown crops and sterilize thousands of acres of valuable agricultural lands. During planning, the San Luis Drain sparked controversy among residents in the San Francisco Bay Area and Sacramento-San Joaquin Delta, where the drain was originally planned to discharge near Antioch in Contra Costa County. Following years of negotiations and federal budgetary constraints, the San Luis Drain was ultimately built out to about half of its intended length, roughly 88 miles, and rather than discharging into the Delta, irrigation wastewater containing high levels of toxic selenium was instead pooled in a complex of evaporation ponds at Kesterson Reservoir near Gustine in Merced County. Following high rates of deformity and death among migratory and nesting waterfowl and other wetland species at Kesterson (discussed below), Reclamation discontinued use of the San Luis Drain and reservoir. The San Luis Drain failed to meet the drainage needs of the San Luis service area, was effectively retired, and is thus not eligible for listing in the NRHP or CRHR under these criteria for its involvement with the CVP.

However, under these same criteria, the San Luis Drain possesses significance for its important association with the ecological disaster at Kesterson Reservoir in the early to mid-1980s and the associated subsequent advances in environmental research / wetlands preservation, along with shifts in governmental reclamation policies and the broadening of CVP's attention to encompass ecological issues that went well beyond its previous focus centered on the interests of agribusiness in the western San Joaquin Valley. According to *National Park Service National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation*, properties like San Luis Drain, the significant associations of which have occurred within a period of less than 50 years ago, must also meet Criteria Consideration G. To meet Criteria Consideration G, the property needs to show that its associations within the last 50 years are

of "exceptional importance."[129] The San Luis Drain appears to meet this high threshold, and sufficient historical perspective exists to demonstrate this significance. In the early 1980s, USFWS scientists began to discover high rates of embryonic and infant deformity and adult mortality among various plant, fish, and waterfowl species at Kesterson Reservoir, which they soon traced to toxic exposure to selenium, and as the tragedy unfolded, ultimately culminating in the retirement of the San Luis drainage system in 1986, the ecological crisis at Kesterson Reservoir garnered national attention. The disaster was dubbed an "avian holocaust," and it illustrated the extreme environmental risks posed by selenium-contaminated irrigation drainage, reframing the problem from an individual farm-scale issue to a watershed-level environmental protection crisis.[130] California emerged as a global center for selenium-contamination research and environmental management during this period, with scientists establishing firm links between human activity and sites of selenium concentration. In response, environmental managers at the federal, state, and regional levels instituted a growing body of water quality regulations that established maximum daily load limits for selenium among discharges of agricultural drainage, as illustrated by the Grasslands Bypass Project—a joint-state federal drainage program that monitors drainage for trace elements in the Central Valley Grasslands. Perhaps most importantly, the disaster at Kesterson dramatically illustrated the ecological burden that decades of unrestrained and federally subsidized agriculture had placed on the region, leading reformers to fundamentally transform the CVP—which had historically served the interests of agribusinesses—to incorporate environmental stewardship among its mandates. In 1992, the Central Valley Project Improvement Act (CVPIA) was passed into law, which, for the first time, placed wildlife habitat management on equal footing with the agricultural and industrial goals of the CVP. Since the passage of the CVPIA, Reclamation and its federal, state, and local partner agencies have implemented habitat improvement projects on the American, Stanislaus, Yuba, and Sacramento rivers and delivered CVP water to federal, state, and private managed wetlands throughout the state. Most importantly, it has ceased all drainage discharges into wildlife refuges.

As the structural vehicle for delivering selenium-contaminated subsurface irrigation drainage water to Kesterson Reservoir, the San Luis Drain possesses strong and meaningful associations with the Kesterson disaster, an environmental calamity of exceptional historical significance for the critical role it played in transforming governmental policy. Thus, the two point-observations and one linear segment of the San Luis Drain recorded on this form contribute to its significance under these criteria. The period of significance under these criteria dates from

[129] National Park Service, *National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation*, 1990, rev. 1995, 41, 43.
[130] Harold E. Thomas, "Ode to the San Luis Drain," *Groundwater* 24, no. 1 (January 1986): 79.

1982, when USFWS scientists first detected selenium toxicosis among various plant and animal species at Kesterson, and 1988, when the U.S. Department of Interior—having discontinued use of the San Luis drainage facilities—remediated the selenium contamination problem at Kesterson by dewatering and infilling the evaporation ponds.

Criteria B and 2

The CVP was the result of the efforts of many individuals and agencies over many years and no one person or group of people rises in the historical record as playing a direct role in its implementation in a way that would be best demonstrated by San Luis Drain; therefore, San Luis Drain is not individually eligible for listing in the NRHP under Criterion B or in the CRHR under Criterion 2.

Criteria C and 3

San Luis Drain does not possess individual eligibility for listing in the NRHP and CRHR under Criterion C or Criterion 3. While the San Luis Drain is a rare structural type (interceptor drain) within the CVP, construction of the structure was ultimately not completed to its full schematics, and it failed to adequately remedy the regional drainage problem (which persists to the present). Originally planned to span 188 miles between Kettleman City in Kings County to a discharge point near Antioch in Contra Costa County, construction on the San Luis Drain was impeded by political opposition and budgetary constraints, and it was ultimately built out to 88 miles—less than half the intended span—from a point near Five Points in Fresno County to the Kesterson Reservoir outside of Gustine in Merced County. The structure is a largely non-operational concrete-lined trapezoidal channel with numerous appurtenant structures—such as checks, siphons, and crossings. The San Luis Drain was designed and built to receive and convey subsurface drainage water from regionally distributed drainage collector systems that were operated by irrigation districts, which in turn collected drainage from underground pipe networks lain on private farms. The San Luis drainage system has largely been retired as designed. It not only was not built out to its full extent, but it also did not meet its the drainage objectives, and thus does not possess significance for its engineering.

Under these same criteria, the San Luis Drain is likewise not significant for its construction methodology. Reclamation had employed large industrial trimmers for canal excavation for decades prior to the construction of the drain recorded on this form. During construction of Delta-Mendota Canal in particular, contractors navigated the same issues relating to the regional groundwater table elevated above the canal trench. While construction on the San Luis Drain innovated upon and in many ways streamlined earlier methods, this effort did not introduce fundamentally new technologies or methodologies. Therefore, the drain recorded on this form does not possess individual significance in this regard.

Also considered under these criteria, San Luis Drain does not represent the important work of a master engineer or builder. Lead project engineer for San Luis Drain, Edward J. Brannan joined Reclamation in 1937 as a transitman on the Columbia Basin Project before he was promoted to construction engineer on the Spokane Valley Project in Washington in 1965 and ultimately the San Luis Drain in the late 1960s and early 1970s. Brannan does not appear to have developed new designs but rather follow the standardized designs drafted earlier by Reclamation engineer Harry Raymond McBirney.[131] Additionally, Gordon H. Ball, Inc., and Ball, Ball & Brosamer, who collectively won three construction contracts for San Luis Drain comprising nearly 80 percent of the extant structure (69.51 miles) in addition to Kesterson Reservoir, were the companies responsible for the largest share of the drain's construction. While they were prolific contractors, there is insufficient evidence to support Gordon H. Ball and Ball, and Ball & Brosamer, as master builders. Moreover, both firms appear to have specialized in heavy highway construction, not canal building. While construction of San Luis Drain was a large undertaking for the companies, it does not best represent their body of work. They were most known during the 1960s and 1970s for construction of highways, runways, and general concrete work. San Luis Drain would not best represent the work of any of the other contractors who won contracts for San Luis Drain because their contributions to the project were only to a small fraction of the overall project. For these reasons, the drain recorded on this form is not individually eligible for listing in the NRHP or CRHR under these criteria.

Criteria D and 4

San Luis Drain is not eligible under NRHP Criterion D or CRHR Criterion 4 for information potential because it was designed and built according to well-documented practices, and the project is well documented through drawings, textual records, and photographs.

4.4.1. Character-defining Features, Integrity, and Boundary of San Luis Drain

In general, the character-defining features of the recorded segment of the San Luis Drain are its alignment, the size, shape, and dimensions of the canal prism, and its concrete lining material. Individual elements within the study area that contribute to the significance of San Luis Drain along the approximately five-mile recorded segment are those structures that are directly related to its significance under NRHP Criterion A / CRHR Criterion 1, i.e. structures that directly relate to the conveyance of subsurface irrigation drainage water from the southern terminus in Fresno County north to Kesterson in Merced County. Structures like check structures and siphons that convey and control the water's northerly flow all related directly to the drain's significance and purpose and therefore contribute to the significance of the historic property. Structures in the study area that accommodate pre-existing uses like the

[131] "Water Project Post is Filled," *Spokane Daily Chronicle* (February 16, 1965): 3.

Drain U-121.2 undercrossing and trapezoidal road crossing do not contribute to the historical significance of this linear historic property because they are not directly related to the conveyance of subsurface irrigation wastewater, and instead serve ancillary purposes.

The recorded segment of the San Luis Drain along with its contributing structures all retain historic integrity to their period of significance, 1982-1988, and would contribute to the overall resource if the San Luis Drain possesses sufficient integrity throughout its span. In terms of design and setting, the recorded segment of the San Luis Drain remains in its original location, the setting of which remains defined by flat rural farmland. In terms of design, materials, and workmanship, research did not reveal that any substantial modifications have been made to any of the character-defining features that would reduce the integrity of this segment of the study property. While it is unclear when some inlets were added to the structure, these additions are comparably minor and do not detract from the overall feeling of the resource. The recorded drain segment suffers diminished integrity of association because it is no longer operational.

The boundaries of the San Luis Drain are the channel's right-of-way, encompassing the canal prism and two flanking embankments, between the southern terminus—a point near Five Points in Fresno County—and the northern terminus at the former Kesterson Reservoir.

4.5. Summary evaluation of ineligible built environment resources

In addition to Delta-Mendota Canal and San Luis Drain, this report evaluated three other built environment resources within the APE and concluded that none met any of the NRHP or CRHR significance criteria. These properties consist of two rural residential properties on Lammers Road (APN 251-050-120 and 240-140-260) in San Joaquin County and a drainage canal that is part of Firebaugh Canal Water District in Fresno County.

5. FINDING OF EFFECT

Under Section 106 of the NHPA, Reclamation is required to consider the effects of the proposed project on historic properties. Delta-Mendota CanalAn adverse effect, as defined in 36 CFR Part 800.5(a)(1), is found "when an undertaking may alter, directly or indirectly, any characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association."

The historic properties in the APE are Delta-Mendota Canal, San Luis Drain, San Joaquin Pipelines of the Hetch Hetchy Aqueduct, Santa Fe Grade, and Outside Canal. This section presents information regarding the criteria of adverse effects followed by analysis of project impacts to each of the historic properties.

5.1. Criteria of Adverse Effects

The NHPA Section 106 regulations state that if there are historic properties in the APE that may be affected by a federal undertaking, the agency official shall assess adverse effects, if any, in accordance with the Criteria of Adverse Effects defined in 36 CFR Part 800.5. These regulations state an "adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association." Application of the Criteria of Adverse Effects assesses how an undertaking will affect those features of a historic property that contribute to its eligibility for listing in the NRHP. Effects can be direct, indirect, and cumulative. Direct effects include physical destruction or damage, the introduction of visual, auditory, or vibration impacts as well as neglect to a historic property. Indirect effects are reasonably foreseeable effects caused by the undertaking that may occur at a future date or be farther removed in distance. Cumulative effects are the impacts of a project taken into account with known past or present projects, as well as foreseeable future, projects.

The following are examples of adverse effects listed in 36 CFR Part 800.5(a)(2):

i. Physical destruction of or damage to all or part of the property;

ii. Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation, and provision of handicapped access, that is not consistent with the Secretary of the Interior's (SOI) standards for the treatment of historic properties (36 CFR Part 68) and applicable guidelines;

iii. Removal of the property from its historic location;

iv. Change of the character of the property's use or of physical features within the property's setting that contributes to its historic significance;

v. Introduction of visual, atmospheric or audible elements that diminish the integrity of the property's significant historic features;

vi. Neglect of a property which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe or Native Hawaiian organization; and

vii. Transfer, lease, or sale of property out of federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance.

The *Secretary of the Interior's Standards for the Treatment of Historic Properties* (SOI Standards) provides guidance on the preservation and protection for cultural resources listed in or eligible for listing in the National Register of Historic Places. Four types of treatments – Preservation, Rehabilitation, Restoration, and Reconstruction – comprise the SOI Standards. Rehabilitation would be the most relevant treatment to apply to this project because the treatment type emphasizes repairing a historic structure while preserving its character-defining features.

The SOI Standards for Rehabilitation are:

1. A property will be used as it was historically or be given a new use that requires minimal change to its distinctive materials, features, spaces, and spatial relationships.

2. The historic character of a property will be retained and preserved. The removal of distinctive materials or alteration of features, spaces, and spatial relationships that characterize a property will be avoided.

3. Each property will be recognized as a physical record of its time, place, and use. Changes that create a false sense of historical development, such as adding conjectural features or elements from other historic properties, will not be undertaken.

4. Changes to a property that have acquired historic significance in their own right will be retained and preserved.

5. Distinctive materials, features, finishes, and construction techniques or examples of craftsmanship that characterize a property will be preserved.

6. Deteriorated historic features will be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature will match the old in design, color, texture, and, where possible, materials. Replacement of missing features will be substantiated by documentary and physical evidence.

7. Chemical or physical treatments, if appropriate, will be undertaken using the gentlest means possible. Treatments that cause damage to historic materials will not be used.

8. Archeological resources will be protected and preserved in place. If such resources must be disturbed, mitigation measures will be undertaken.

9. New additions, exterior alterations, or related new construction will not destroy historic materials, features, and spatial relationships that characterize the property. The new work shall be differentiated from the old and will be compatible with the historic materials, features, size, scale and proportion, and massing to protect the integrity of the property and its environment.

10. New additions and adjacent or related new construction will be undertaken in such a manner that, if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.

5.2. Application of Adverse Effects

The Delta-Mendota Canal Subsidence Correction Project would adversely affect Delta-Mendota Canal, but would not adversely affect the other historic properties in the APE. This conclusion is the same for both Alternative 1 and Alternative 2. Overall, the project would cause an adverse effect; however there are aspects of the project that meet SOI Standards.

The following analyzes the potential adverse effects caused by the proposed project actions under Alternative 1 and Alternative 2.

5.2.1. Alternative 1

Delta-Mendota Canal

Alternative 1 would adversely affect Delta-Mendota Canal through physical destruction of components of the historic property, as well as through alteration of the historic property in a manner that is inconsistent with the SOI Standards. Characteristics of the historic property that qualifies it for inclusion in the NRHP would be altered such that its integrity of design, materials, workmanship, feeling, and association would be diminished, impacting Delta-Mendota Canal's ability to convey its significance.

Alternative 1 would not cause the removal of Delta-Mendota Canal from its historic location and thus it would retain integrity of location. It would not change the character of Delta-Mendota Canal's use or physical features within the its setting that contributes to its historic

significance, and thus Delta-Mendota Canal would retain integrity of setting. The alternative would also not introduce visual, atmospheric, or audible elements that diminish Delta-Mendota Canal's historic integrity, nor would it lead to negelect of Delta-Mendota Canal that would cause it to deteriorate. Furthermore, the alternative would not lead to the transfer, lease, or sale of property out of federal ownership or control. Under the SOI Standards for Rehabilitation, Delta-Mendota Canal would continue to be used as it has been historically, no features would be added that could create a false sense of history, and no chemical treatments are planned that would cause damage to historic materials.

Alternative 1 would impact the following character-defining features of Delta-Mendota Canal: canal prism, lining, embankments, maintenance roads, turnouts, and wasteway gates.

Raising the concrete lining along 86 miles of the canal would be an alteration of the historic property that is consistent with SOI Standards because the raise would be materially appropriate – concrete – placed at the slope ratio called for in the original specifications. The new concrete would be differentiated from the prior concrete raises with a horizontally placed seal. Additionally, the lining raise would rehabilitate the capacity of the canal to its original design specifications.

Raising the earth embankment at deficient bank segments along approximately 70 miles of the canal would be an alteration of the historic property that is consistent with SOI Standards because it would use fill materially from nearby borrow areas that is consistent with the original material construction, it would not substantially alter the shape or cross section of the embankment and would rehabilitate the embankment to support the lining raise which would restore the original capacity of the canal.

Installing an asphalt chip seal to the left bank maintenance road would be a minor material alteration from the existing compacted gravel road surface that would not alter the character of the historic property.

Stabilizing the earth-lined 18 miles of the canal by lowering the water depth and excavating two-foot deep sections of earthen material would alter the character-defining dimensions of the canal prism in a manner that is not consistent with SOI Standards. This proposed action would alter the original design dimensions and would be a demolition of the compacted earth lining of this segment of the canal.

Repairing distressed concrete lining at eight locations by removing damaged lining would be a material demolition of character-defining features of the canal and as such would cause integrity loss of design and original materials.

The proposed modifications to 17 of the check structures by raising gates and applying FRP wrap would be an alteration that does not meet the SOI Standards. Project design does not yet include detailed description or drawings of the gate raise; however, alteration of the gates would cause an historic loss of integrity of design and materials. Replacement of the hoist systems would cause a material loss of historic integrity.

Like the check structures, project design for wasteway turnout gates is not complete; however, raising the structures would be an alteration that does not meet the SOI Standards. This action would cause a loss of historic integrity of design and materials. Replacement of the hoist systems would cause a material loss of historic integrity.

The project description indicates that 82 turnouts along the left bank of Delta-Mendota Canal would require raising, presumably within the 86 miles that would be subject to raising the concrete lining. The project description does not indicate which turnouts would be subject to this modification; some of the 97 turnouts identified in **Appendix C** that are on the left bank within these segments may not be subject to modification. Those that would be modified would presumably suffer a loss of historic integrity of design and materials by demotion of material and loss of historic integrity of design.

San Luis Drain

Alternative 1 does not propose any actions that have potential to impact the portion of San Luis Drain within the APE. The project does not propose to make any alterations to the siphon that carries San Luis Drain across Delta-Mendota Canal.

San Joaquin Pipelines, Hetch Hetchy Aqueduct

Delta-Mendota Canal is siphoned under the San Joaquin Pipelines. Alternative 1 does not propose any alterations to any of the Delta-Mendota Canal siphons, therefore, the project would not impact this historic property. There are no proposed project actions that would materially alter this historic property.

Santa Fe Grade

Alternative 1 does not propose any actions that have potential to impact the short segment of Santa Fe Grade witin the APE. The grade is located outside of the Delta-Mendota Canal embankment and would not be impacted by modifications made to the embankemnt.

Outside Canal

Delta-Mendota Canal is siphoned under the Outide Canal. Alternative 1 does not propose any alterations to any of the Delta-Mendota Canal siphons, therefore, the project would not

impact this historic property. There are no proposed project actions that would materially alter this historic property.

5.2.2. Alternative 2

Delta-Mendota Canal

Like Alternative 1, Alternative 2 would adversely affect Delta-Mendota Canal through physical destruction of components of the historic property, as well as through alteration of the historic property in a manner that is inconsistent with the SOI Standards. Characteristics of the historic property that qualifies it for inclusion in the NRHP would be altered such that its integrity of design, materials, workmanship, feeling, and association would be diminished, impacting Delta-Mendota Canal's ability to convey its significance.

This alternative would not cause the removal of Delta-Mendota Canal from its historic location and thus it would retain integrity of location. It would not change the character of Delta-Mendota Canal's use or physical features within the its setting that contributes to its historic significance, and thus Delta-Mendota Canal would retain integrity of setting. The alternative would also not introduce visual, atmospheric, or audible elements that diminish Delta-Mendota Canal's historic integrity, nor would it lead to negelect of Delta-Mendota Canal that would cause it to deteriorate. Furthermore, the alternative would not lead to the transfer, lease, or sale of property out of federal ownership or control. Under the SOI Standards for Rehabilitation, Delta-Mendota Canal would continue to be used as it has been historically, no features would be added that could create a false sense of history, and no chemical treatments are planned that would cause damage to historic materials.

Alternative 2 proposes many of the same actions as Alternative 1; however, this alternative reduces the concrete lining raise to 73 miles and the embankment raise to 56 miles. This alternative proposes more alterations to the earth-lined segment of Delta-Mendota Canal.

Alternative 2 of the proposed project would impact the following character-defining features of Delta-Mendota Canal: canal prism, lining, embankments, maintenance roads, turnouts, and wasteway gates.

Raising the concrete lining along 73 miles of the canal would be an alteration of the historic property that is consistent with SOI Standards because the raise would be materially appropriate – concrete – placed at the slope ratio called for in the original specifications. The new concrete would be differentiated from the prior concrete raises with a horizontally placed seal. Additionally, the lining raise would rehabilitate the capacity of the canal to its original design specifications.

Raising the earth embankment at deficient bank segments along approximately 56 miles of the canal would be an alteration of the historic property that is consistent with SOI Standards because it would use fill materially from nearby borrow areas that is consistent with the original material construction, it would not substantially alter the shape or cross section of the embankment and would rehabilitate the embankment to support the lining raise which would restore the original capacity of the canal.

Modifying the earth-lined 18 miles of the canal by lowering the water depth, excavating two-foot deep sections, and placing a geocomposite liner at the bottom of the canal would materially demolish the earth lining of the canal and alter the original design and materials of this segment of the canal. This proposed action would cause a loss of historic integrity of materials and design in a manner that is not consistent with SOI Standards. This proposed action would alter the original design dimensions and would be a demolition of the compacted earth lining of this segment of the canal.

Repairing distressed concrete lining at three locations by removing damaged lining would be a material demolition of character-defining features of the canal and as such would cause integrity loss of design and original materials.

The proposed modifications to 17 of the check structures by raising gates and applying FRP wrap would be an alteration that does not meet the SOI Standards. Project design does not yet include detailed description or drawings of the gate raise; however, alteration of the gates would cause an historic loss of integrity of design and materials. Replacement of the hoist systems would cause a material loss of historic integrity.

Like the check structures, project design for wasteway turnout gates is not complete; however, raising the structures would be an alteration that does not meet the SOI Standards. This action would cause a loss of historic integrity of design and materials. Replacement of the hoist systems would cause a material loss of historic integrity.

The project description indicates that 82 turnouts along the left bank of Delta-Mendota Canal would require raising, presumably within the 86 miles that would be subject to raising the concrete lining. The project description does not indicate which turnouts would be subject to this modification; some of the 97 turnouts identified in **Appendix C** that are on the left bank within these segments may not be subject to modification. Those that would be modified would presumably suffer a loss of historic integrity of design and materials by demotion of material and loss of historic integrity of design.

San Luis Drain

Alternative 2 does not propose any actions that have potential to impact the portion of San Luis Drain within the APE. The project does not propose to make any alterations to the siphon that carries San Luis Drain across Delta-Mendota Canal.

San Joaquin Pipelines, Hetch Hetchy Aqueduct

Delta-Mendota Canal is siphoned under the San Joaquin Pipelines. Alternative 2 does not propose any alterations to any of the Delta-Mendota Canal siphons, therefore, the project would not impact this historic property. There are no proposed project actions that would materially alter this historic property.

Santa Fe Grade

Alternative 2 does not propose any actions that have potential to impact the short segment of Santa Fe Grade witin the APE. The grade is located outside of the Delta-Mendota Canal embankment and would not be impacted by modifications made to the embankemnt.

Outside Canal

Delta-Mendota Canal is siphoned under the Outide Canal. Alternative 2 does not propose any alterations to any of the Delta-Mendota Canal siphons, therefore, the project would not impact this historic property. There are no proposed project actions that would materially alter this historic property.

6. Preparers' Qualifications

Christopher D. McMorris and Heather K. Norby of JRP Historical Consulting, LLC, prepared this report. Mr. McMorris is a Principal and Architectural Historian at JRP. He holds a M.S. in Historic Preservation from Columbia University in New York. He has more than 24 years of experience conducting a wide variety of historical research and cultural resource management projects. He served as the project manager for this project, coordinating with CDM Smith, Reclamation, and the Authority, directing the JRP team, and editing this report and its components. Ms. Norby is a Senior Historian / Architectural Historian. She holds an M.A. in History from the University of California, Berkeley and has more than 14 years of experience in the field. Ms. Norby conducted fieldwork and research, and is the lead author of this report. She has contributed to numerous technical reports and architectural survey and evaluation projects related to architectural and engineering works including large dams, hydroelectric power plants, and Reclamation's Friant-Kern Canal. Senior Historian / Architectural Historian Steven J. "Mel" Melvin also assistant with review of the DPR 523 forms prepared for this project. Mr. McMorris, Ms. Norby, and Mr. Melvin meet the US Secretary of the Interior's Professional Qualification Standards under History and Architectural History.

Research Assistant Abigail E. Lawton assisted with the DPR 523 forms, fieldwork, and research. Ms. Lawton completed coursework for an M.A. in Historic Preservation Planning at Cornell University (degree expected December 2022). Research Assistant Andrew T. Young also assisted with the DPR 523 forms, fieldwork, and research. Mr. Young is a graduate student at California State University, Sacramento, earning a M.A. in Public History. Ms. Rebecca Flores prepared graphics for this report and assisted with database management tasks. She holds a A.S. in Geographic Information Systems from American River College, Sacramento.

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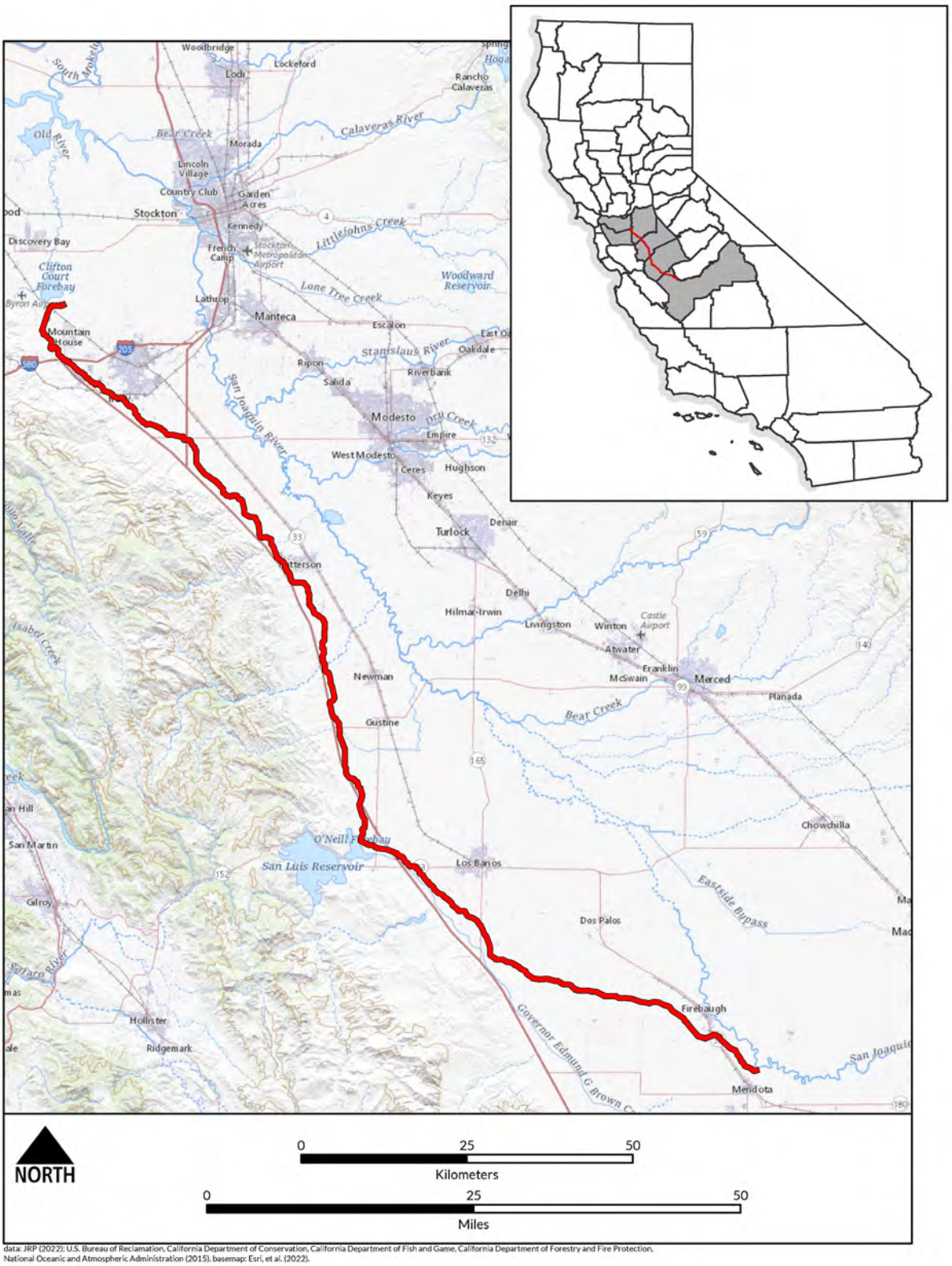
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Appendix A: Maps

Project Location & Vicinity

Area of Potential Effects (APE) Maps

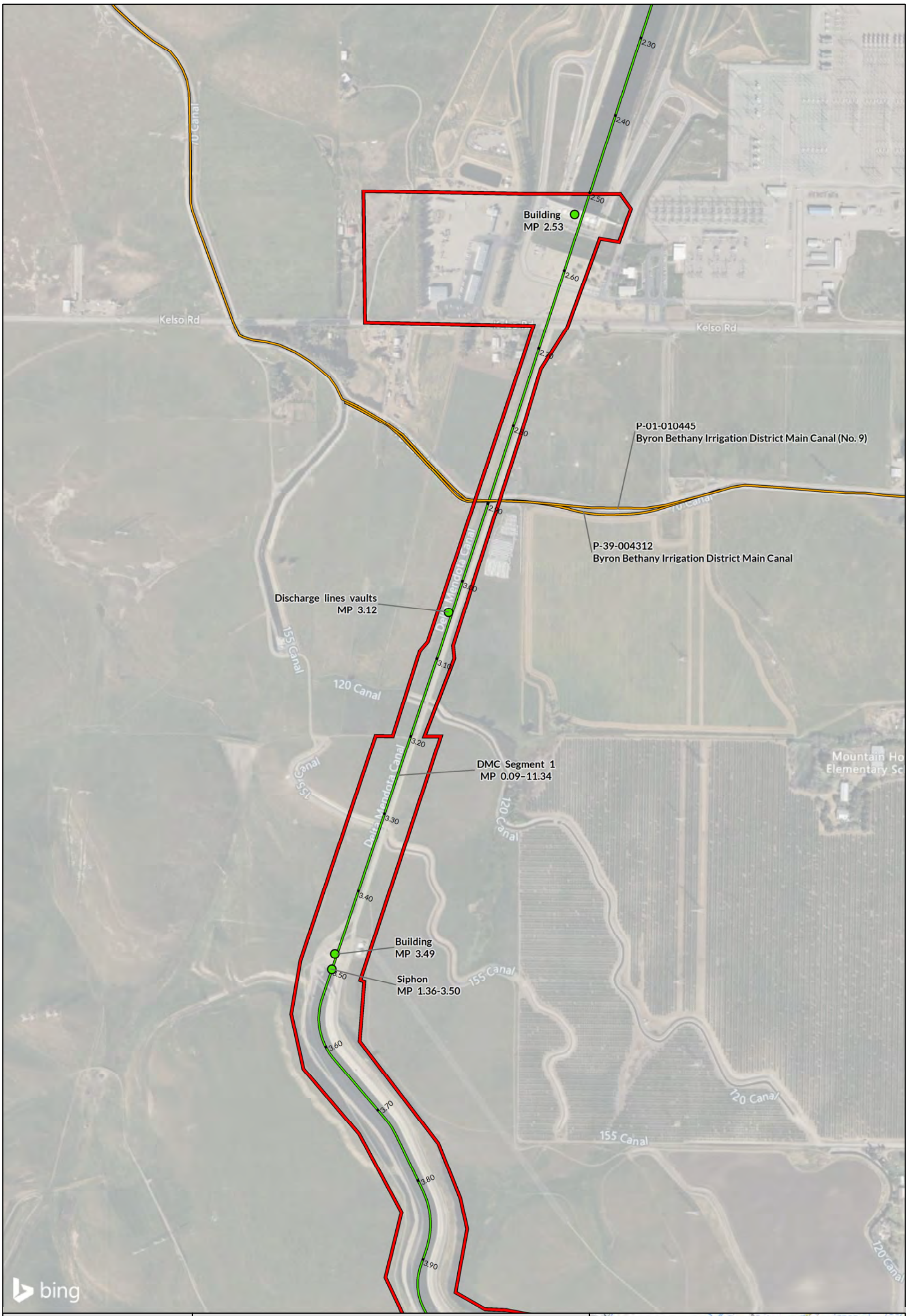


data: JRP (2022); U.S. Bureau of Reclamation, California Department of Conservation, California Department of Fish and Game, California Department of Forestry and Fire Protection, National Oceanic and Atmospheric Administration (2015). basemap: Esri, et al. (2022).

Project Vicinity & Location Map



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).



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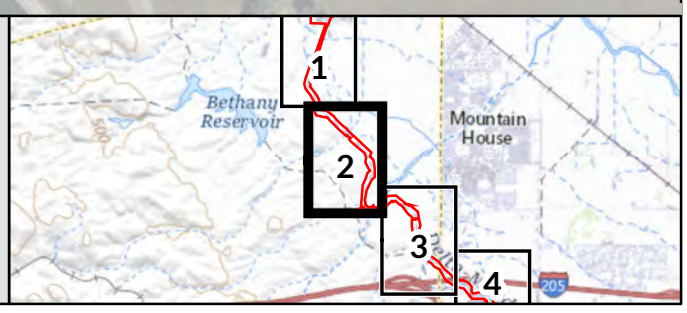
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source: JRP (2022); Bing (2022); Esri, et al. (2022).



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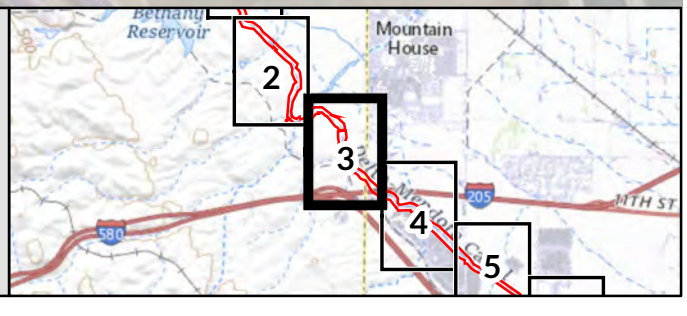
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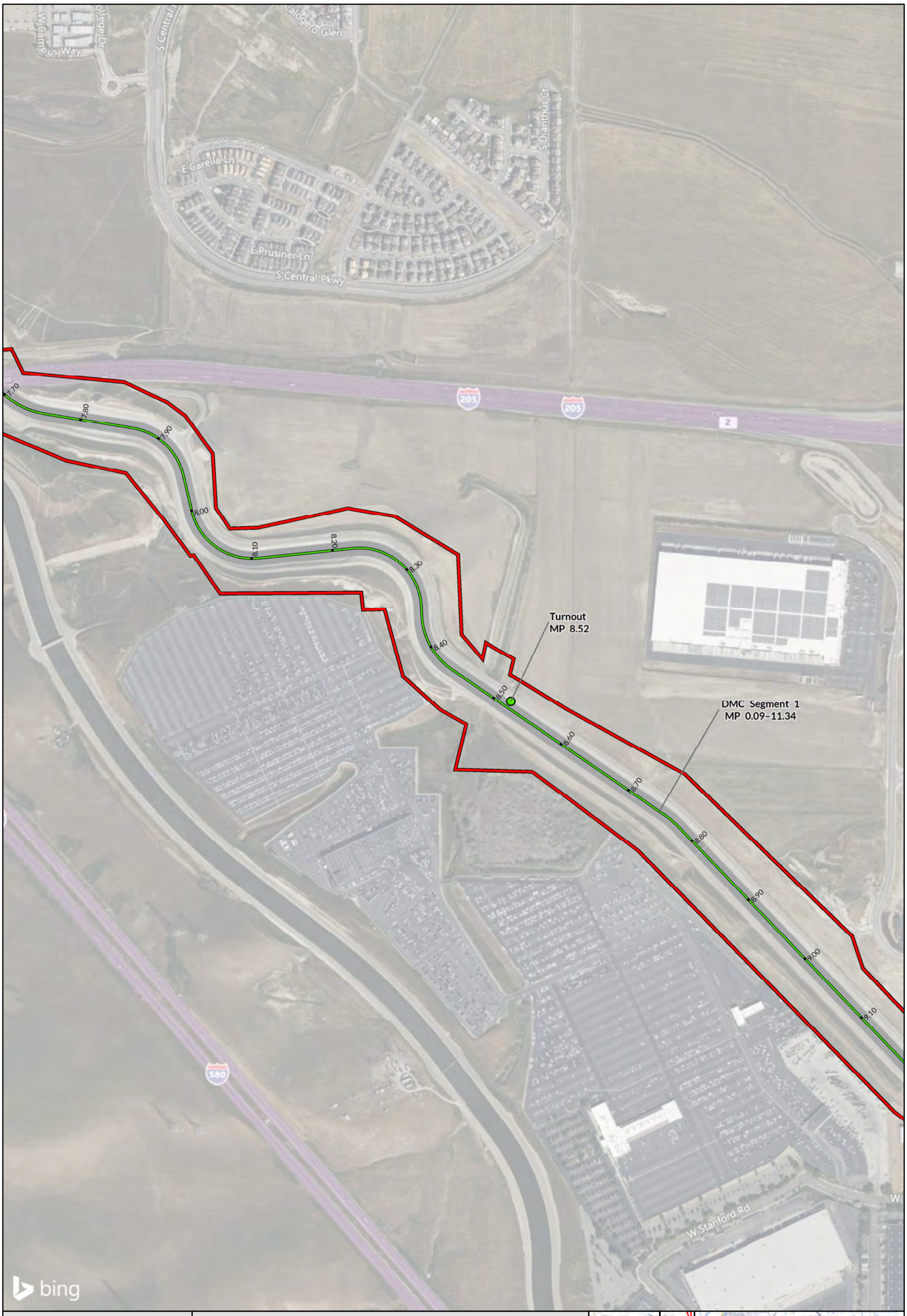
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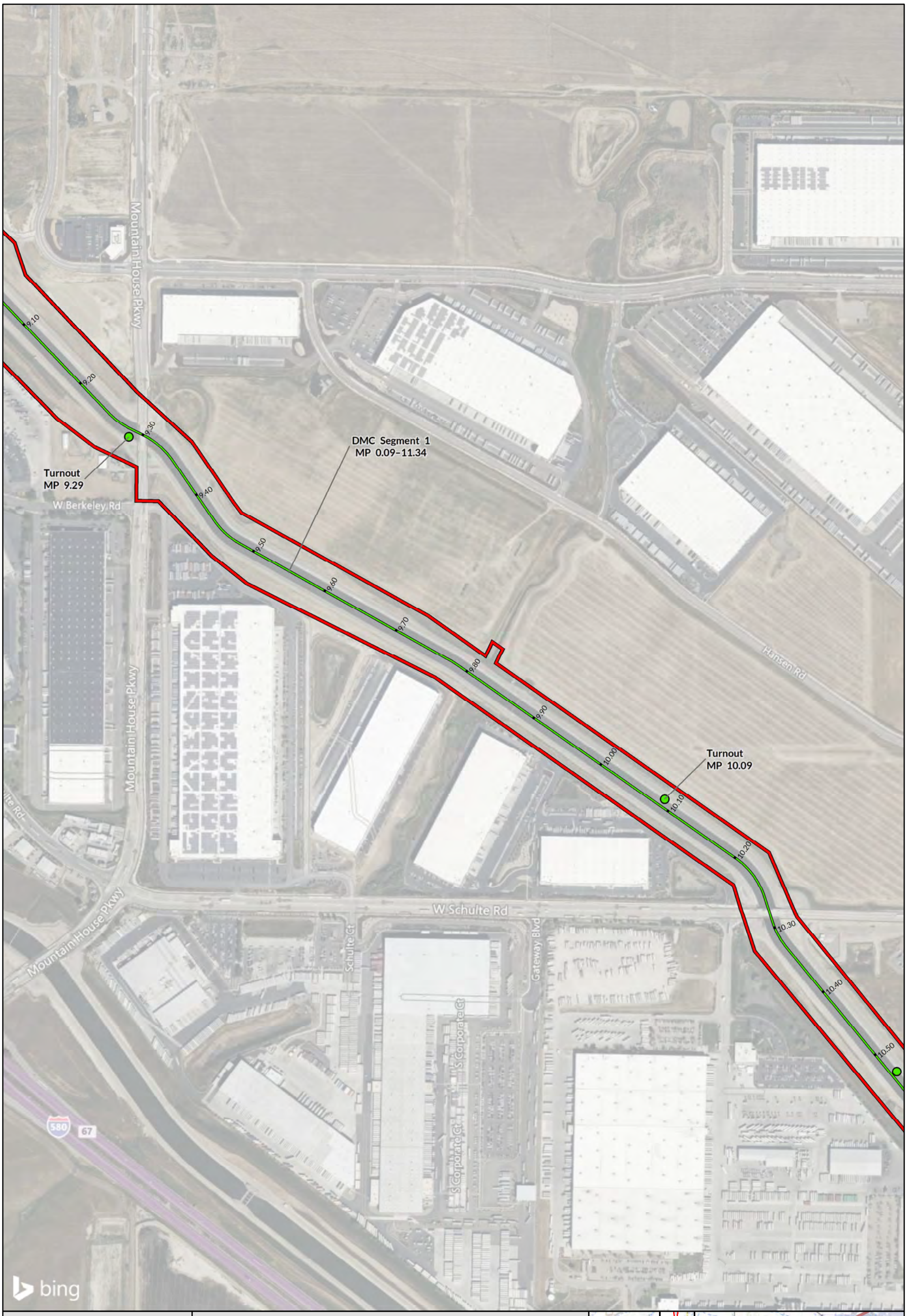
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source: JRP (2022); Bing (2022); Esri, et al. (2022).



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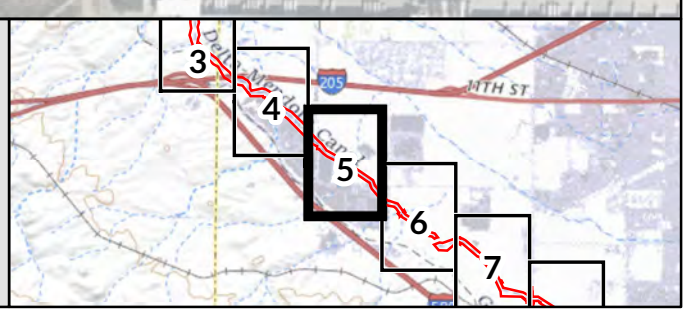
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source: JRP (2022); Bing (2022); Esri, et al. (2022).

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Hood Way
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W Schulte Rd
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DMC Segment 1
MP 0.09–11.34
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10.70
10.80
10.90
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11.10
11.20
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11.40
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Turnout
MP 11.28
Check No. 1
MP 11.35
Turnout
MP 11.45
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Southern Pacific Railroad in San Joaquin County
Hansen Rd
Hansen Rd
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LEGEND

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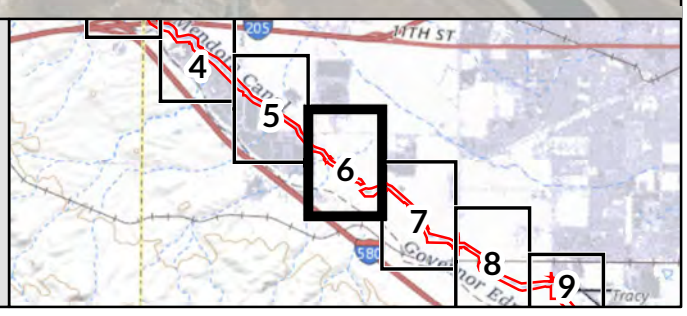
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source: JRP (2022); Bing (2022); Esri, et al. (2022).

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PG & E Stanislaus-Newark Circuits #1 & 2

DMC Segment 2
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MP 12.37

APN: 251-050-120

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S Lammers Rd

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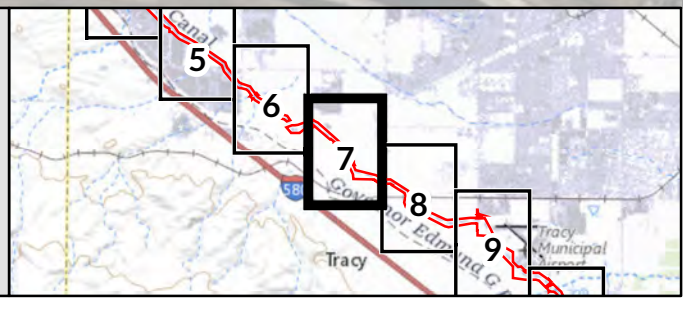
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source: JRP (2022); Bing (2022); Esri, et al. (2022).

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Western Pacific Railroad/Union Pacific RR

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DMC Segment 2
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S Lammers Rd

Ellis Town Dr

Cordelia Dr

Rio Grande Dr

Northington Dr

Avalon St

Flag

Memory Ln

Augusta Ave

Long Ave

Summit Dr

McKenzie Ave

Beaumont Ave

Martha Dr

Tracy Hills Dr

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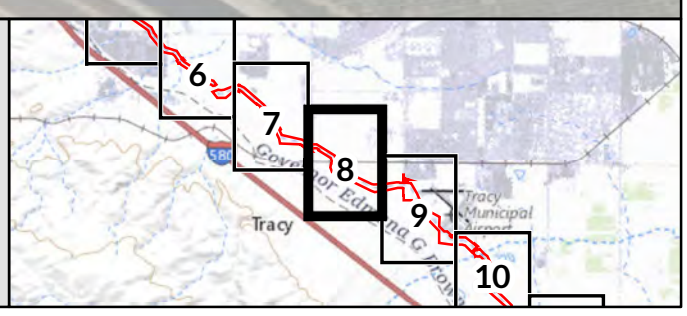
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source: JRP (2022); Bing (2022); Esri, et al. (2022).

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Windsong
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Pickering St
Tracker Pl
Oavie Pl
Tracy Hills Dr
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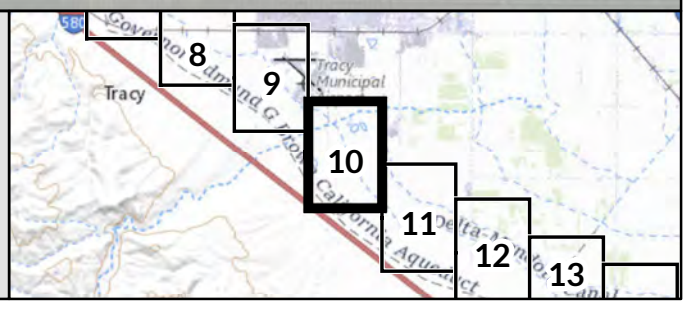
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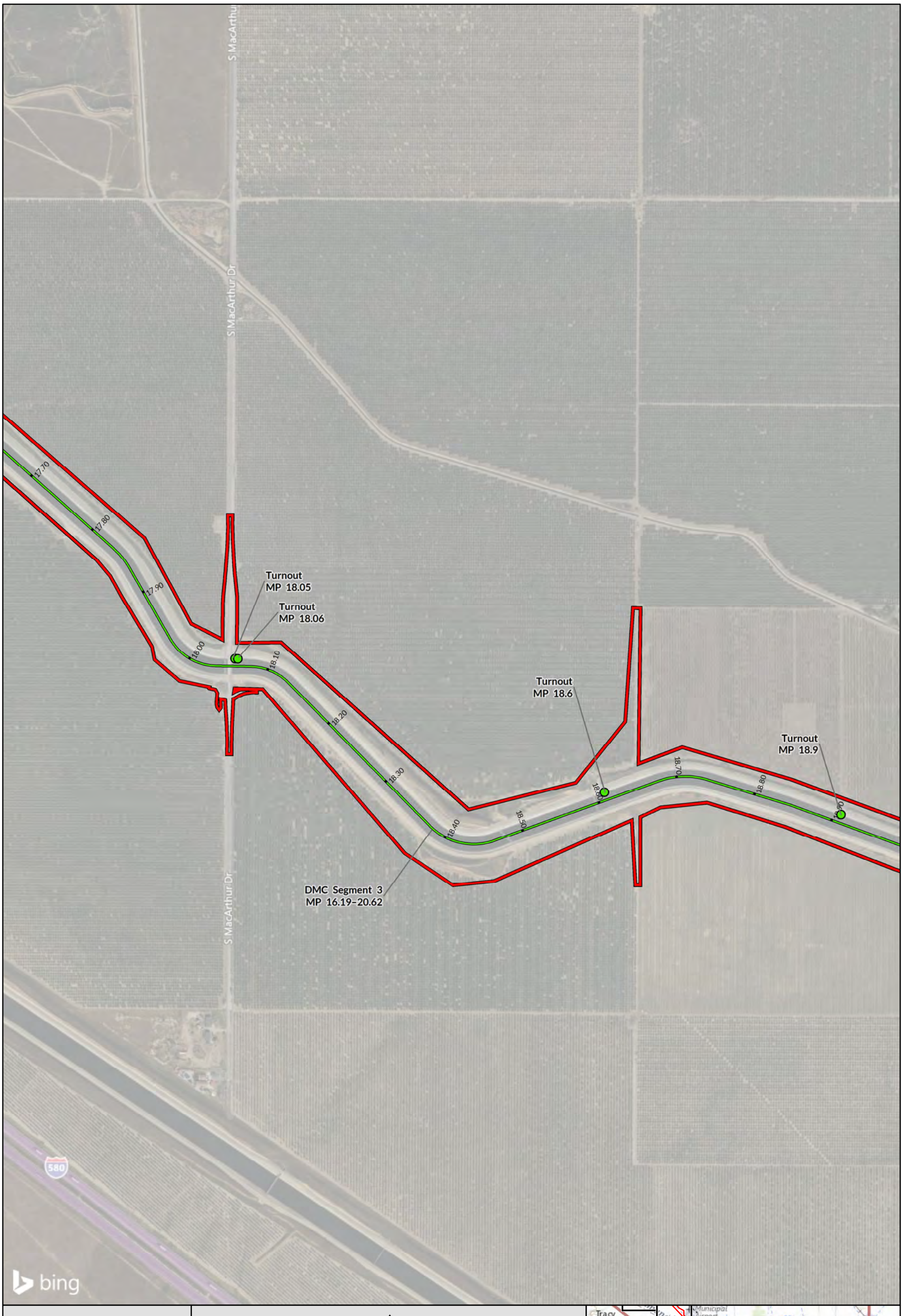
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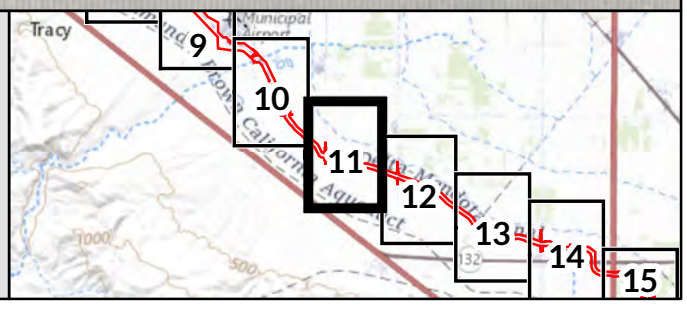
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source: JRP (2022); Bing (2022); Esri, et al. (2022).

Turnout
MP 19.18

Turnout
MP 19.39

DMC Segment 3
MP 16.19–20.62

Turnout
MP 19.59

Turnout
MP 20

19.00
19.10
19.20
19.30
19.40
19.50
19.60
19.70
19.80
19.90
20.00
20.10

S Chrisman Rd

bing

LEGEND

APE

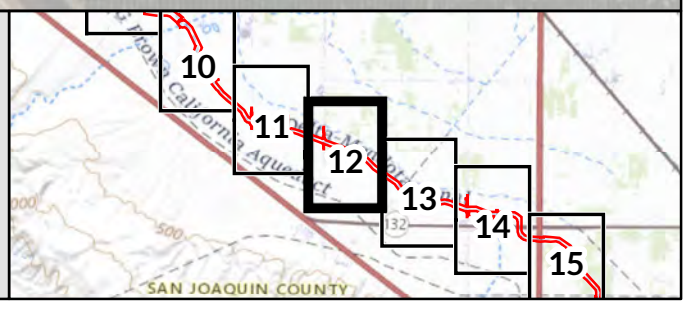
Eligible/Contributing

Ineligible/Non-Contributing

NORTH

0 0.2 0.4
Kilometers

0 0.2 0.4
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).

DMC Segment 3
MP 16.19-20.62

20.10
20.20
20.30
20.40
20.50
20.60
20.70
20.80
20.90
21.00
21.10
21.20
21.30

Turnout
MP 20.59

Check No. 3
MP 20.63

DMC Segment 4
MP 20.63-24.42

Turnout
MP 21.25

132
2
132

bing

LEGEND

APE

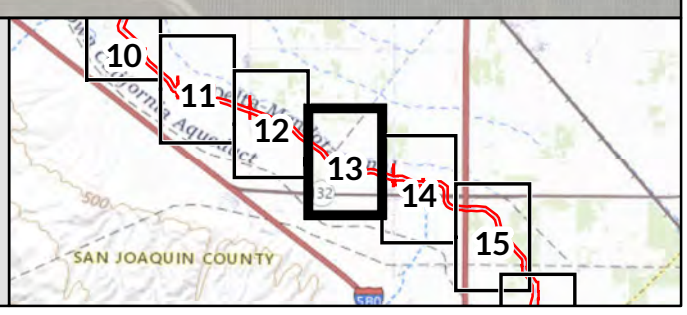
Eligible/Contributing

Ineligible/Non-Contributing

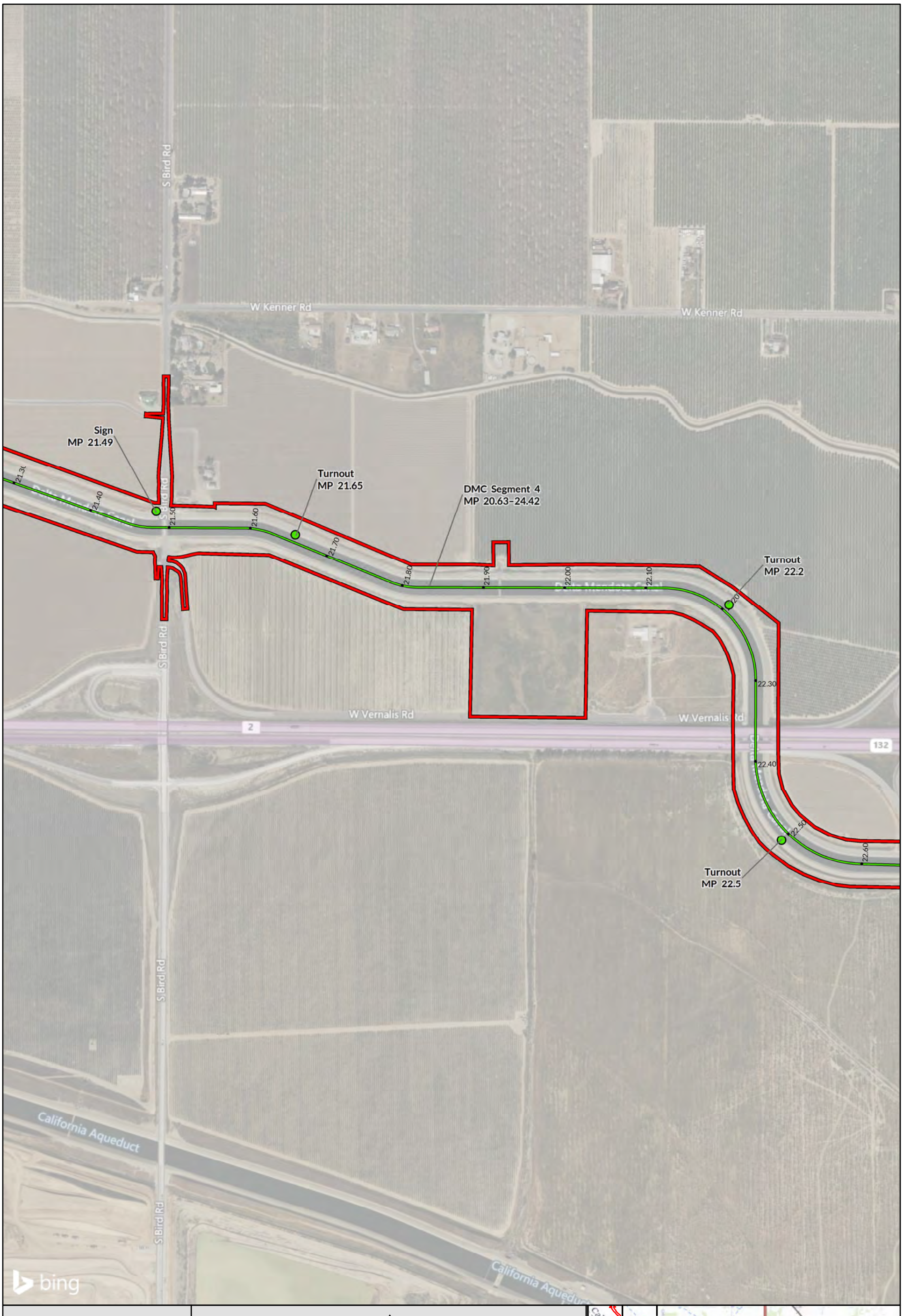
NORTH

0 0.2 0.4
Kilometers

0 0.2 0.4
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

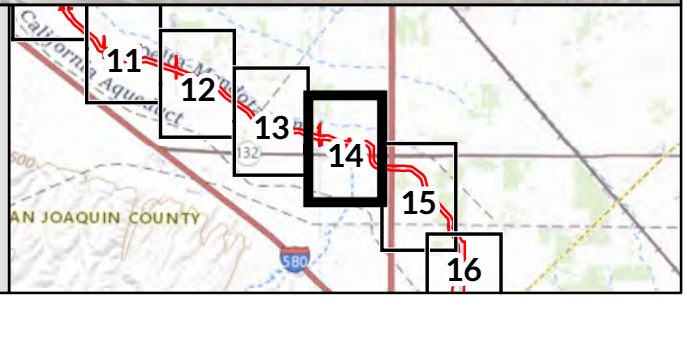
NORTH

0 0.2 0.4

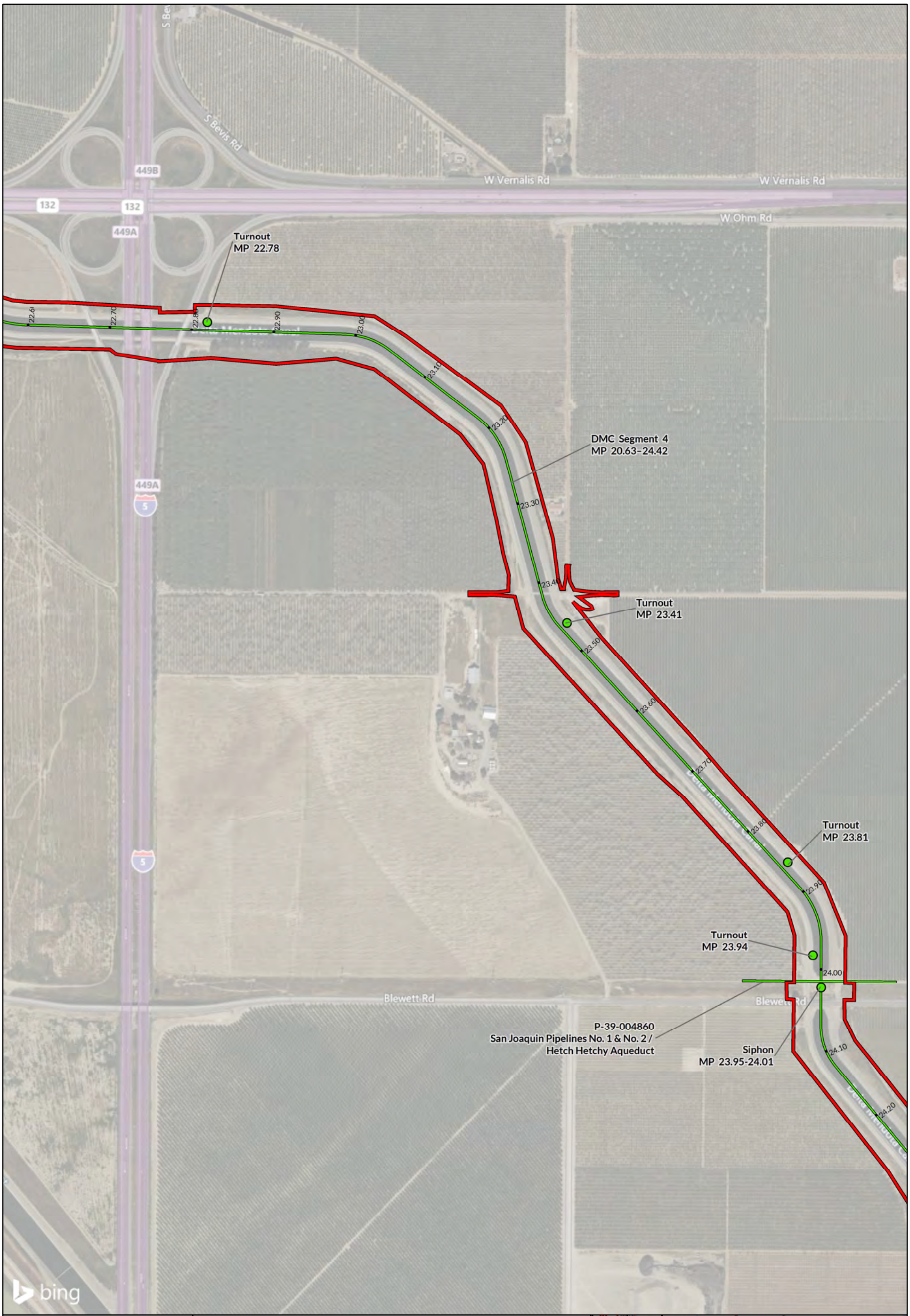
Kilometers

0 0.2 0.4

Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

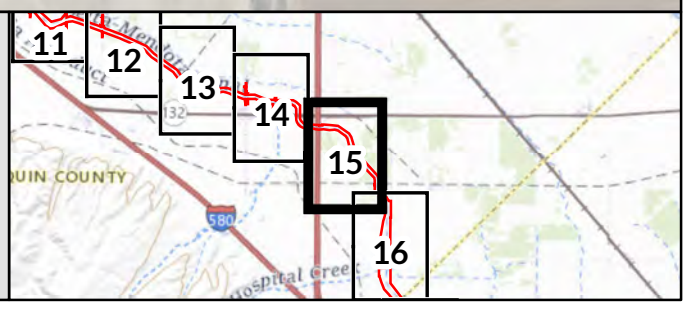
NORTH

0 0.2 0.4

Kilometers

0 0.2 0.4

Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).

DMC Segment 4
MP 20.63-24.42

Turnout
MP 24.38

Check No. 4
MP 24.42

DMC Segment 5
MP 24.43–29.81

24.10
24.20
24.30
24.40
24.50
24.60
24.70
24.80
24.90
25.00
25.10
25.20
25.30
25.40
25.50
25.60
25.70

Delta Mendota Canal
S Koster Rd
California Aque

bing

LEGEND

APE

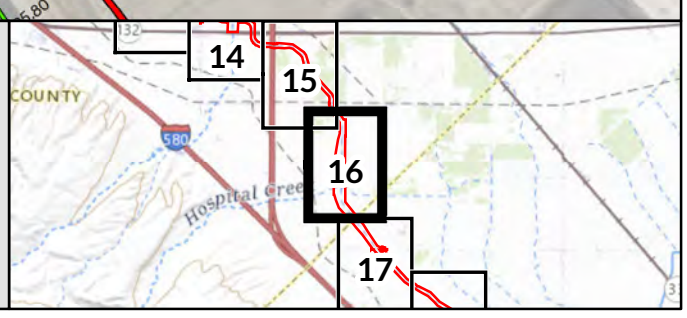
Eligible/Contributing

Ineligible/Non-Contributing

NORTH

0 0.2 0.4
Kilometers

0 0.2 0.4
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).

DMC Segment 5
MP 24.43–29.81

25.70
25.80
25.90
26.00
26.10
26.20
26.30
26.40
26.50
26.60
26.70
26.80
26.90

S Koster Rd
Gaffery Rd
California Aqueduct
Westley Safety Rest Area
bing

LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

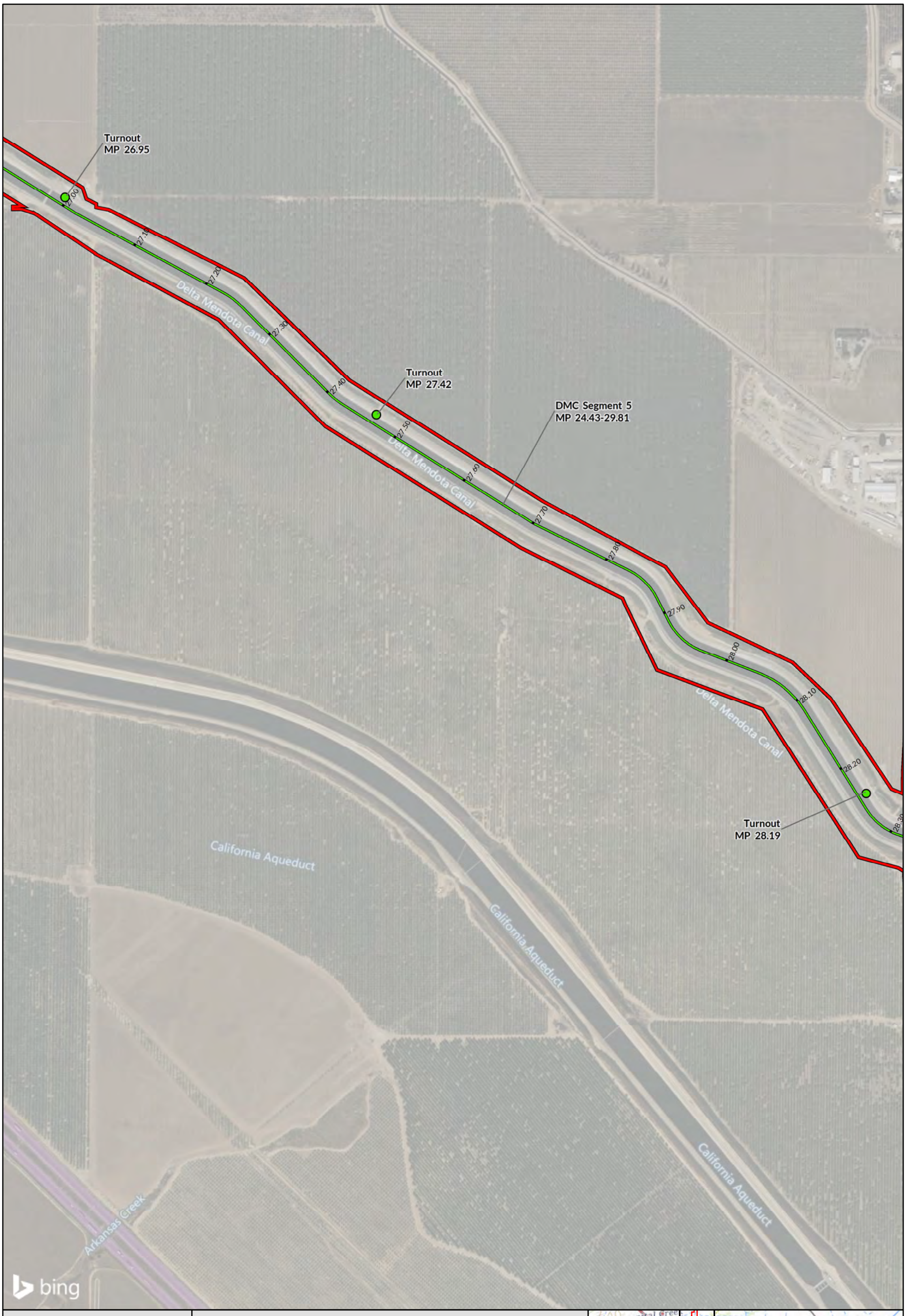
NORTH

0 0.2 0.4
Kilometers

0 0.2 0.4
Miles

16
17
18
19

source: JRP (2022); Bing (2022); Esri, et al. (2022).



LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

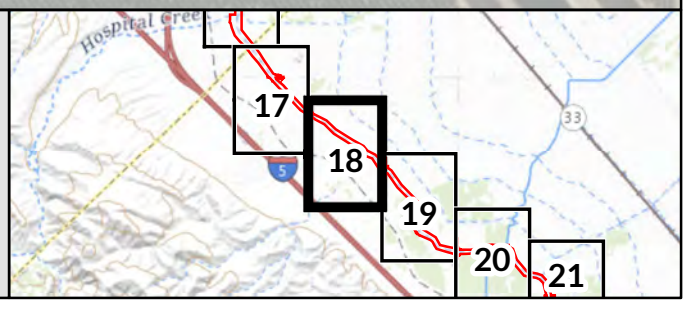
NORTH

0 0.2 0.4

Kilometers

0 0.2 0.4

Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).

Turnout
MP 28.19

28.20
28.30
28.40
28.50
28.60
28.70
28.80
28.90
29.00
29.10
29.20
29.30
29.40
29.50
29.60
29.70
29.80
29.90

Delta Mendota Canal

DMC Segment 5
MP 24.43-29.81

Turnout
MP 28.89

Welty Rd
Welty Rd

McCracken Rd
McCracken Rd

W Hamilton Rd
W Hamilton Rd

Khalsa Rd

California Aqueduct
California Aqueduct

P-50-002328
Tesla-Salado-Manteca 115 kV Transmission Line

Turnout
MP 29.56

Check No. 5
MP 29.81

DMC Segment 6
MP 29.82-34.41

bing

LEGEND

APE

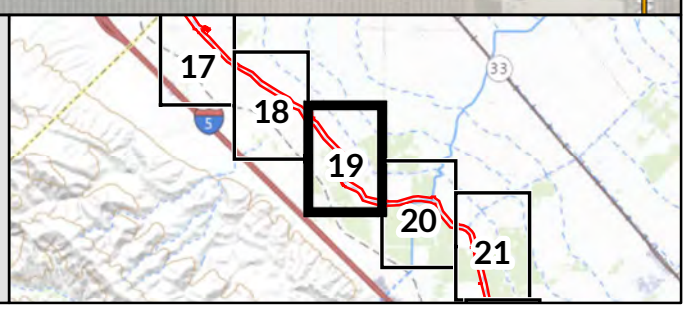
Eligible/Contributing

Ineligible/Non-Contributing

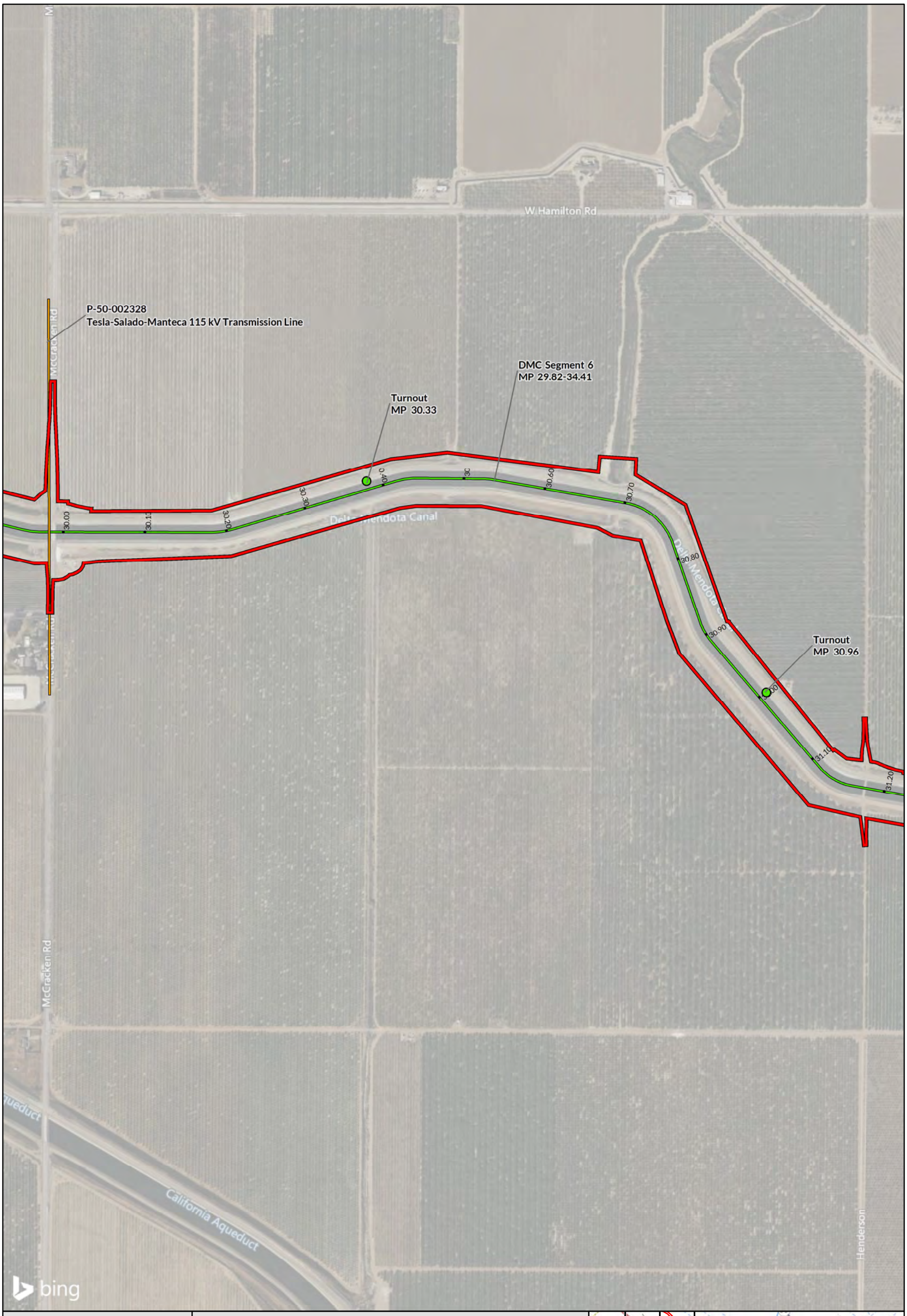
NORTH

0 0.2 0.4
Kilometers

0 0.2 0.4
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).

W Stanislaus Rd

31.20

31.30

31.40

31.50

DMC Segment 6
MP 29.82-34.41

31.60

Turnout
MP 31.6

31.70

31.80

31.90

32.00

32.10

32.20

32.30

Turnout
MP 32.36

32.40

Henderson

bing

LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

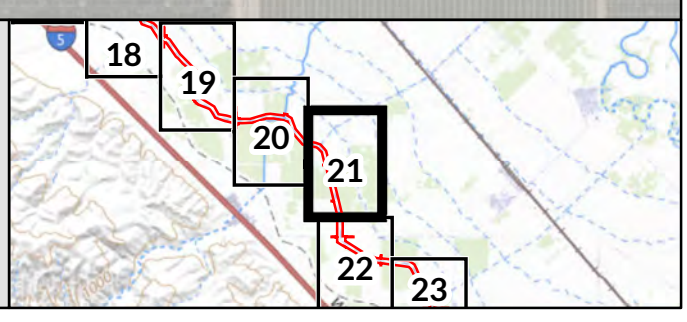
NORTH

0 0.2 0.4

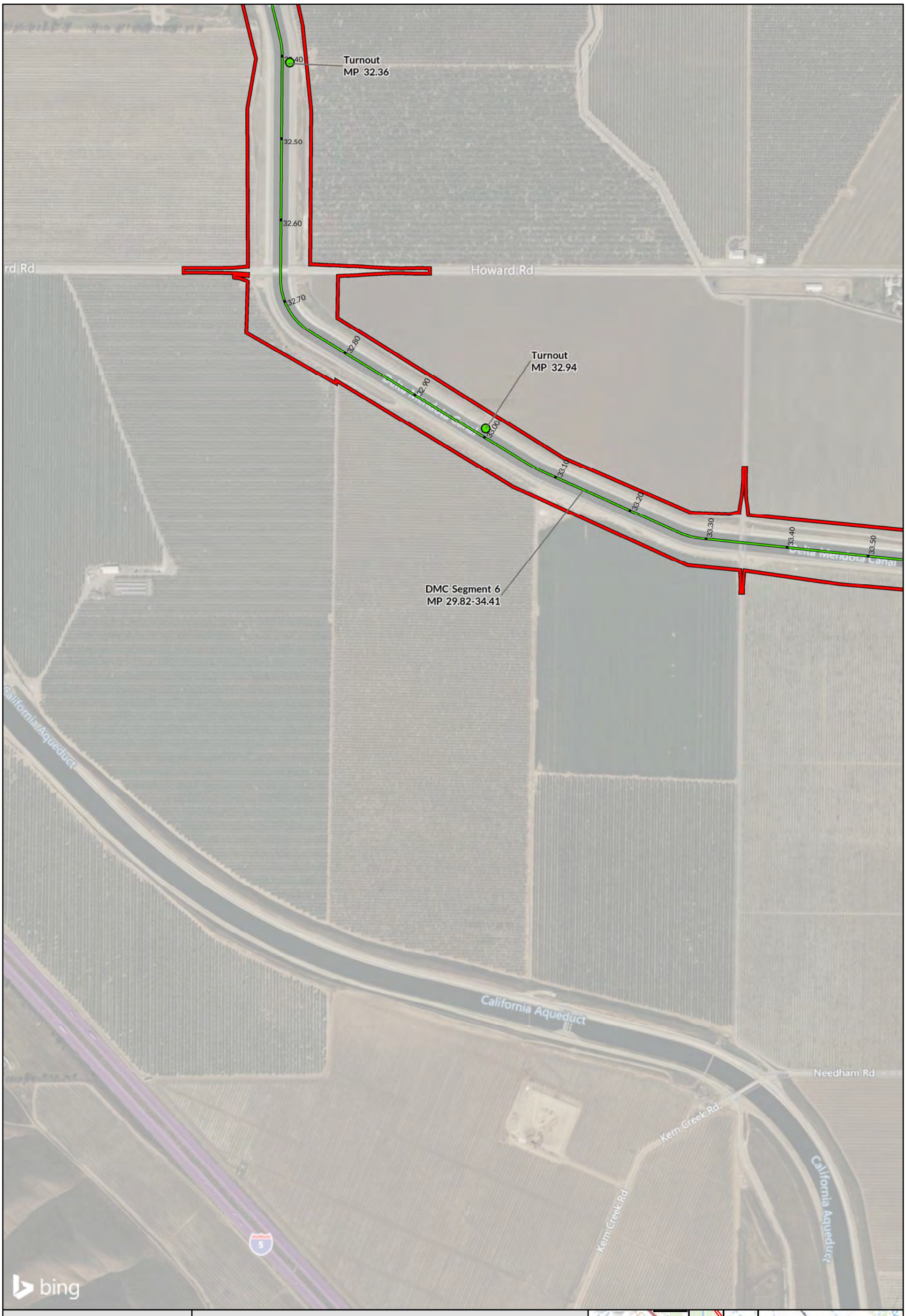
Kilometers

0 0.2 0.4

Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

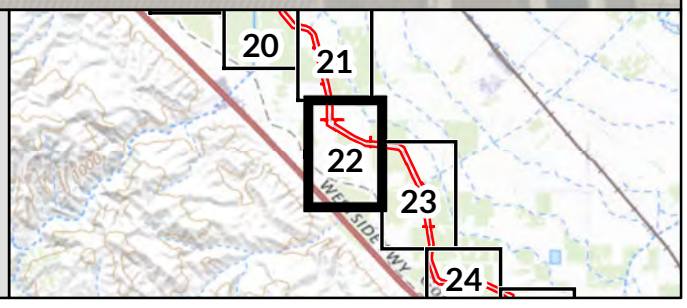
NORTH

0 0.2 0.4

Kilometers

0 0.2 0.4

Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).

Turnout
MP 33.71

DMC Segment 6
MP 29.82-34.41

Turnout
MP 34.08

Westley Wasteway
MP 34.32

Check No. 6
MP 34.42

Turnout
MP 34.55

DMC Segment 7
MP 34.42-38.67

Turnout
MP 35.18

Delta Mendota Canal

Stark Rd

Westley Wasteway

bing

LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

NORTH

0 0.2 0.4

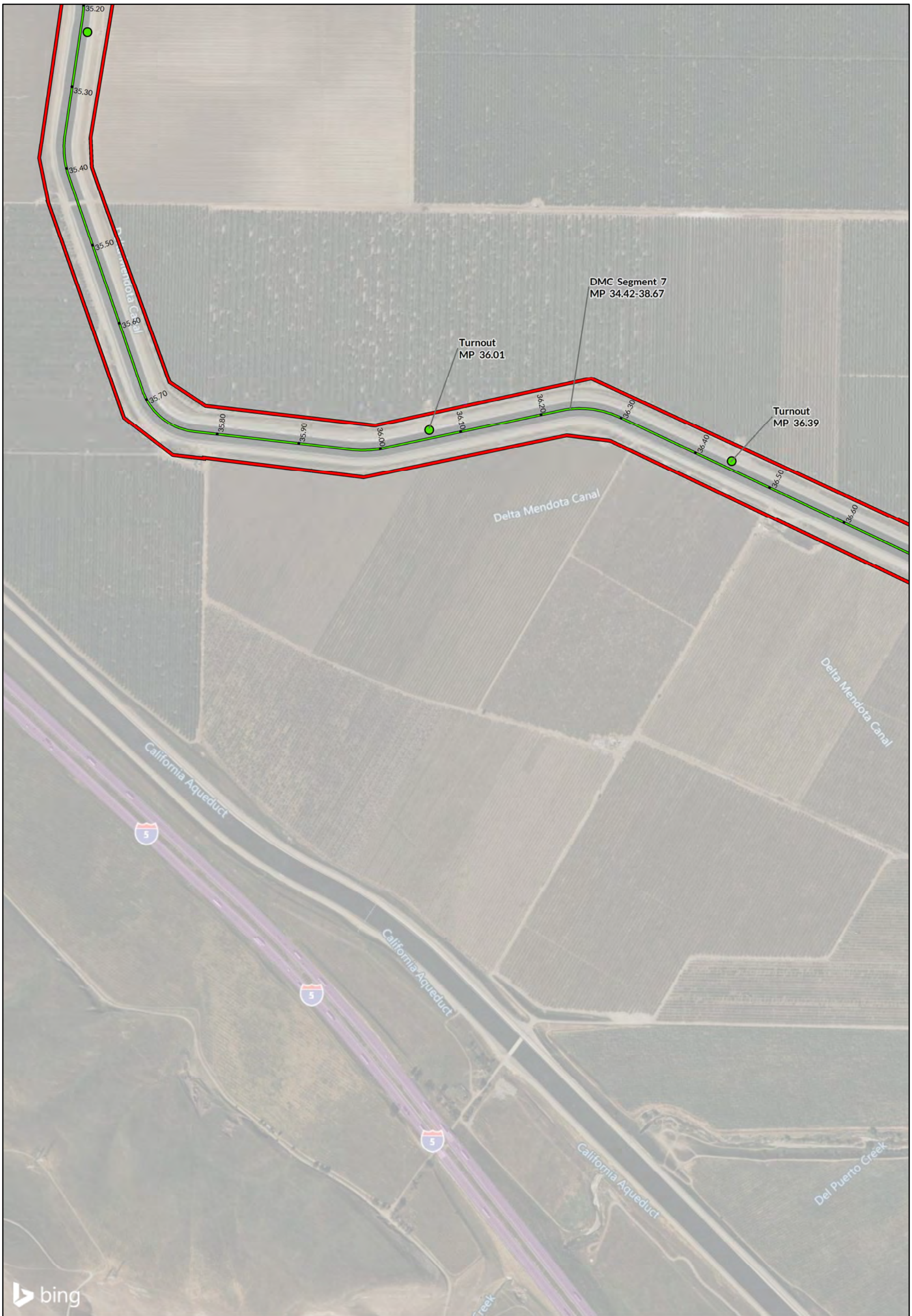
Kilometers

0 0.2 0.4

Miles

21 22 23 24 25

source: JRP (2022); Bing (2022); Esri, et al. (2022).



LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

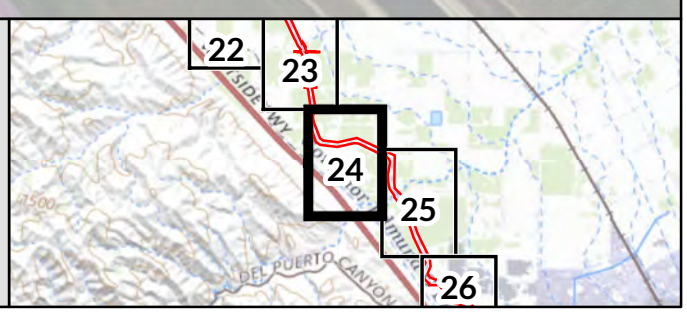
NORTH

0 0.2 0.4

Kilometers

0 0.2 0.4

Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).

Turnout
MP 36.68

DMC Segment 7
MP 34.42-38.67

Siphon
MP 37.24-37.31

Turnout
MP 37.58

Turnout
MP 38.15

36.70
36.80
36.90
37.00
37.10
37.20
37.30
37.40
37.50
37.60
37.70
37.80
37.90
38.00
38.10
38.20
38.30

Zacharias Rd
Zacharias Rd
Lateral Number 5 South
Delta Mendota Canal
California Aqueduct
bing

LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

NORTH

0 0.2 0.4
Kilometers

0 0.2 0.4
Miles

23
24
25
26
Patterson

source: JRP (2022); Bing (2022); Esri, et al. (2022).

DMC Segment 7
MP 34.42-38.67

Check No. 7
MP 38.69

Turnout
MP 38.8

Turnout
MP 39.22

DMC Segment 8
MP 38.68-44.25

Turnout
MP 39.78

Delta Mendota Canal
California Aqueduct
Wsid Lat Number 6 South
Rogers Rd
Keystone Pacific Pkwy
Haggerty Dr
Annamarie Ave
Speno Dr
Renzo Ln
Sperry Ave
Del Puerto Canyon Rd
Diablo Grande Pkwy
434
5
bing

38.30
38.40
38.50
38.60
38.70
38.80
38.90
39.00
39.10
39.20
39.30
39.40
39.50
39.60
39.70
39.80
39.90
40.00
40.10
40.20
40.30

LEGEND

APE

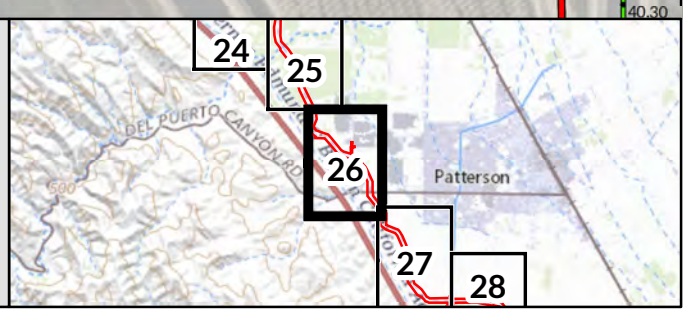
Eligible/Contributing

Ineligible/Non-Contributing

NORTH

0 0.2 0.4
Kilometers

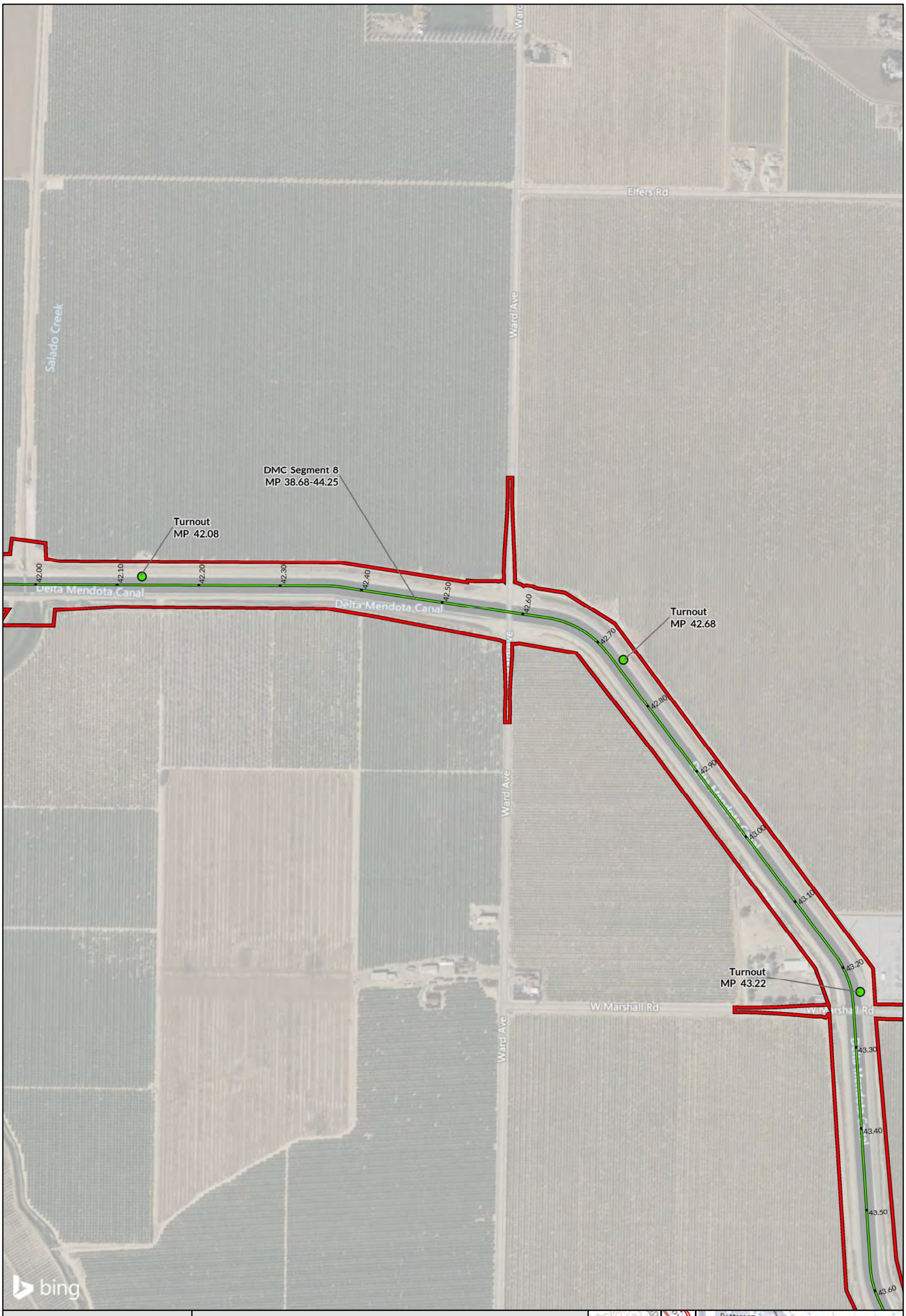
0 0.2 0.4
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).



LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

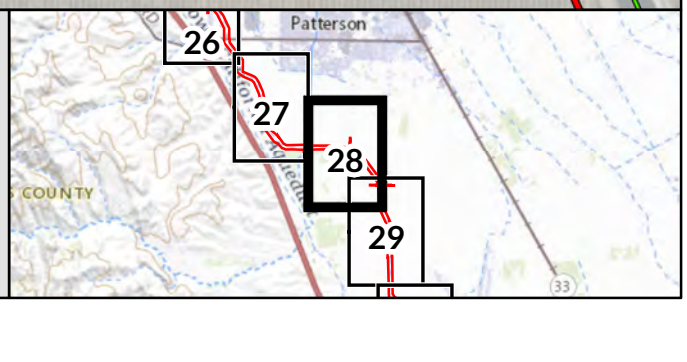
NORTH

0 0.2 0.4

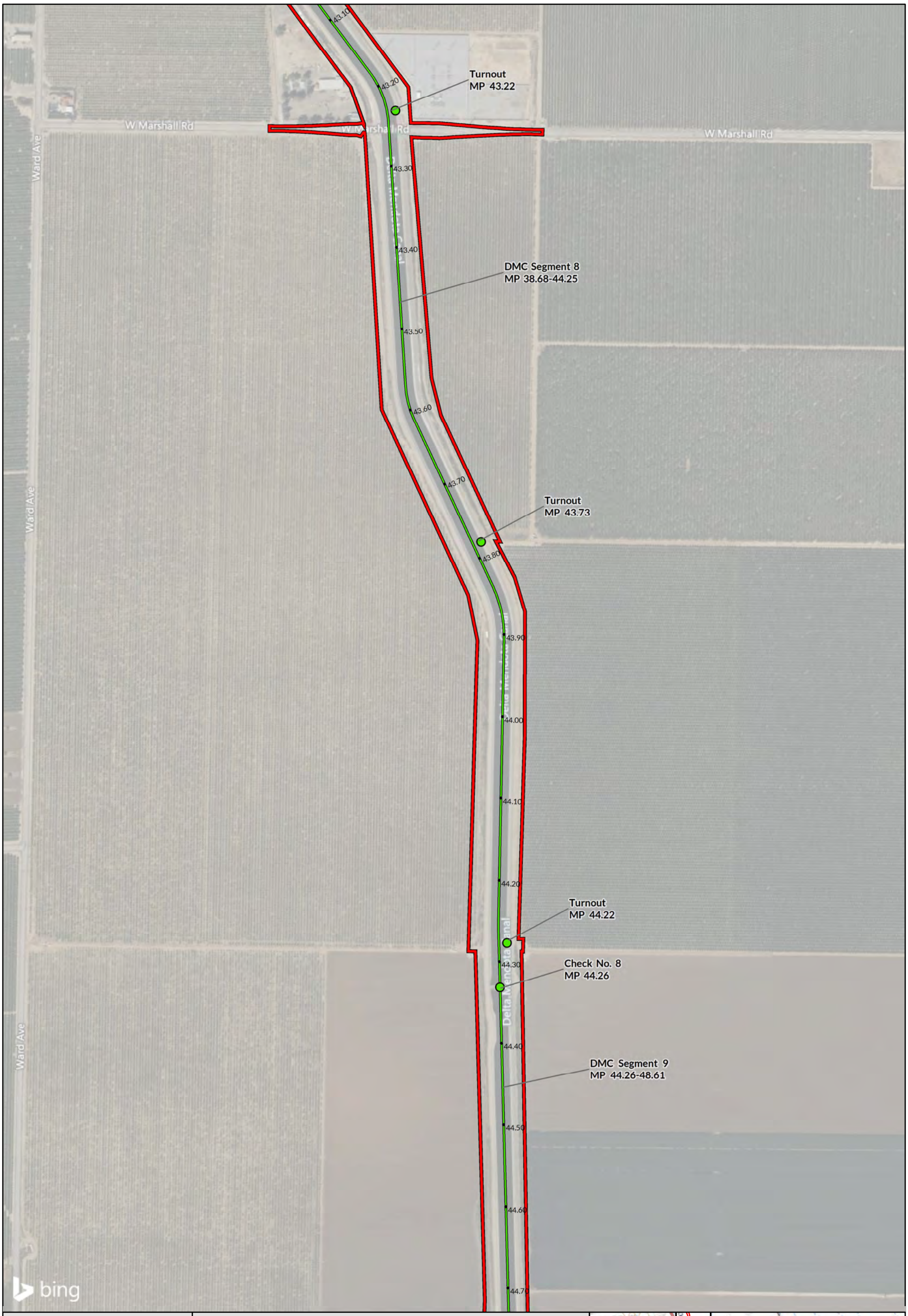
Kilometers

0 0.2 0.4

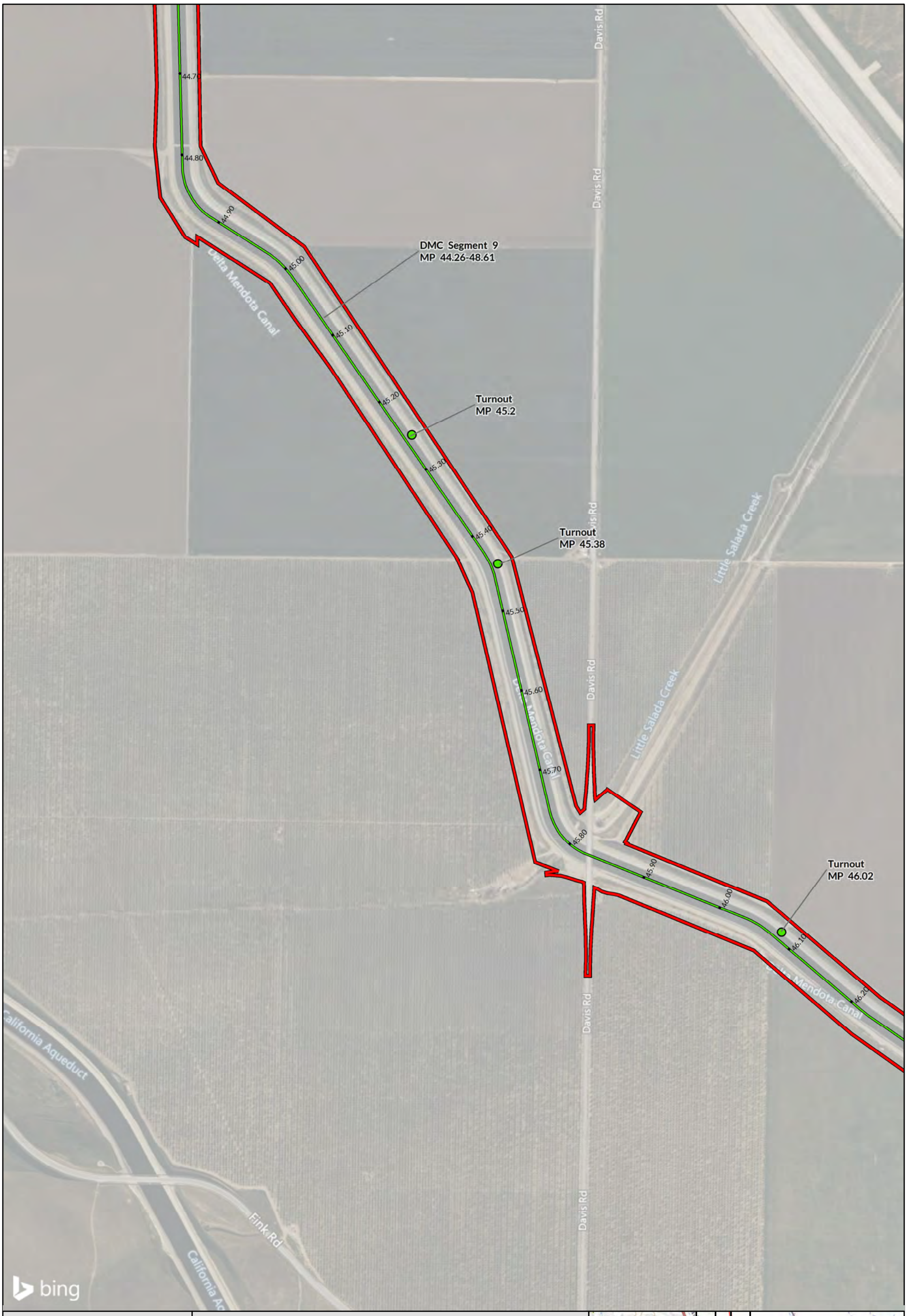
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).



LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

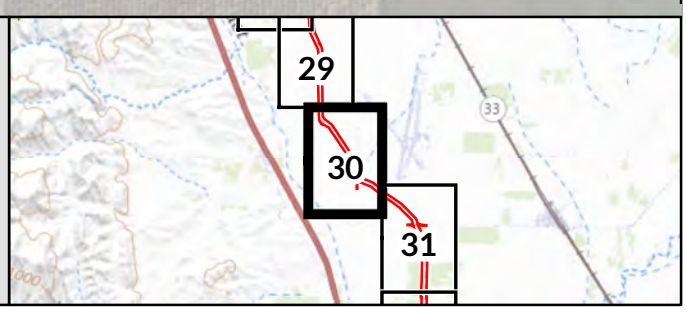
NORTH

0 0.2 0.4

Kilometers

0 0.2 0.4

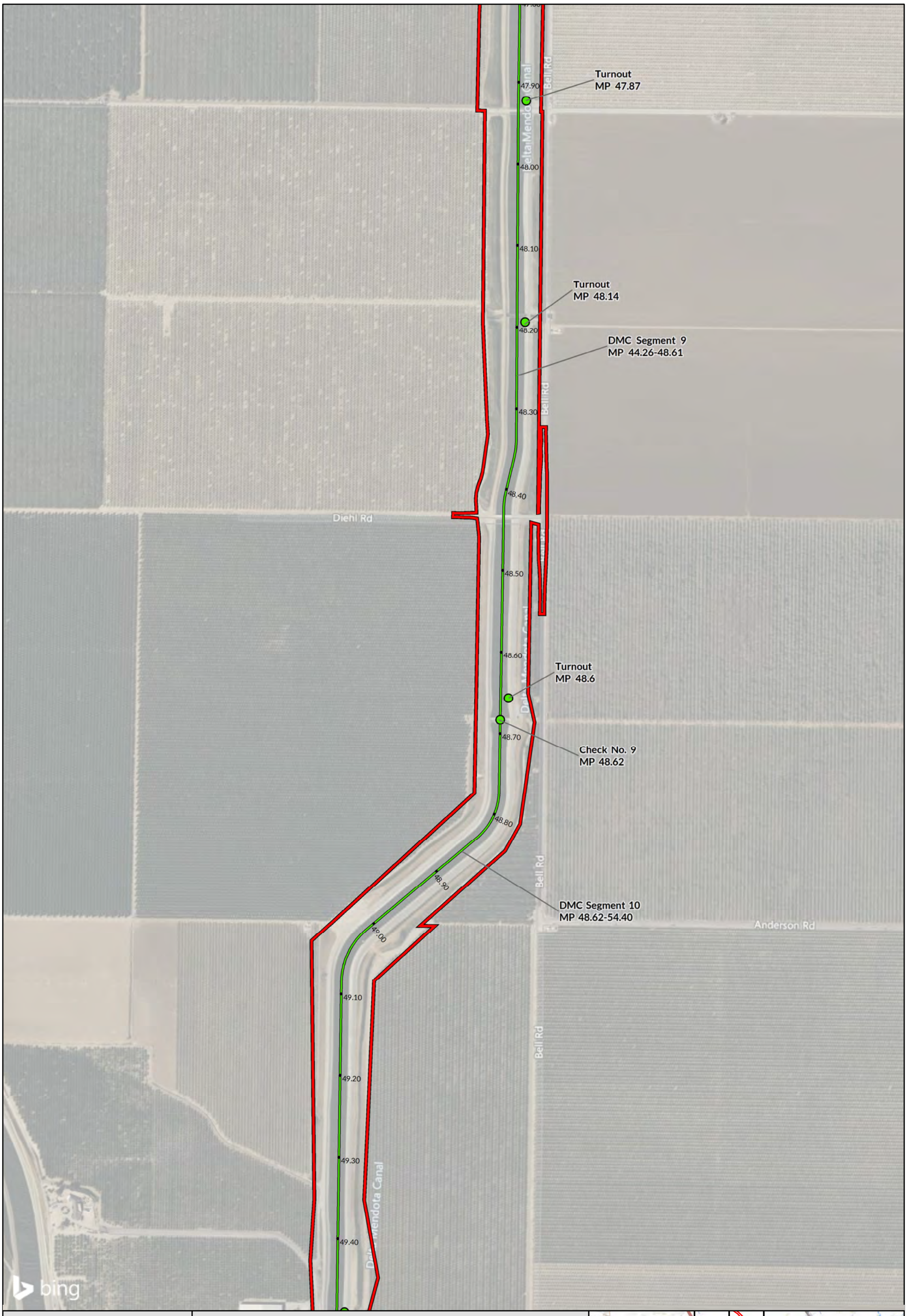
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).



LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

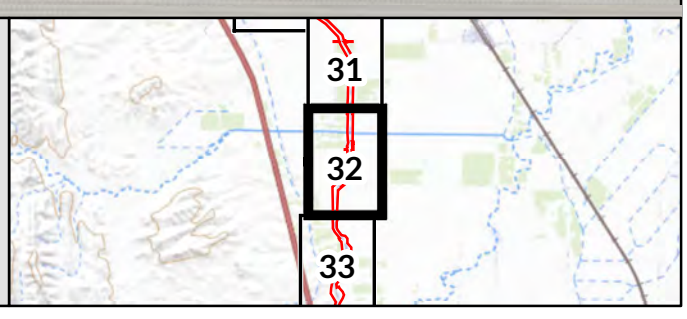
NORTH

0 0.2 0.4

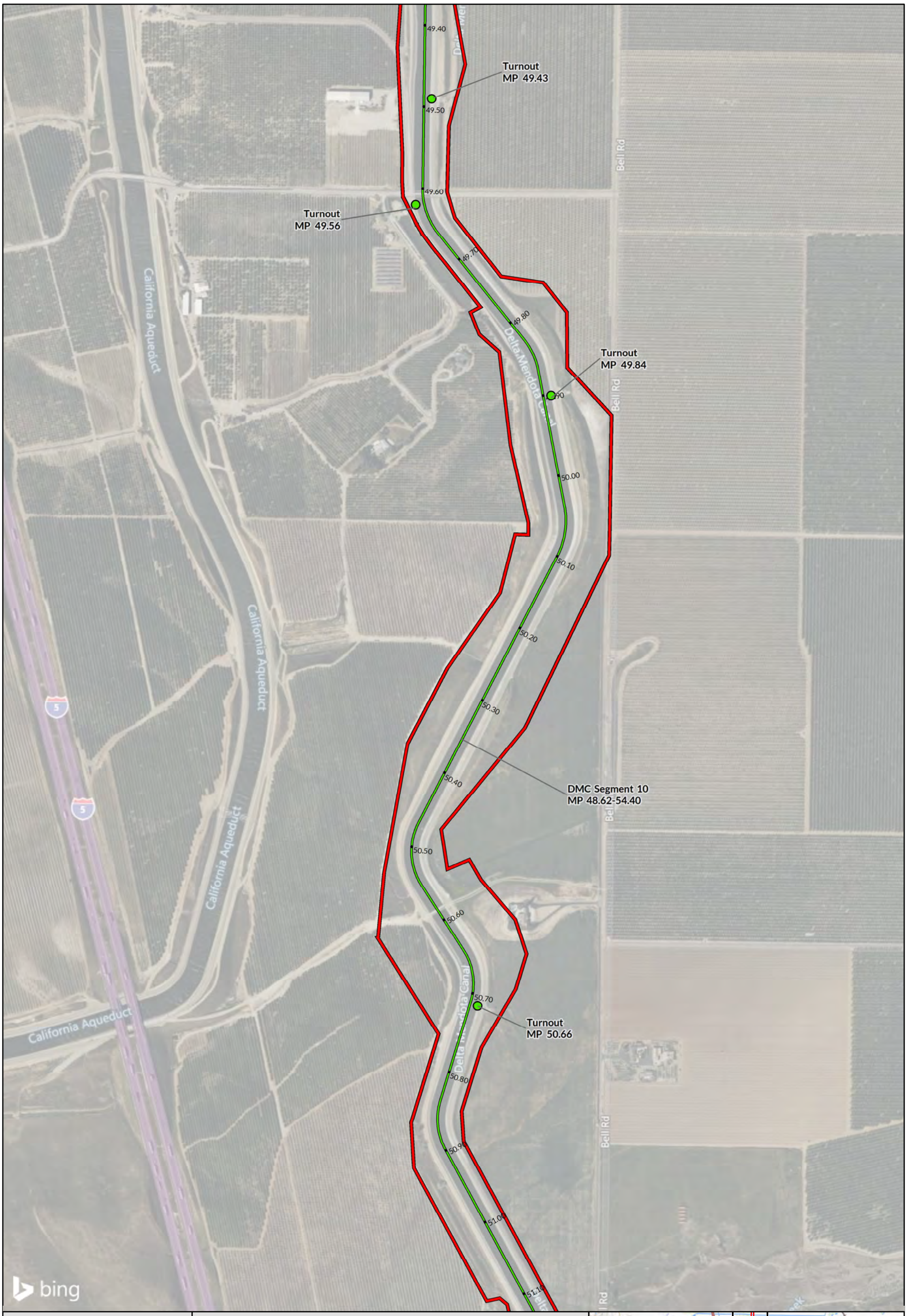
Kilometers

0 0.2 0.4

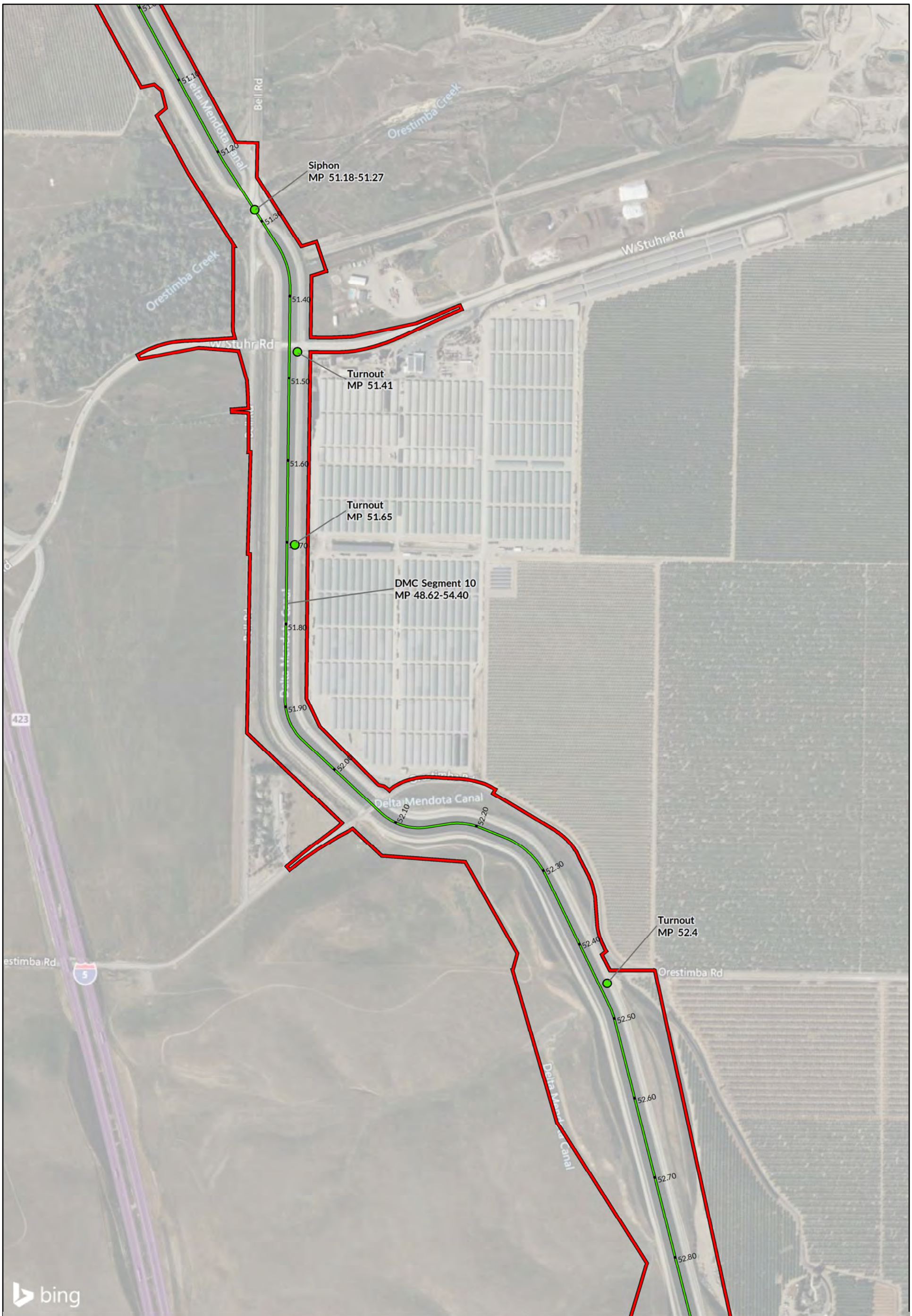
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



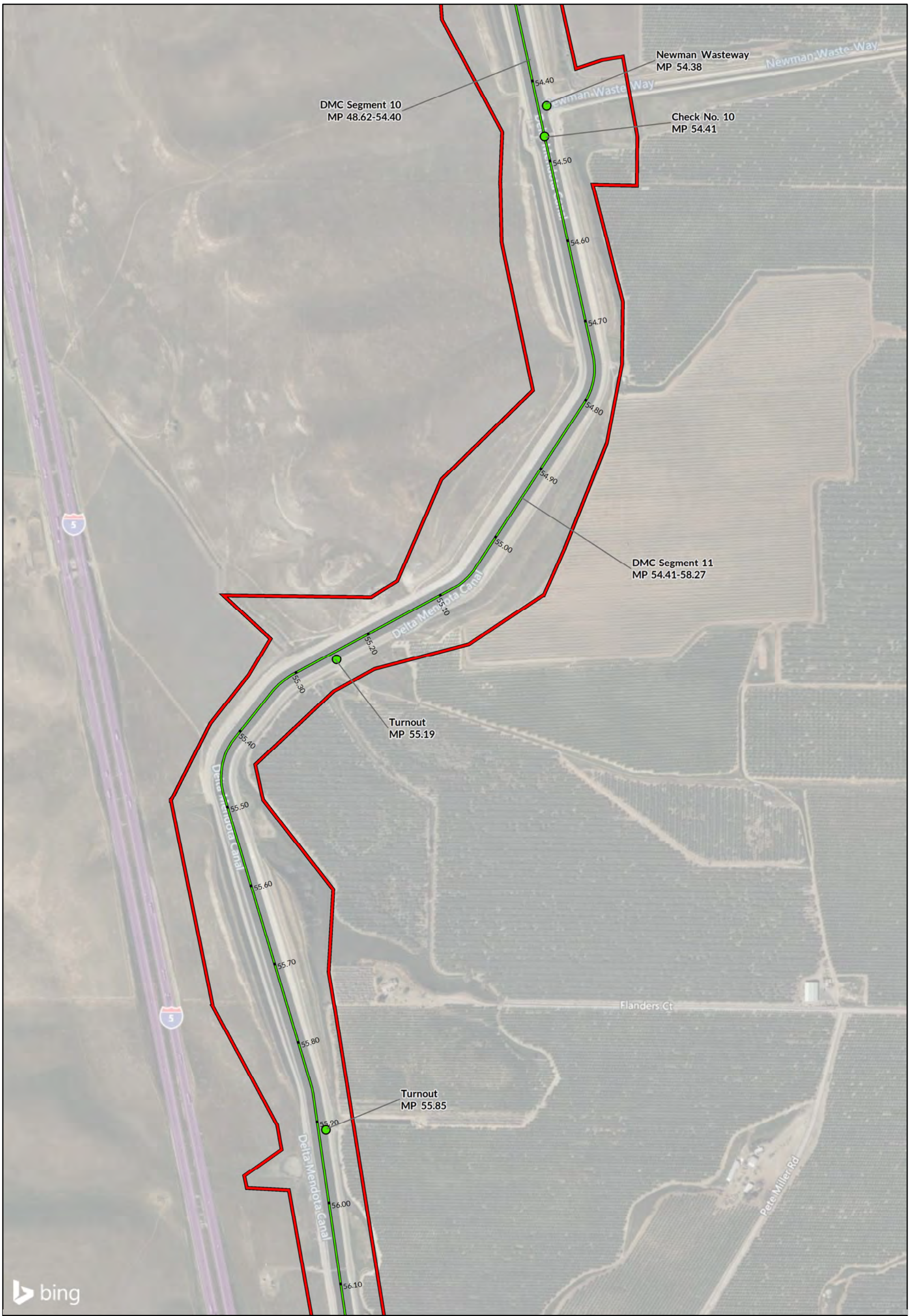
source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).

DMC Segment 11
MP 54.41-58.27

Turnout
MP 56.82

Turnout
MP 57.46

56.10
56.20
56.30
56.40
56.50
56.60
56.70
56.80
56.90
57.00
57.10
57.20
57.30
57.40
57.50
57.60
57.70
57.80

Pete Miller Rd
Delta Mendota Canal
5
418

bing

LEGEND

APE

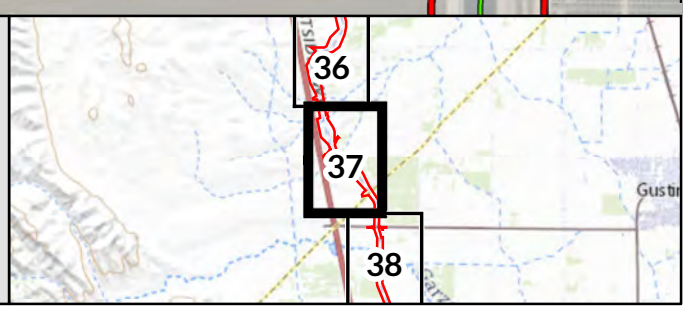
Eligible/Contributing

Ineligible/Non-Contributing

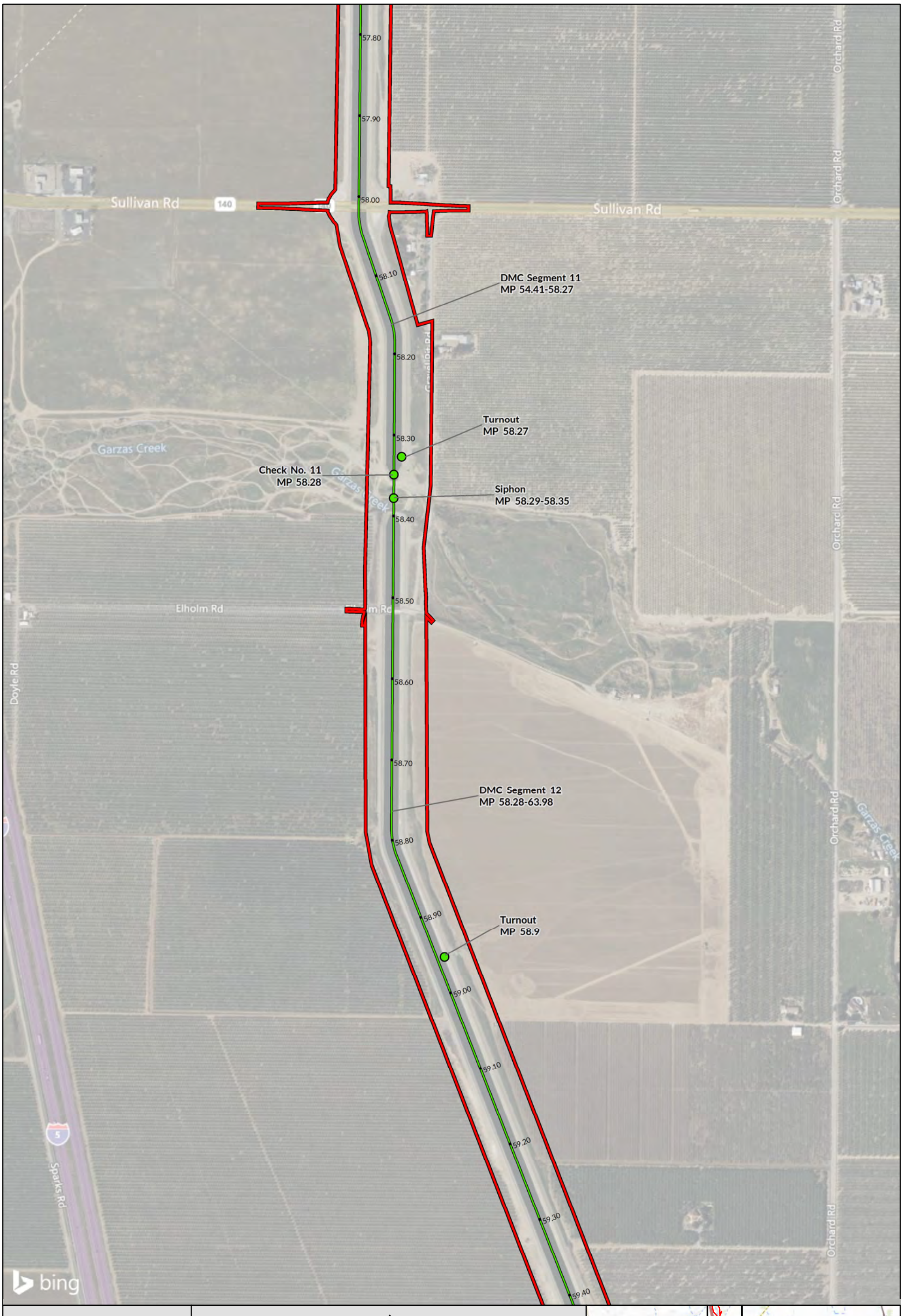
NORTH

0 0.2 0.4
Kilometers

0 0.2 0.4
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

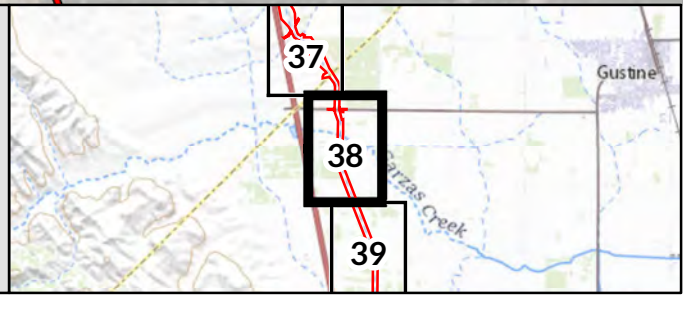
NORTH

0 0.2 0.4

Kilometers

0 0.2 0.4

Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).

Turnout
MP 59.53

DMC Segment 12
MP 58.28-63.98

Turnout
MP 60.65

Taglio Rd

Taglio Rd

Orchard Rd

Orchard Rd

59.30
59.40
59.50
59.60
59.70
59.80
59.90
60.00
60.10
60.20
60.30
60.40
60.50
60.60
60.70
60.80
60.90

bing

LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

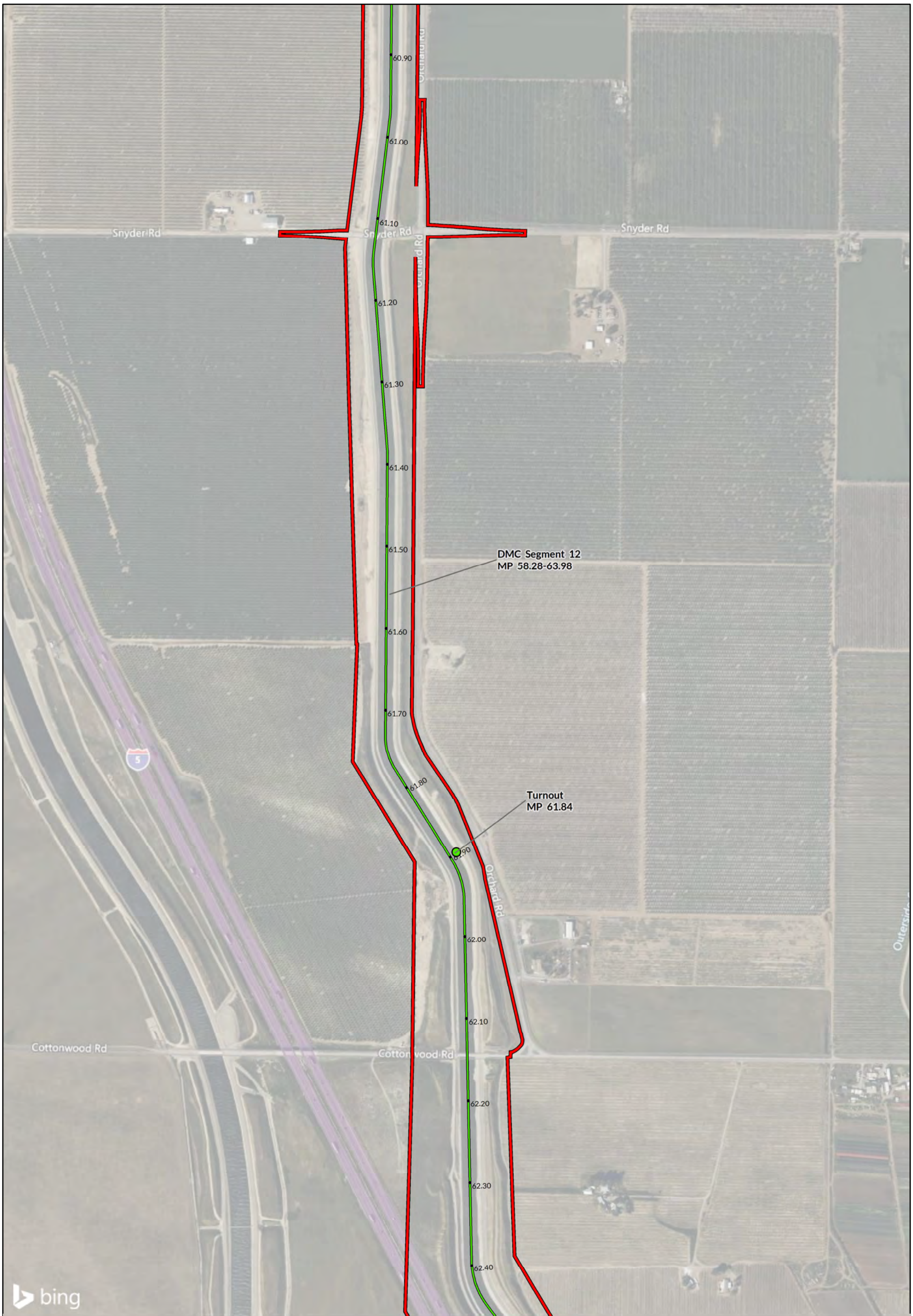
NORTH

0 0.2 0.4
Kilometers

0 0.2 0.4
Miles

38
39
40

source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).

62.40
62.50
62.60
62.70
62.80
62.90
63.00
63.10
63.20
63.30
63.40
63.50
63.60
63.70

Turnout
MP 62.67

DMC Segment 12
MP 58.28-63.98

5
5
5

bing

LEGEND

APE

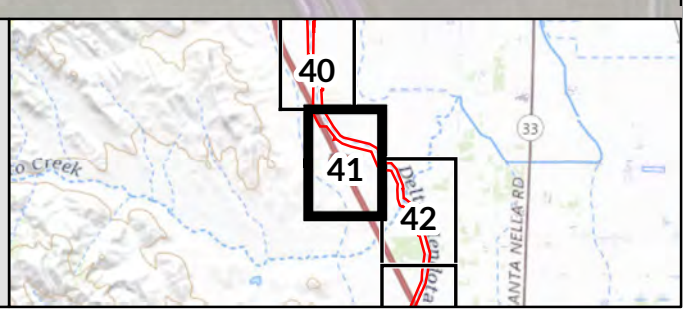
Eligible/Contributing

Ineligible/Non-Contributing

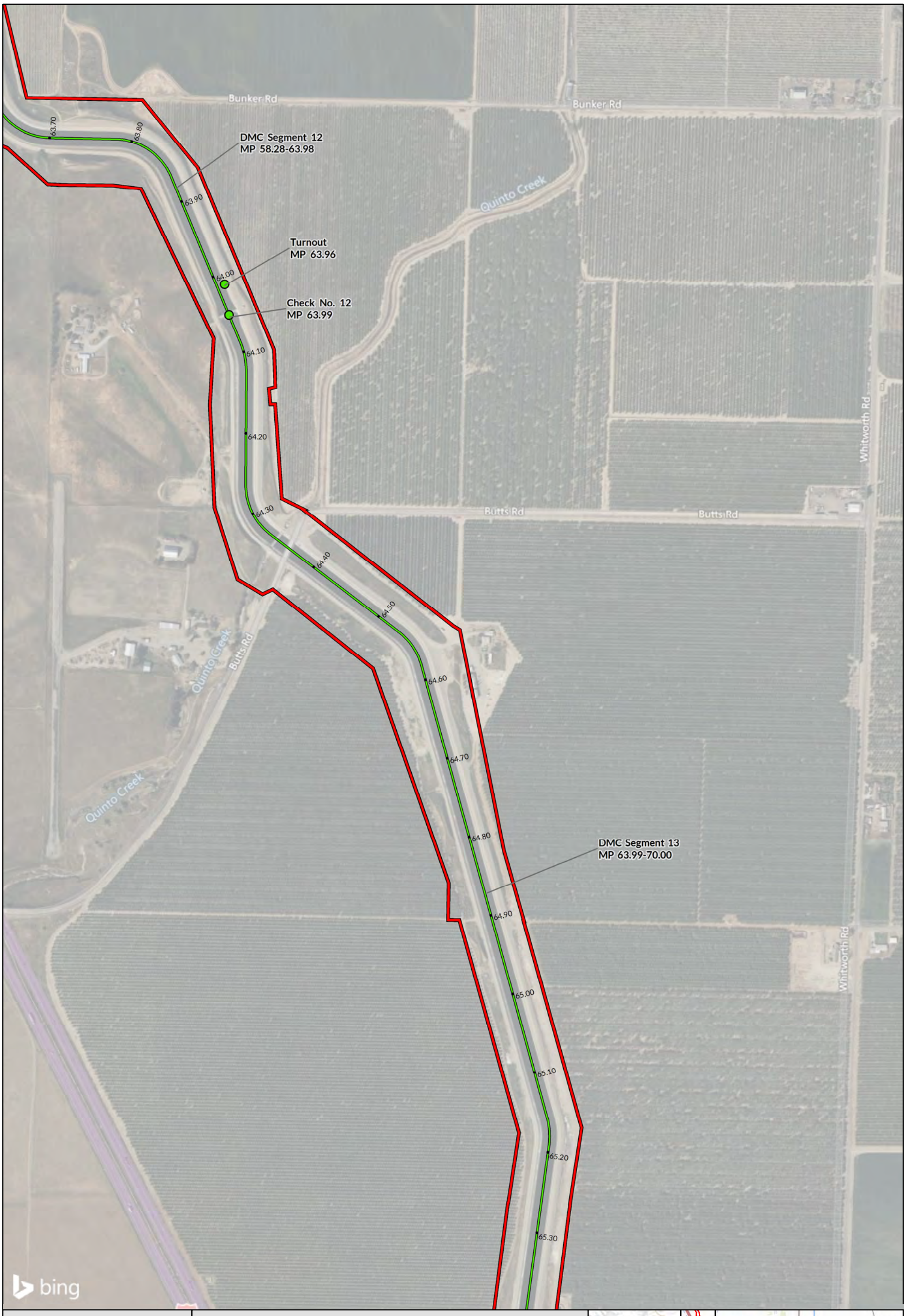
NORTH

0 0.2 0.4
Kilometers

0 0.2 0.4
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).

65.30
40
Turnout
MP 65.35
65.50
65.60
65.70
65.80
65.90
66.00
66.10
Turnout
MP 66.06
66.20
66.30
DMC Segment 13
MP 63.99-70.00
66.40
66.50
66.60
66.70
Turnout
MP 66.73
66.80
66.90
Whitworth Rd
Romero Rd
5
bing

LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

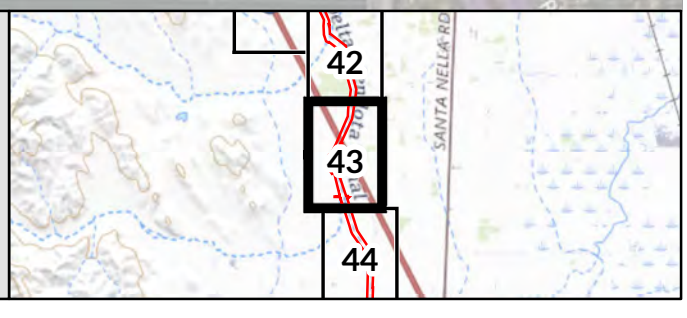
NORTH

0 0.2 0.4

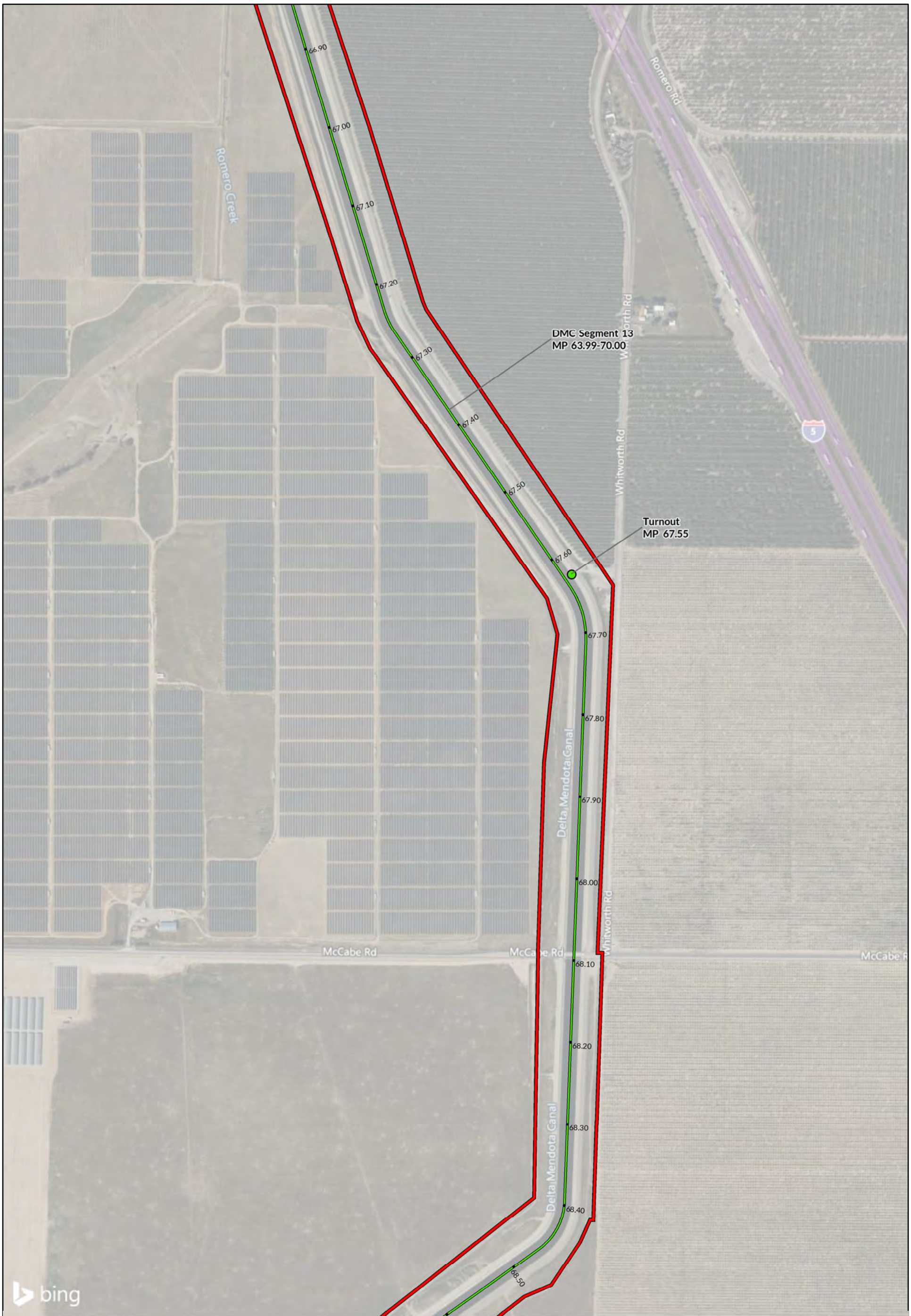
Kilometers

0 0.2 0.4

Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

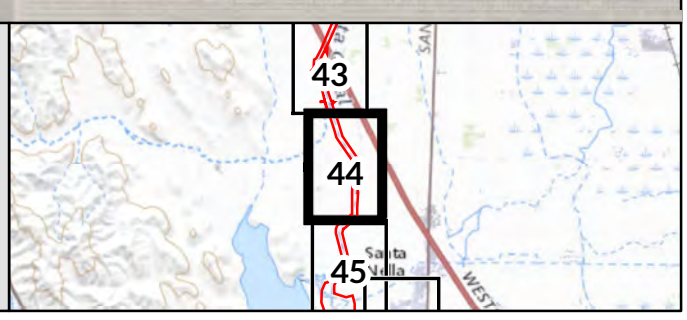
NORTH

0 0.2 0.4

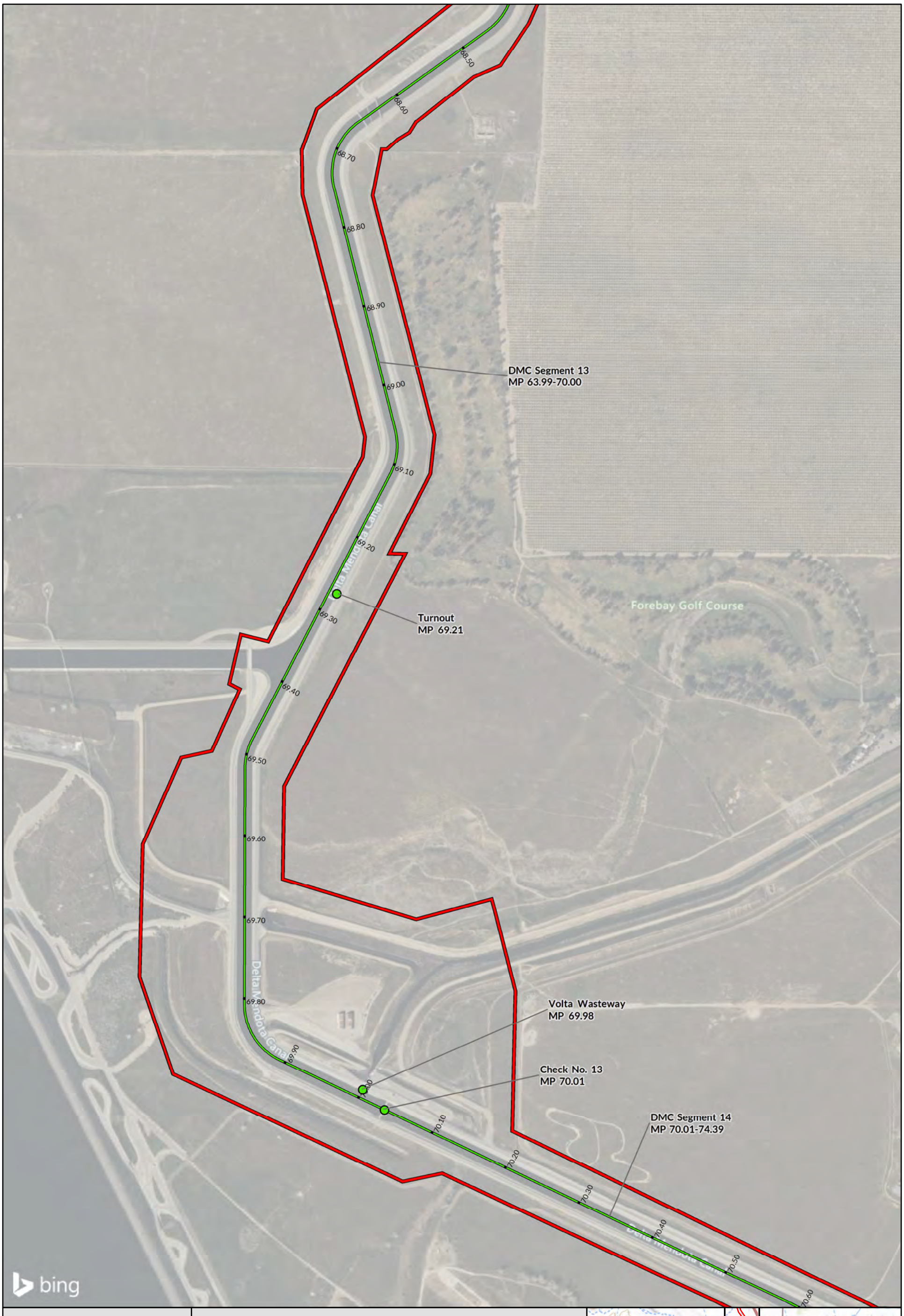
Kilometers

0 0.2 0.4

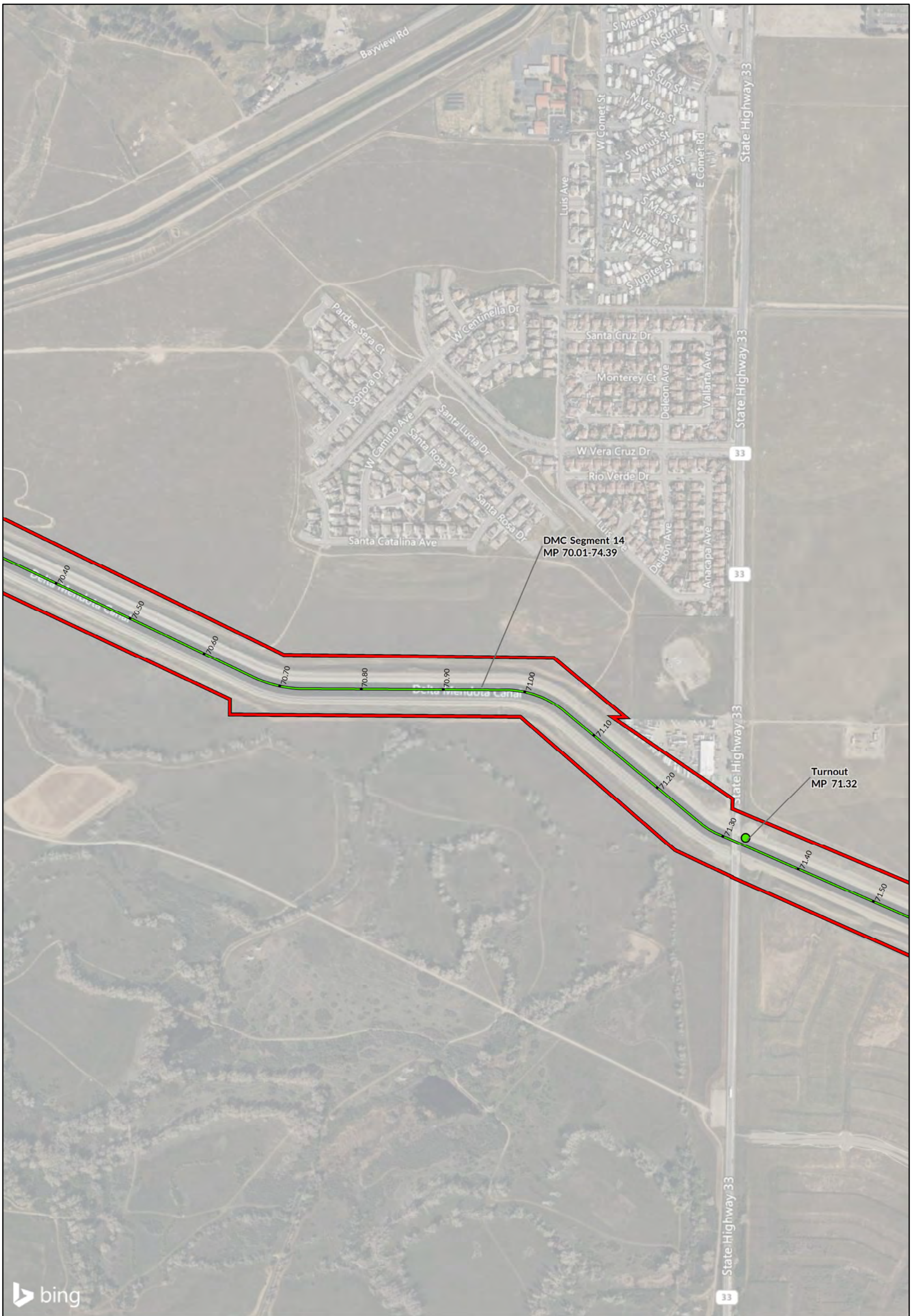
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).



LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

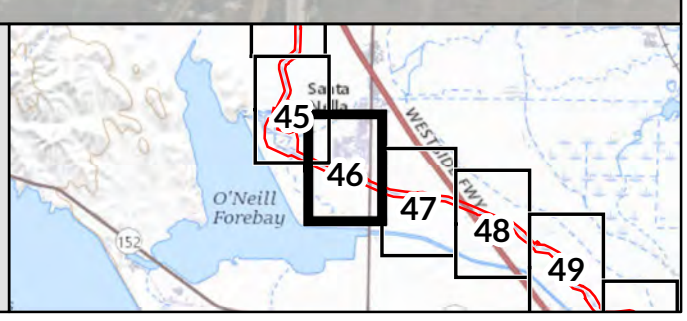
NORTH

0 0.2 0.4

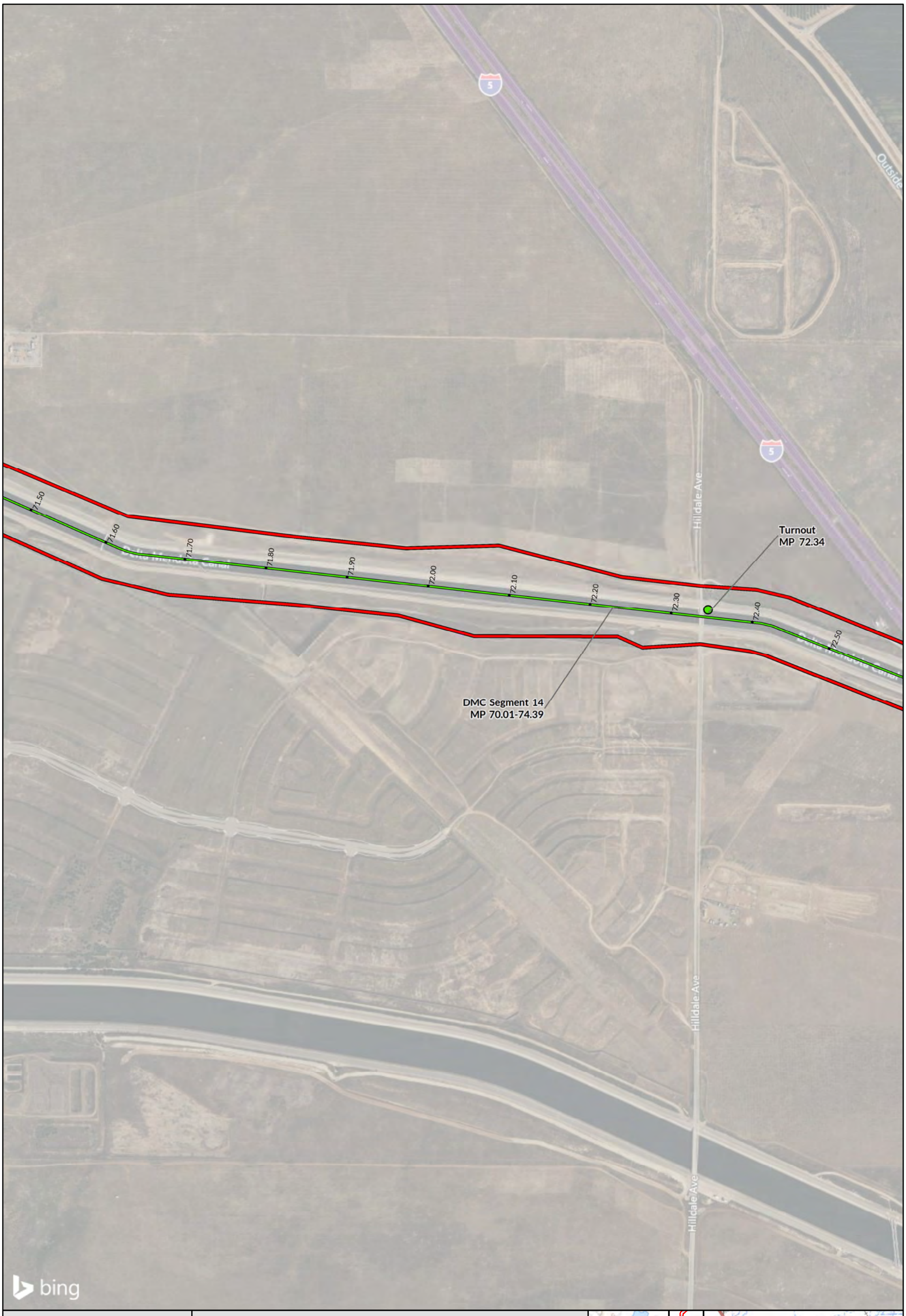
Kilometers

0 0.2 0.4

Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

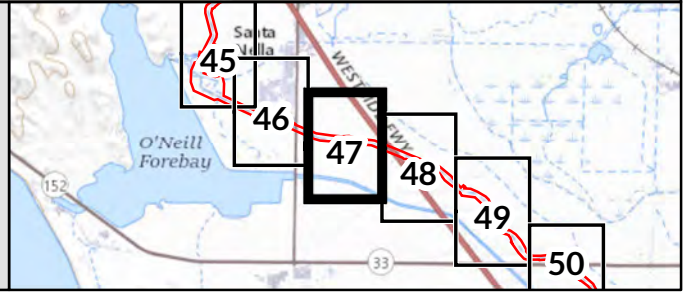
NORTH

0 0.2 0.4

Kilometers

0 0.2 0.4

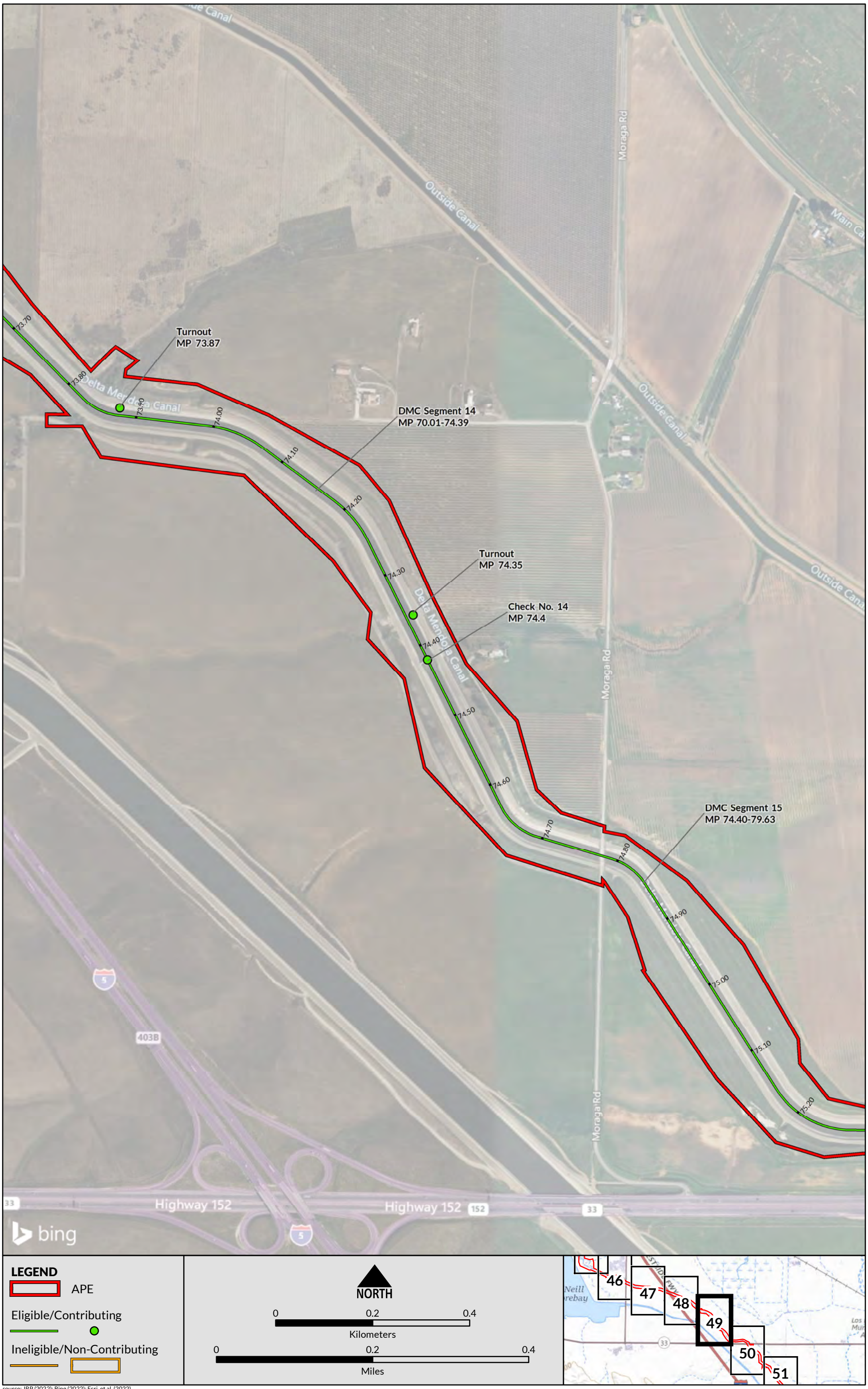
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).

Turnout
MP 75.43

DMC Segment 15
MP 74.40-79.63

Outside Canal

Highway 152

33

152

75.30

75.40

75.50

75.70

75.80

75.90

76.00

76.10

76.20

76.30

76.40

76.50

76.60

76.70

Billy Wright Rd S

Pioneer Rd

bing

LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

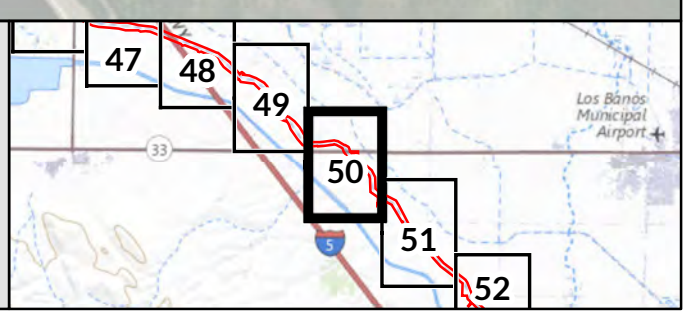
NORTH

0 0.2 0.4

Kilometers

0 0.2 0.4

Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).

Turnout
MP 76.77

DMC Segment 15
MP 74.40-79.63

Turnout
MP 77.24

Outside Canal
Volta Rd
Pioneer Rd
Delta Mendota Canal
76.70
76.80
76.90
77.00
77.10
77.20
77.30
77.40
77.50
77.60
77.70
77.80
77.90
78.00
78.10
78.20
bing

LEGEND

APE

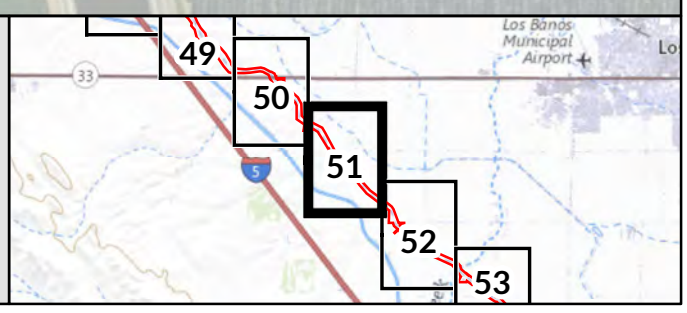
Eligible/Contributing

Ineligible/Non-Contributing

NORTH

0 0.2 0.4
Kilometers

0 0.2 0.4
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).

Turnout
MP 78.57

DMC Segment 15
MP 74.40-79.63

Turnout
MP 79.13

78.20
78.30
78.40
78.50
78.60
78.70
78.80
78.90
79.00
79.10
79.20
79.30
79.40
79.50
79.60

Canyon Rd
W Sunset Ave
Delta Mendota Canal
Volta Rd
MERCEY SPRINGS RD

bing

LEGEND

APE

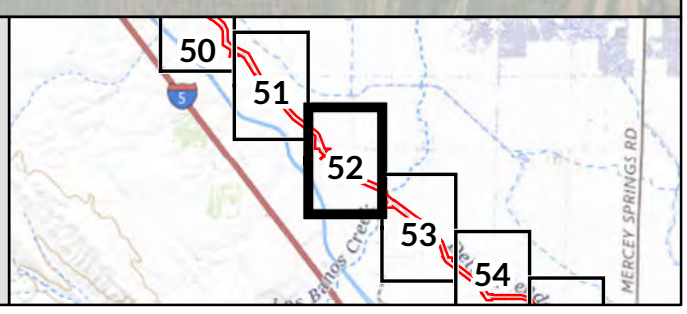
Eligible/Contributing

Ineligible/Non-Contributing

NORTH

0 0.2 0.4
Kilometers

0 0.2 0.4
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).

DMC Segment 15
MP 74.40-79.63

Check No. 15
MP 79.65

Siphon
MP 79.64-79.72

DMC Segment 16
MP 79.64-85.08

Turnout
MP 80.99

79.60
79.70
79.80
79.90
80.00
80.10
80.20
80.30
80.40
80.50
80.60
80.70
80.80
80.90
81.00
81.10

S Creek Rd
Cactus Dr
Delta Mendota Canal
Alvarado Trail

bing

LEGEND

APE

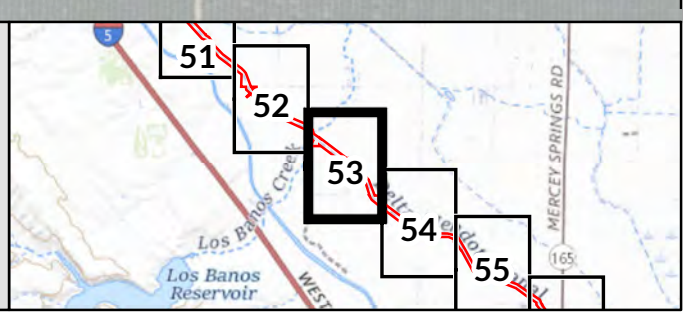
Eligible/Contributing

Ineligible/Non-Contributing

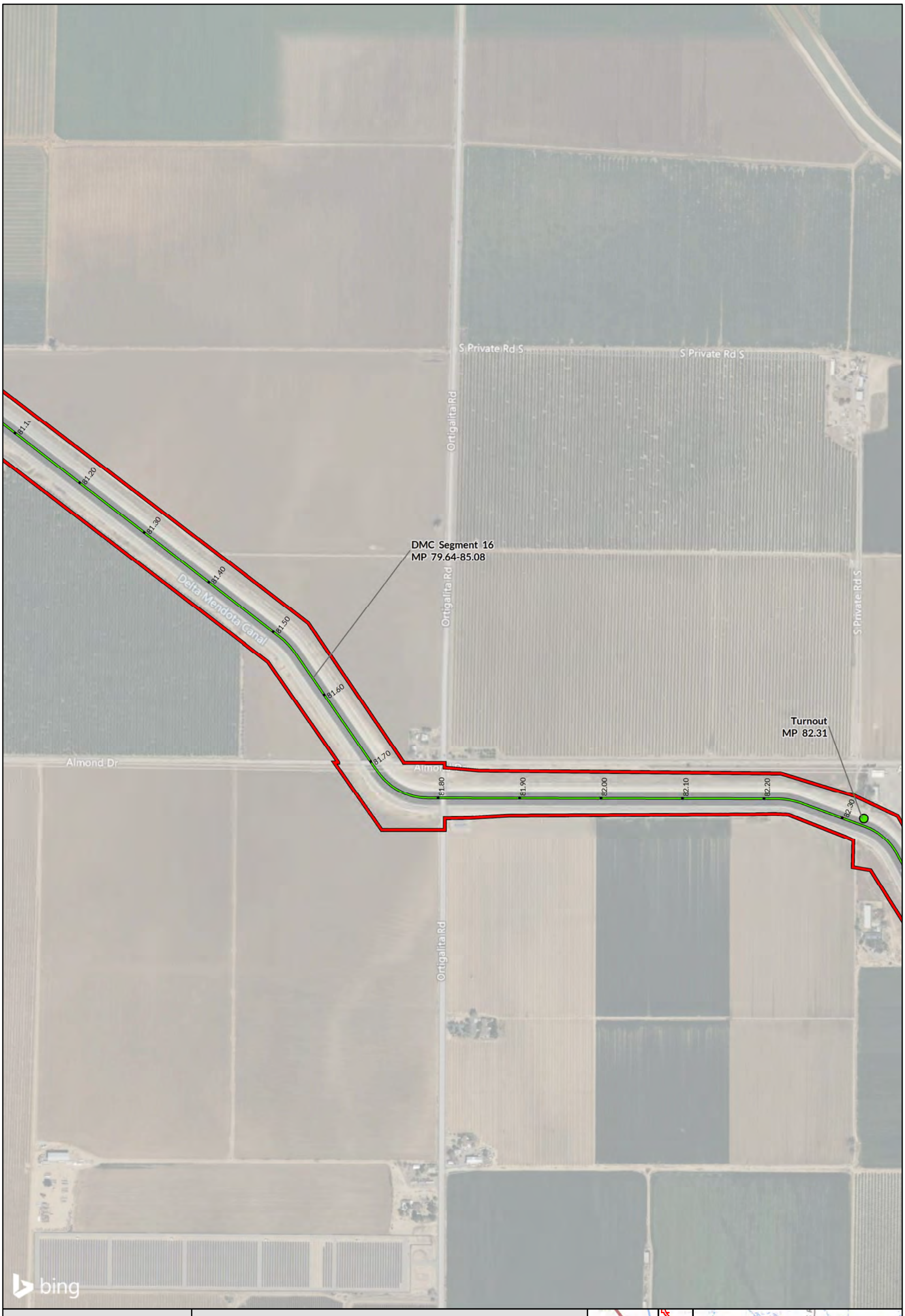
NORTH

0 0.2 0.4
Kilometers

0 0.2 0.4
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

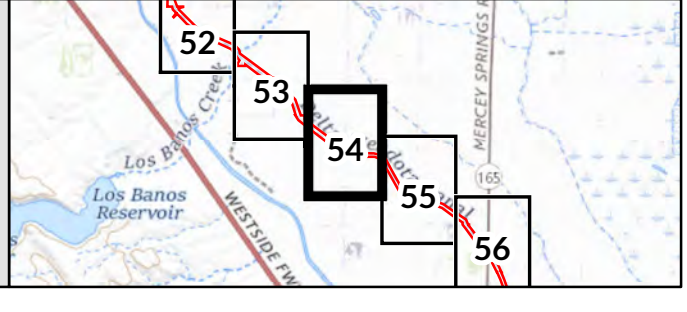
NORTH

0 0.2 0.4

Kilometers

0 0.2 0.4

Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).

S Private Rd S
Center Ave
Outside Canal
Outside Canal
Almond Dr
Turnout
MP 82.31
Almond Dr
82.40
82.50
82.60
DMC Segment 16
MP 79.64-85.08
82.70
82.80
82.90
Turnout
MP 83.08
83.00
83.10
Delta-Mendota Canal
83.20
83.30
83.40
83.50
Delta-Mendota Canal
83.60
83.70
Center Ave
Center Ave
Charleston Rd
Charleston Rd
Charleston Rd
bing

LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

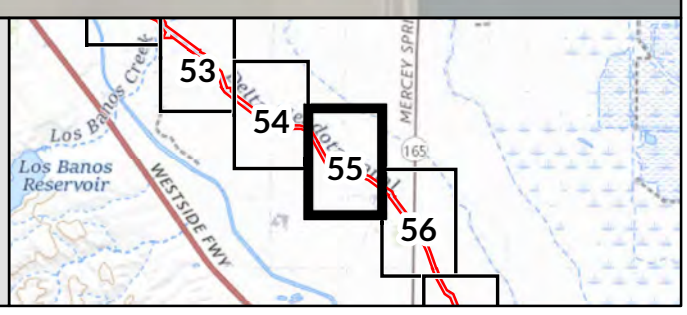
NORTH

0 0.2 0.4

Kilometers

0 0.2 0.4

Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).

Turnout
MP 89.56

89.60
89.70
89.80
89.90
90.00
90.10
90.20
90.30
90.40
90.50
90.60
90.70

DMC Segment 17
MP 85.09-90.53

Check No. 17
MP 90.54

DMC Segment 18
MP 90.54-96.80

bing

LEGEND

APE

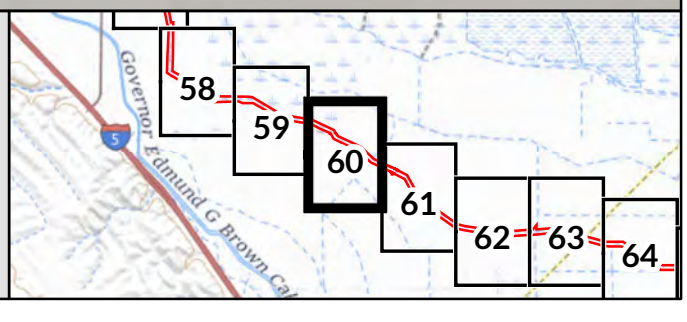
Eligible/Contributing

Ineligible/Non-Contributing

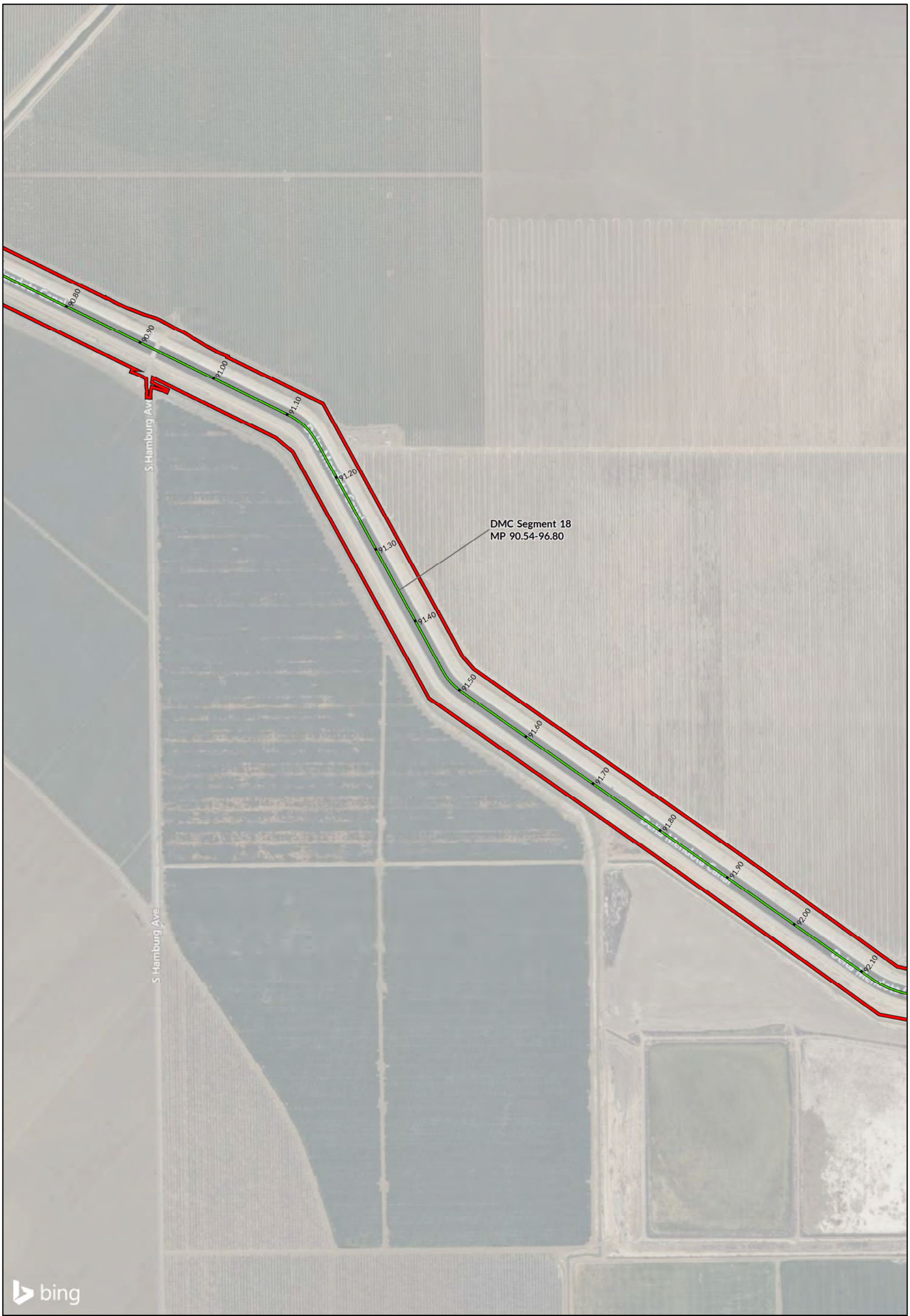
NORTH

0 0.2 0.4
Kilometers

0 0.2 0.4
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).

DMC Segment 18
MP 90.54-96.80

92.10
92.20
92.30
92.40
92.50
92.60
92.70
92.80
92.90
93.00
93.10

bing

LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

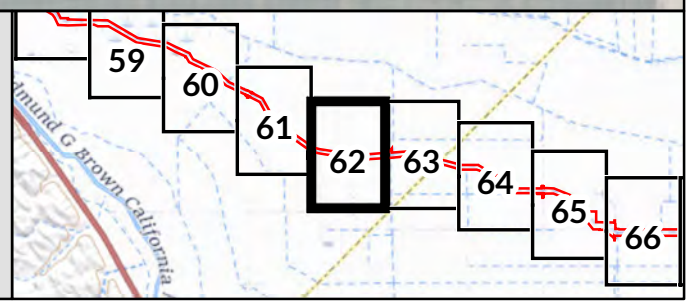
NORTH

0 0.2 0.4

Kilometers

0 0.2 0.4

Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).

DMC Segment 18
MP 90.54-96.80

93.20
93.30
93.40
93.60
93.70
93.80
93.90
94.00
94.10
94.20

Oxford Ave

Althea Ave

bing

LEGEND

APE

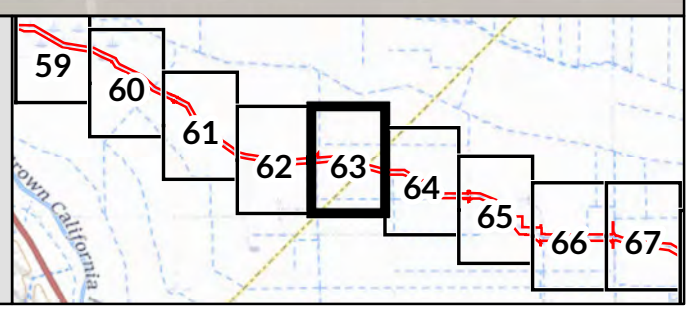
Eligible/Contributing

Ineligible/Non-Contributing

NORTH

0 0.2 0.4
Kilometers

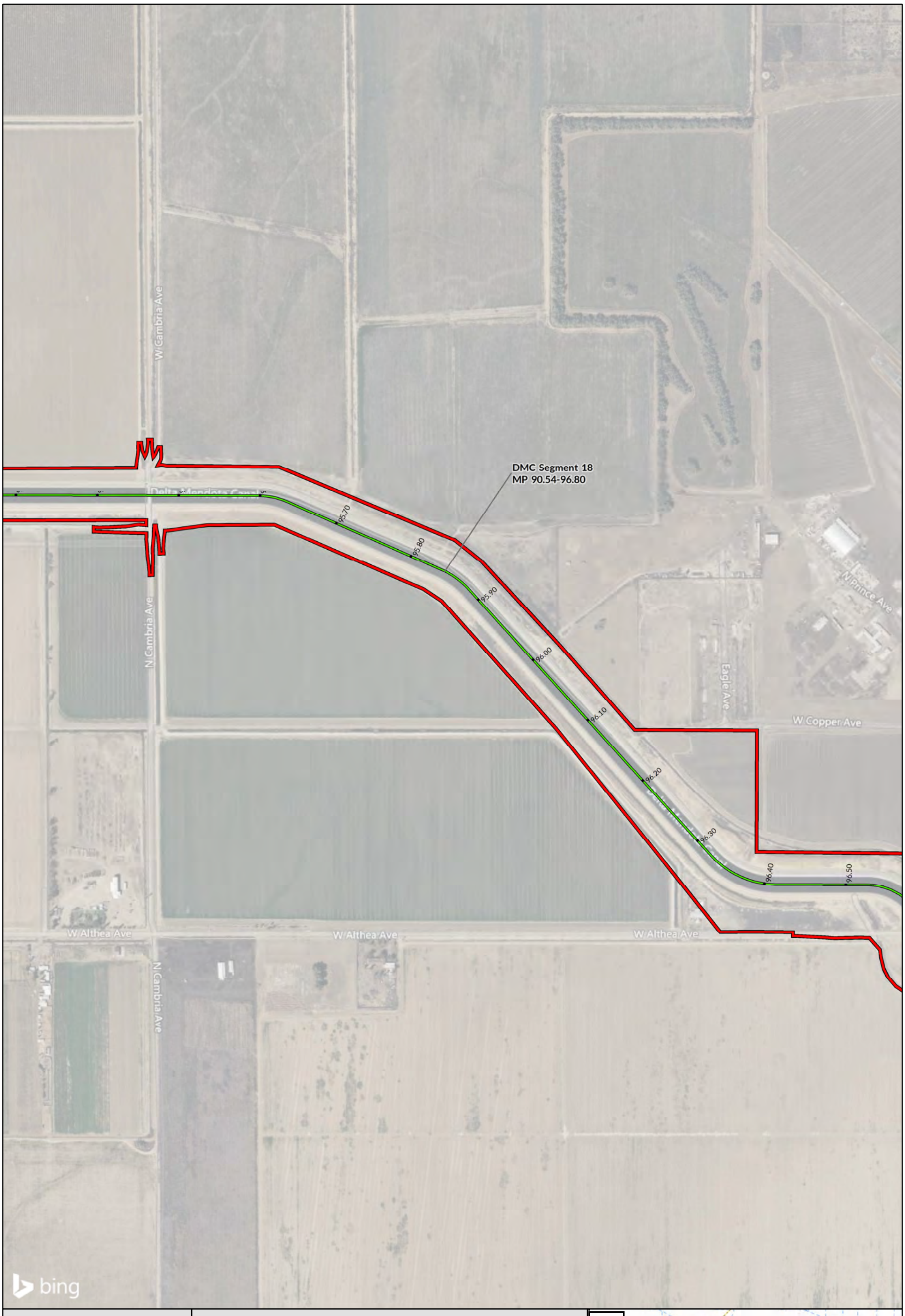
0 0.2 0.4
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).

DMC Segment 18
MP 90.54-96.80

Check No. 18
MP 96.82

DMC Segment 19
MP 96.81-105.05

96.60
96.70
96.80
96.90
97.00
97.10
97.20
97.30
97.40
97.50
97.60

W Courtney Ave

bing

LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

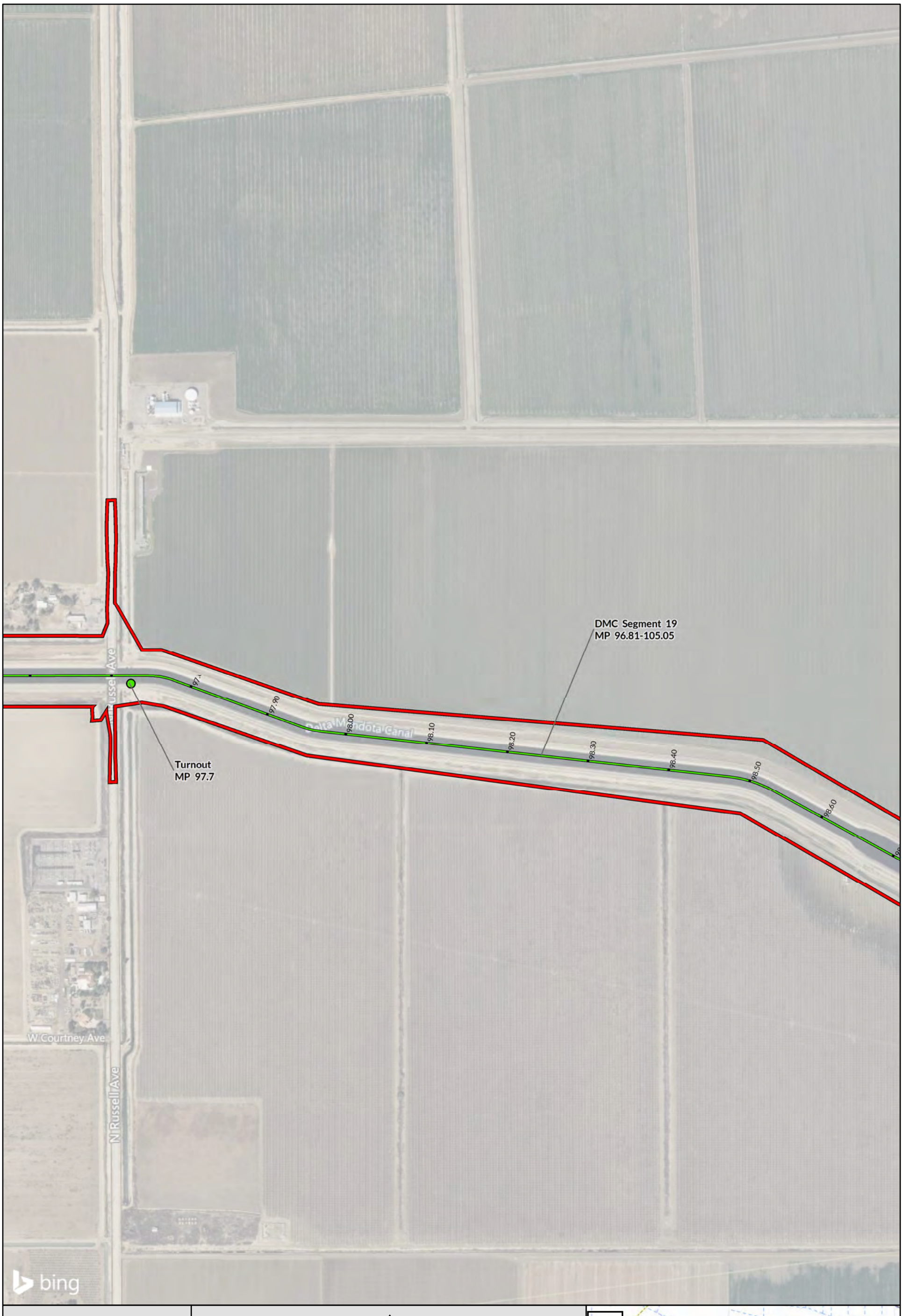
NORTH

0 0.2 0.4
Kilometers

0 0.2 0.4
Miles

62 63 64 65 66 67 68 69 70

source: JRP (2022); Bing (2022); Esri, et al. (2022).



LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

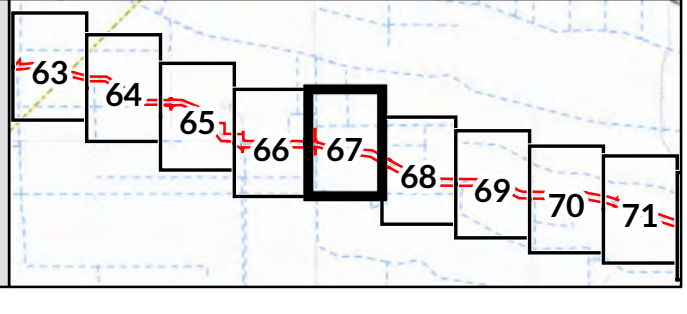
NORTH

0 0.2 0.4

Kilometers

0 0.2 0.4

Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).

1st Lift Canal

1st Lift Canal

98.70

98.80

98.90

99.00

99.10

99.20

99.30

99.40

99.50

99.60

99.70

99.80

Delta Mendota Canal

DMC Segment 19
MP 96.81-105.05

bing

LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

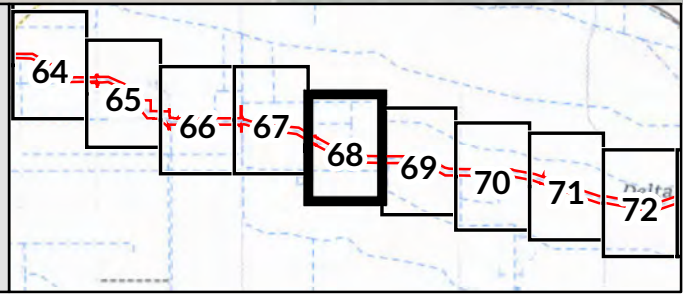
NORTH

0 0.2 0.4

Kilometers

0 0.2 0.4

Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).

DMC Segment 19
MP 96.81-105.05

1st Lift Canal

Second Lift Canal

100.40

100.50

100.60

100.70

100.80

bing

LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

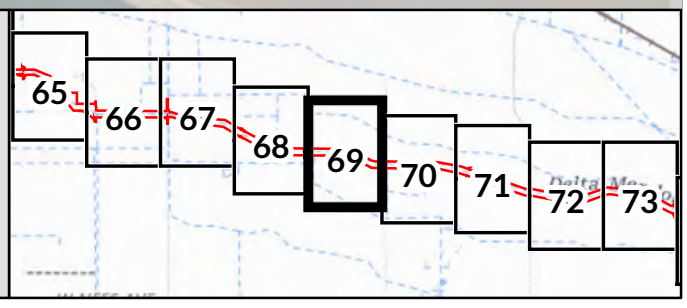
NORTH

0 0.2 0.4

Kilometers

0 0.2 0.4

Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).

DMC Segment 19
MP 96.81-105.05

101.90
102.00
102.10
102.20
102.30
102.40
102.50
102.60
102.70
102.80
102.90

Delta Mendota Canal
1st Lift Canal
Delta Mendota Canal
1st Lift Canal

N Fairfax Ave
N Fairfax Ave

bing

LEGEND

APE

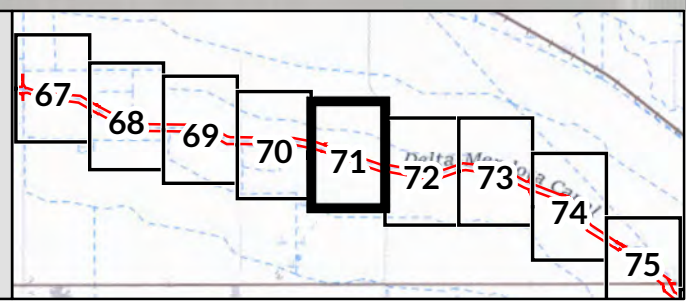
Eligible/Contributing

Ineligible/Non-Contributing

NORTH

0 0.2 0.4
Kilometers

0 0.2 0.4
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).

N Fairfax Ave

1st Lift Canal

Delta Mendota Canal

103.00
103.10
103.20
103.30
103.40
103.50
103.60
103.70
103.80
103.90
104.00

Delta Mendota Canal

1st Lift Canal

DMC Segment 19
MP 96.81-105.05

N Fairfax Ave

Second Lift Canal

Second Lift Canal

N Fairfax Ave

bing

LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

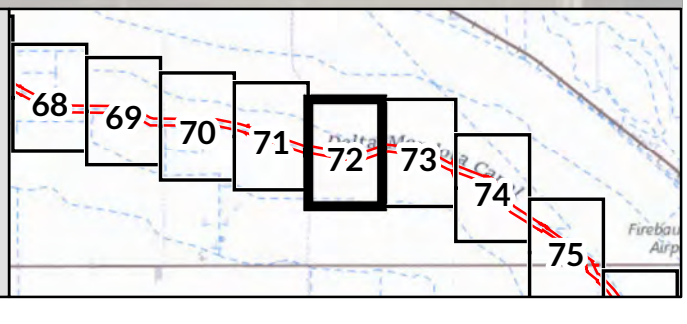
NORTH

0 0.2 0.4

Kilometers

0 0.2 0.4

Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).

Check No. 19
MP 105.06

DMC Segment 20
MP 105.06-111.25

105.10
105.20
105.30
105.40
105.50
105.60
105.70
105.80
105.90
106.00
106.10
106.20
106.30
106.40

W Jerrold Ave
Santa Fe Grade
Outside C
Delta Mendota Canal
1st Lift Canal
Second Lift Canal
bing

LEGEND

APE

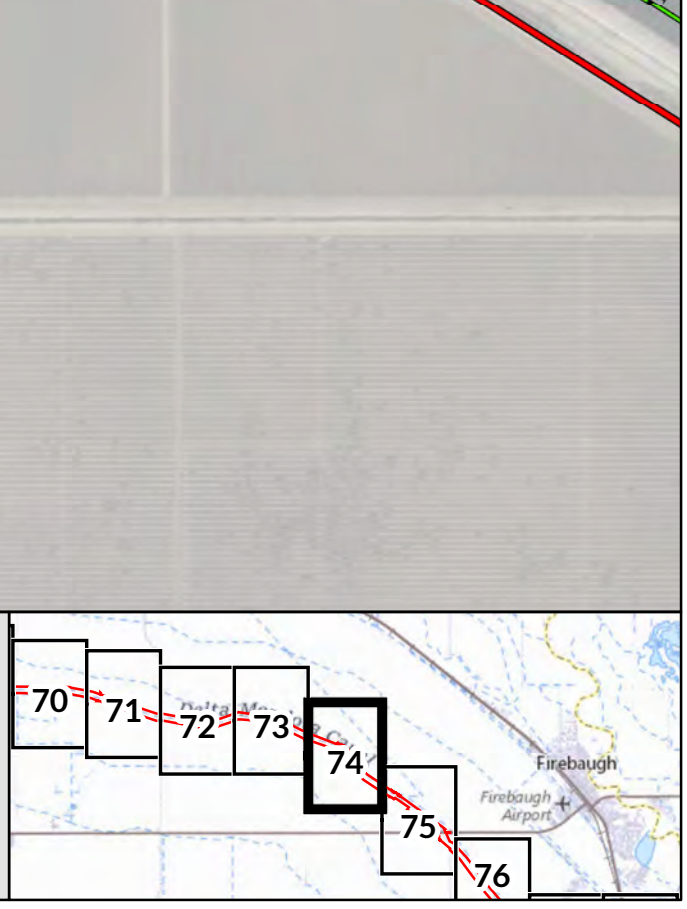
Eligible/Contributing

Ineligible/Non-Contributing

NORTH

0 0.2 0.4
Kilometers

0 0.2 0.4
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).



LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

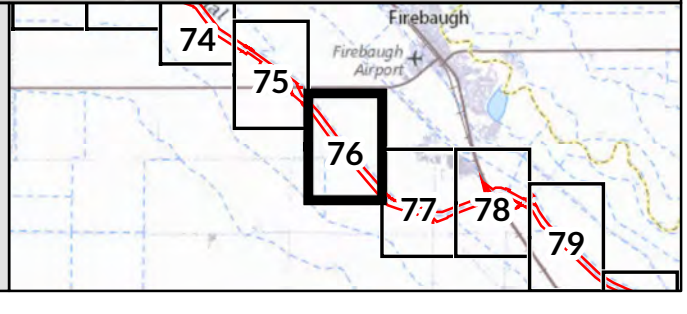
NORTH

0 0.2 0.4

Kilometers

0 0.2 0.4

Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).

P-24-000083
Old Santa Fe Grade (Road)

DMC Segment 20
MP 105.06-111.25

P-24-000083
Old Santa Fe Grade (Road)

N Washoe Ave

W Bullard Ave

Santa Fe Grade

First Lift Canal

1st Lift Canal

Delta Mendota Canal

Second Lift Canal

109.30
109.40
109.50
109.60
109.70
109.80
109.90
110.00
110.10
110.20
110.30
110.40
110.50

bing

LEGEND

APE

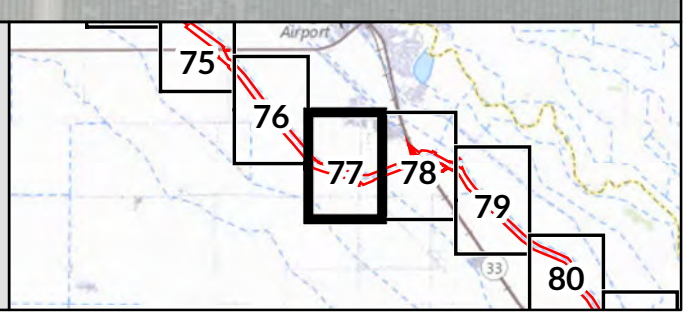
Eligible/Contributing

Ineligible/Non-Contributing

NORTH

0 0.2 0.4
Kilometers

0 0.2 0.4
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).

P-10-003930
Southern Pacific Railroad

P-39-000002
Southern Pacific Railroad in San Joaquin County

San Luis Drain

Firebaugh Wasteway
MP 111.22

Drain U-121.2

Check No. 20
MP 111.26

San Luis Drain

Siphon
MP 110.96-111.02

DMC Segment 21
MP 111.26-116.47

DMC Segment 20
MP 105.06-111.25

Helm Canal Rd
Outside Canal
Delta Mendota Canal
State Highway 33
W Sierra Ave
W Bullard Ave
First Lift Canal
1st Lift Canal
Santa Fe Grade
N San Diego Ave
bing

LEGEND

APE

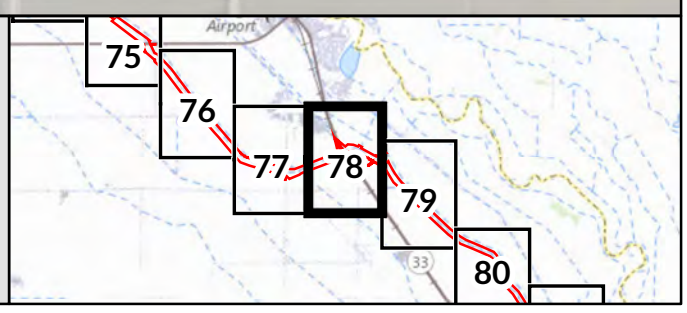
Eligible/Contributing

Ineligible/Non-Contributing

NORTH

0 0.2 0.4
Kilometers

0 0.2 0.4
Miles



source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).

Outside Canal
Outside Canal
Outside Canal
Helm Canal Rd
Main Canal
Drain U-121.2
San Luis Drain
DMC Segment 21
MP 111.26-116.47
Highway 33
First Lift Canal
bing
113.10
113.20
113.30
113.40
113.50
113.60
113.70
113.80
113.90
114.00
114.10
114.20
114.30
114.40
114.50
114.60
114.70

LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

NORTH

0 0.2 0.4

Kilometers

0 0.2 0.4

Miles

77 78 79 80 81 82

source: JRP (2022); Bing (2022); Esri, et al. (2022).

Drain U-121.2

DMC Segment 21
MP 111.26-116.47

Siphon
MP 115.57-115.59

San Luis Drain

LEGEND

APE

Eligible/Contributing

Ineligible/Non-Contributing

NORTH

0 0.2 0.4
Kilometers

0 0.2 0.4
Miles

79 80 81 82

source: JRP (2022); Bing (2022); Esri, et al. (2022).



source: JRP (2022); Bing (2022); Esri, et al. (2022).

Appendix B: DPR 523 Forms

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary # _____
HRI # _____
Trinomial _____
NRHP Status Code 2S2

Other Listings _____
Review Code _____ Reviewer _____ Date _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

P1. Other Identifier: Delta-Mendota Canal

***P2. Location:** ☐ **Not for Publication** ☒ **Unrestricted** ***a. County:** Alameda, Contra Costa, San Joaquin, Stanislaus, Merced, Fresno

***b. USGS 7.5' Quad:** See Continuation Sheet

c. Address: _____ City _____ Zip _____

d. UTM: (Northern endpoint): Zone 10S 626724mE 4186397mN; (Southern endpoint): Zone 10S 734677 mE 4073832 mN

e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate)

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries)

This form presents an inventory and National Register of Historic Places (NRHP) evaluation of the Delta-Mendota Canal (DMC), a component of the US Bureau of Reclamation's (Reclamation) Central Valley Project (CVP) (**Photograph 1**). Completed in 1951 as a key component of the joint state-federal CVP, the DMC spans 116 miles from just upstream from C.W. Bill Jones Pumping Plant (Tracy Pumping Plan) near Tracy to Mendota Pool in western Fresno County at the south end. DMC conveys water along the west side of the San Joaquin Valley in a southerly direction, delivering water to Mendota Pool and to water users at turnouts along its route. For the purposes of this form, the DMC has been divided into 22 segments (**Table 1**), with each segment roughly spanning the distance between successive check structures from north to south. All DMC segments are recorded on the attached Department of Parks and Recreation (DPR) 523E Linear Features Records, and they have been designated Segments 1 through 22 (see Continuation Sheet). Mileposts (M.P.) indicate locations along the canal from north to south.

***P3b. Resource Attributes:** (List attributes and codes) HP11 – Engineering Structure; HP20 – Canal/Aqueduct

***P4. Resources Present:** ☐ Building ☒ Structure ☐ Object ☐ Site ☐ District ☐ Element of District ☐ Other (Isolates, etc.)



P5b. Description of Photo: (View, date, accession#) **Photograph 1:** View of the DMC around M.P. 28.96 with Hamilton Road bridge in distance; camera facing downstream from left bank, May 11, 2022 (A00586).

***P6. Date Constructed/Age and Sources:** ☒ Historic ☐ Prehistoric ☐ Both
1951 (U.S. Bureau of Reclamation)

***P7. Owner and Address:**
U.S. Department of the Interior
Bureau of Reclamation
Mid Pacific Regional Office
2800 Cottage Way
Sacramento, CA 95825

***P8. Recorded by:** (Name, affiliation, address)
Heather Norby, Abigail Lawton, & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

***P9. Date Recorded:** May – June 2022

***P10. Survey Type:** Intensive

***P11. Report Citation:** (Cite survey report and other sources, or enter "none.") Heather K. Norby & Christopher D. McMorris, JRP Historical Consulting, LLC, *Historic Resources Evaluation and Effects Analysis Report for the Delta-Mendota Canal Subsidence Correction Project*, 2022.

***Attachments:** ☐ None ☒ Location Map ☒ Sketch Map ☒ Continuation Sheet ☒ Building, Structure, and Object Record ☐ Archaeological Record ☐ District Record ☒ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐ Other (list) _____

B1. Historic Name: Delta-Mendota Canal
B2. Common Name: Delta-Mendota Canal
B3. Original Use: water conveyance B4. Present Use: water conveyance
***B5. Architectural Style:** utilitarian infrastructure
***B6. Construction History**: (Construction date, alteration, and date of alterations) Construction of DMC began in 1946 and was completed in 1951. Between 1964 and 1970, numerous alterations were made. In 1965 an open channel to the O'Neill Forebay was added at M.P. 69.3, and the DMC was realigned at that area to accommodate this change. At the same time, the concrete-lined sections of the DMC between M.P. 3.50 – 69.00 were raised approximately 18 inches. Around the entrance to the new channel, M.P. 69.00 – 69.25, the lining was raised approximately 24 inches. Throughout the rest of the 1960s, the timber piers and bents of bridges in this span were replaced with concrete piers and bents for reinforcement and to accommodate the raising of the canal wall. Check structures were not raised at that time. As drainage conditions have changed, some inlets have become obsolete. Modifications have been made, including removal of some flap gates.

***B7. Moved?** ☒ **No** ☐ **Yes** ☐ **Unknown** **Date:** _____ **Original Location:** _____
***B8. Related Features:** Other Central Valley Project structures
B9. Architect: U.S. Department of the Interior (USDI), Reclamation, Central Valley Project – California, Delta Division; and USDI, Reclamation, Denver Office
b. Builder: Multiple (see Continuation Sheet)
***B10. Significance: Theme:** Water Conveyance; Engineering **Area:** California
Period of Significance: 1946-1951 **Property Type:** Canal **Applicable Criteria:** A/1 and C/3
(Discuss importance in terms of historical or architectural context as defined by theme, period, and geographic scope. Also address integrity.)

Delta-Mendota Canal meets National Register of Historic Places (NRHP) Criterion A and California Register of Historical Resources (CRHR) Criterion 1 at the state level because of its primary role in accomplishing the visionary goal of the CVP to transfer water between the Sacramento River and San Joaquin River basins. Delta-Mendota Canal is also individually eligible for listing in the NRHP and CRHR under Criterion C and Criterion 3 because its size and scale demonstrate the magnitude of the engineering and construction accomplishment of the CVP, and because it demonstrates Reclamation engineer Oscar Boden's important contributions to design of the Delta Division of the CVP. This property has been evaluated in accordance with Section 106 of the National Historic Preservation Act of 1966 (as amended) (54 U.S.C. 306108) and its implementing regulations (36 CFR Part 800), and Section 15064.5(a)(2)-(3) of the CEQA Guidelines, using the criteria outlined in Section 5024.1 of the California Public Resources Code (See Continuation Sheet).

B11. Additional Resource Attributes: _____

***B12. References:** USDI, Bureau of Reclamation, Delta-Mendota Canal, Technical Record of Design and Construction (Denver: 1959); USDI, Reclamation, "The Contribution of Irrigation and the Central Valley Project to the Economy of the Area and the Nation," (Government Printing Office: Washington, 1956), also see footnotes.

B13. Remarks:

See Continuation Sheet.

***B14. Evaluator:** Heather Norby, JRP Historical Consulting, LLC

***Date of Evaluation:** August 2022

(This space reserved for official comments.)

P3a. Description (continued):

Table 1. Delta-Mendota Canal Segments Presented in Linear Feature Records

DMC Segment No.	Canal Segment	Milepost Span
1	Just below Fish Collecting Facilities to just above Check No. 1	0.09 – 11.34
2	Check No. 1 to just above Check No. 2	11.35 – 16.18
3	Check No. 2 to just above Check No. 3	16.19 – 20.62
4	Check No. 3 to just above Check No. 4	20.63 – 24.42
5	Check No. 4 to just above Check No. 5	24.43 – 29.81
6	Check No. 5 to just above Check No. 6	29.82 – 34.41
7	Check No. 6 to just above Check No. 7	34.42 – 38.67
8	Check No. 7 to just above Check No. 8	38.68 – 44.25
9	Check No. 8 to just above Check No. 9	44.26 – 48.61
10	Check No. 9 to just above Check No. 10	48.62 – 54.40
11	Check No. 10 to just above Check No. 11	54.41 – 58.27
12	Check No. 11 to just above Check No. 12	58.28 – 63.98
13	Check No. 12 to just above Check No. 13	63.99 – 70.00
14	Check No. 13 to just above Check No. 14	70.01 – 74.39
15	Check No. 14 to just above Check No. 15	74.40 – 79.63
16	Check No. 15 to just above Check No. 16	79.64 – 85.08
17	Check No. 16 to just above Check No. 17	85.09 – 90.53
18	Check No. 17 to just above Check No. 18	90.54 – 96.80
19	Check No. 18 to just above Check No. 19	96.81 – 105.05
20	Check No. 19 to just above Check No. 20	105.06 – 111.25
21	Check No. 20 to just above Check No. 21	111.26 – 116.47
22	Check No. 21 to the canal terminus at the Mendota Pool	116.48 – 116.61

DMC Alignment and Cross Sections

Originating at the inlet canal upstream from C.W. Bill Jones Pumping Plant near Tracy, the DMC conveys Sacramento River water along the west side of the San Joaquin Valley in a southerly direction, traversing approximately 116 miles through San Joaquin, San Benito, Stanislaus, Merced, and Fresno counties before terminating at Mendota Pool in western Fresno County. Numerous major and minor appurtenant structures are distributed throughout its span: check structures control DMC flows; turnouts distribute water to adjacent water users and irrigation districts; wasteways evacuate the canal of all flows during emergencies; siphons transport the DMC below adjacent roadways, railways, and water courses; bridges transport adjacent roadways over the DMC; and siphon undercrossings, culverts, overchutes, pipe crossings, and inlet drains convey adjacent water courses below, above, or into the DMC. For a detailed discussion of these appurtenant structural types and subtypes, see typology discussions for the various structures below.

The DMC has a trapezoidal cross-section. It has a lining of earth, concrete, and compacted-earth in different sections. The first section from M.P. 0.19 to M.P. 2.52 is lined with loose and compacted earth until it ends at the inlet transition to the Tracy Pumping Plant (**Photograph 2 - Photograph 5**). From the Pumping Plant, the water is carried for 4,822 feet through discharge

pipes to an outlet transition at M.P. 3.50 where the water is released into the concrete-lined section of the canal which extends for roughly 95 miles to M.P. 98.62 (**Photograph 6 - Photograph 9**). After this point, the DMC transitions to a compacted-earth lining, which continues until the terminus of the canal at M.P. 116.61 (**Photograph 10 - Photograph 12**).[1]



Photograph 2: View of riprap (right) and earth lining (left) at the beginning of Earth Section No. 1 of the Delta Mendota Intake Canal at the Tracy Fish Collection Facility, M.P. 0.09; camera facing upstream from left bank, May 9, 2022 (A00165).



Photograph 3: View of earth lining of Intake Canal at M.P. 0.34, above Bethany-Byron Road siphon; camera facing downstream from left bank, May 9, 2022 (A00166).

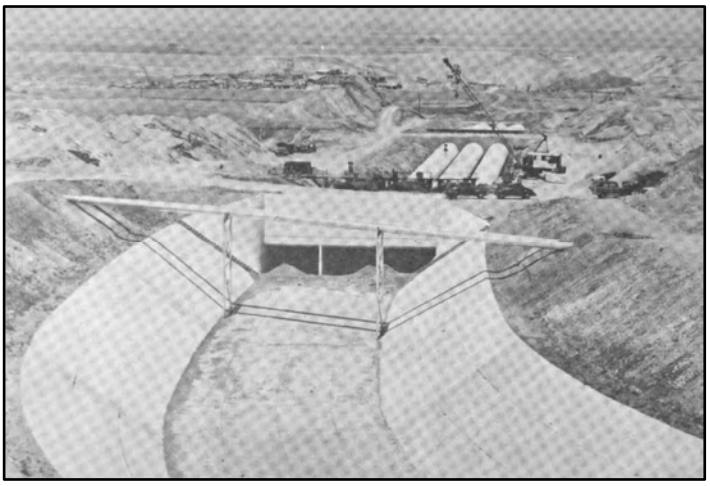


Photograph 4: Downstream view of Intake Canal from M.P. 1.41, showing transition from riprap of Bethany-Byron Road siphon outlet (center right foreground) to earth lining, Pumping Station visible in deep background (top center); camera facing downstream from right bank, May 9, 2022 (A00154)



Photograph 5: End of earth lined Section No. 2 at the beginning of the Pumping Station inlet transition, at M.P. 2.52, which marks the end of the Intake Canal; camera facing left bank from right bank, May 9, 2022. (A00089)

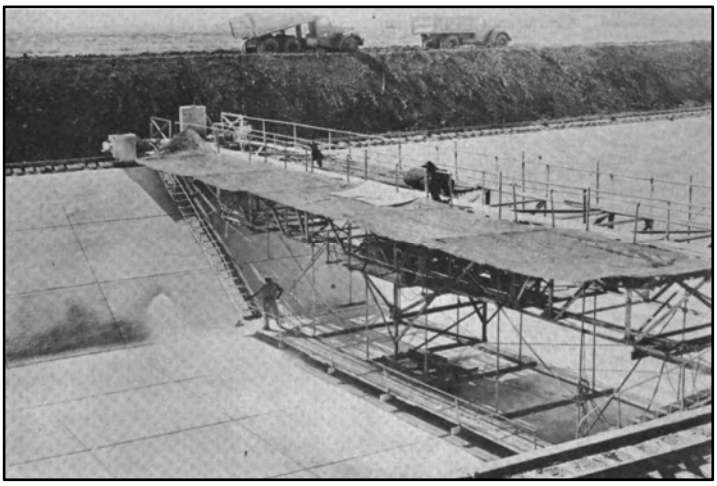
[1] USDI, Reclamation, *Delta-Mendota Canal: Structures List*, May 2020: 1-42.



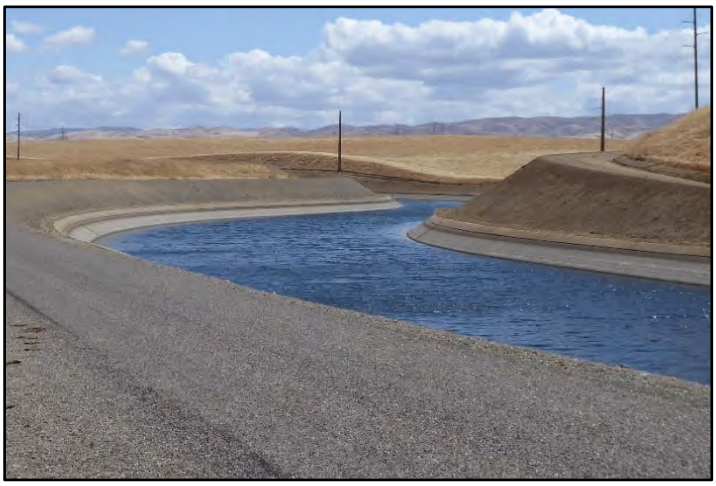
Photograph 6: Historic downstream view of Pumping Station discharge lines and inlet to DMC at M.P. 3.50 (Station L-185+50), ca. 1951.[2].



Photograph 7: Beginning of concrete-lined Section No. 3 at discharge pipes inlet to DMC at M.P. 3.50, raised lining visible at top of canal walls; camera facing west from left bank, May 9, 2022 (A00199).



Photograph 8: Historic view of application of white-pigmented curing compound to finished concrete lining [M.P. unknown]; October 1950.[3]



Photograph 9: View of concrete canal lining and cuts at M.P. 3.78; camera facing downstream from left bank, May 9, 2022 (A00208).

[2] [photograph], DM-534-CV, in USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*, June 1959: Frontispiece.
[3] [photograph], DM-1168-CV, in USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*, June 1959: 136.



Photograph 10: End of concrete lining at 98.62 and riprap transition to beginning of earth-lined Section No. 10 at M.P. 98.64; camera facing downstream from left bank, June 14, 2022 (C0418).



Photograph 11: View of compact-earth lined Section No. 10; camera facing downstream from Farm Bridge at M.P. 99.82, June 14, 2022 (C0430).



Photograph 12: View of Segment 22 from approximately M.P. 116.55, showing the canal's terminus, where it flows into the San Joaquin River; camera facing downstream from right bank, June 15, 2022 (C0537).

The first 3,500 feet of the earthen intake canal are 14.25 feet deep, have a bottom width of 100 feet, and 3:1 side slopes. After the Byron-Bethany Road siphon at M.P. 1.36/1.41, the following 8,600 feet to the inlet transition at the Pumping Station are 16.81 feet deep with a bottom width of 66 feet, to increase the velocity of flow. The concrete-lining is divided into seven sections, each with slightly different dimensions. Overall, the concrete lining originally had a top width of 102.24 feet and depth of 18.08 feet at its start at M.P. 3.50, and gradually narrowed to a top width of 94.62 feet and depth of 15.54 where it terminates at M.P. 98.62.[4]

[4] USDI, Reclamation, *Tracy Pumping Plant and Intake Canal and Discharge Lines: Technical Record of Design and Construction*, May 1959: 9; USDI, Reclamation, Central Valley Project – California (CVP), "Delta-Mendota Canal Subsidence Correction Project: Lining Raise Cross Section Diagrams," Drawing No. DMC1-C-034, September 28, 2021; USDI, Reclamation, Central Valley Project –

The concrete-lining of the first 70 miles was raised 18 inches in 1965 (**Photograph 13**). Near the O'Neill Forebay, M.P. 69 - 69.25, the lining was raised 24 inches. In 1970, subsidence was evident in the lower reach of the canal and this reach, below Mile 70, was scheduled for a lining raise (**Photograph 14**).[5] See **Table 2** for dimensional variations and alterations throughout the DMC.



Photograph 13: View of concrete canal lining on right bank around double-barrel turnout at M.P. 3.54, lining has been raised on either side of the turnout, but the top of the original canal wall is unchanged immediately surrounding the structure; camera facing right bank from left bank, May 9, 2022 (A00203).



Photograph 14: View of canal lining on right bank at M.P. 93.24-93.25, where lining appears to have been raised around a modern turnout and original farm bridge; camera facing right bank from left bank, June 14, 2022 (C0385).

As drainage conditions have changed, some inlets have become obsolete. Modifications have been made, including removal of some flap gates.

Compacted-earth embankments topped with gravel maintenance roads flank both sides of the DMC along its full length (**Photograph 15**). The embankments were generally designed to be a minimum of 25 feet wide, but their exact width and height varies depending on the surrounding topography. The embankments function as levees in many sections where the surrounding land sits below the DMC's normal water surface (**Photograph 16**). In some areas where the canal traverses through a deep cut, the tops of the embankments are at grade with the surrounding land (**Photograph 17**), and at some locations spoils piles are sited along the embankment's outside toe. The width of each maintenance road varies in tandem with the embankment beneath them, but they generally range from approximately 12 to 20 feet. Access to the DMC's maintenance roads are controlled from adjacent public rights-of-way by various types of gates and fencing.

In addition to the major and minor structures enumerated above, the DMC contains other basic repetitive structures distributed throughout its span like ubiquitous steel utility ladders secured to both the left and right embankment interiors.

Deterioration and cracking regularly occurs along the concrete canal lining as well as erosion along the compacted-earth segments. As part of the life cycle of the canal, these conditions are routinely addressed by Friant Water Authority (FWA) O&M staff, who replace and repair concrete panels and repair earth-lined segments.

California (CVP), "Delta-Mendota Canal Subsidence Correction Project: Typical Riprap Lined Section," Drawing No. DMC1-C-035, September 29, 2021

[5] USDI, Reclamation, *Designer's Operating Criteria*, 1971: 4-5, 26; Grimsley, J. O. and M. L. Barmettlor, *Condition of Major Irrigation Structures and Facilities*, Region 2, 1970, Appendix I – 3, 6.



Photograph 15: View of embankment and maintenance road from approximately M.P. 111.28; camera facing downstream from left bank, June 14, 2022 (C0489).



Photograph 16: View of embankment and maintenance road from approximately M.P. 89.56; camera facing downstream from left bank, June 14, 2022 (C0360).



Photograph 17: View of embankment and maintenance road from approximately M.P. 24.89; camera facing downstream from left bank, May 11, 2022 (A00498).

Table 2: DMC Lining Sections[6]

Milepost Span	Lining Material	Base Width	Side Slope	Depth*	Alterations
0.19 – 0.85	Earth	100	3:1	14.25*	None known
0.87 – 2.52	Earth	66	3:1	16.81*	None known
3.50 – 13.66	Concrete	48	1 ½:1	19.58	Canal lining raised on right and left banks approximately 18 inches in 1965
13.70 – 20.62	Concrete	48	1 ½:1	19.37	Canal lining raised on right and left banks approximately 18 inches in 1965
20.66 – 34.41	Concrete	48	1 ½:1	19.17	Canal lining raised on right and left banks approximately 18 inches in 1965
34.45 – 54.4	Concrete	48	1 ½:1	18.96	Canal lining raised on right and left banks approximately 18 inches in 1965
54.44 – 69.00	Concrete	48	1 ½:1	18.75	Canal lining raised on right and left banks approximately 18 inches in 1965
69.00 – 69.25	Concrete	48	1 ½:1	19.25	Canal lining raised on right and left approximately 24 inches in 1965
69.25 – 69.99	Concrete	48	1 ½:1	19.00	Canal lining raised on right and left banks approximately 18 or 24 inches in 1965
70.04 – 85.08	Concrete	48	1 ½:1	15.75	Canal lining possibly raised sometime after 1970
85.10 – 98.62	Concrete	48	1 ½:1	15.54	Canal lining possibly raised sometime after 1970
98.64 – 111.55	Earth	62	2 ½:1	15.40	None known
111.55 – 114.05	Earth	84	2 ½:1	15.40	None known
114.05 – 116.61	Earth	60	2 ½:1	15.40	None known

1. Conveyance Structures

Siphons

Siphons are enclosed structures placed along the canal where the water must be conveyed under a linear feature such as a waterway, roadway, or railroad. The water enters the siphon, passes under the linear feature by force of gravity, and flows back into the canal on the other side. There are 13 extant siphons along the DMC.

Table 3 lists the siphons by DMC segment number as presented in the Linear Feature Records below.

1. Table 3: Geographic Distribution of DMC Siphons

DMC Segment No.	Siphon Totals	Percent of Totals
1	2	15.39%
2	2	15.39%
3	2	15.39%
4	1	7.69%
5	0	--
6	0	--

* Depth refers to depth of excavation, except in non-compacted, loose earth sections of the Delta-Mendota Intake Canal

[6] All measurements in feet. Dimensions, mileposts, and alterations derived from 1959 Technical Records of Design and Construction, 1985, 1992, and 2020 Structures Inventories, historic and modern engineering drawings, and 2022 field survey.

7	1	7.69%
8	0	--
9	0	--
10	1	7.69%
11	0	--
12	1	7.69%
13	0	--
14	0	--
15	0	--
16	1	7.69%
17	0	--
18	0	--
19	0	--
20	1	7.69%
21	1	7.69%
22	0	--
Total	**13**	**100%**

While individual siphon lengths and slopes are determined principally by the surrounding topography, their basic designs are generally uniform, with only slight dimensional or structural variation. Siphons begin at an inlet transition where the canal walls narrow and gradually shift from sloped to vertical at the siphon inlet headwall. The height of each headwall varies, depending on the natural topography around the canal but generally ranging between approximately 23-30 feet tall. The width of each headwall likewise varies depending on the natural topography as well as the number and type of barrels. Of the thirteen siphons, twelve are multiple-barrel siphons composed of either three or four concrete barrel boxes. The only single-barrel siphon is composed of a cylindrical, monolithic concrete barrel. Most multiple-barrel siphons have barrels that are either 16-by-16-feet or 12-by-16-feet (**Photograph 18** - **Photograph 21**). The exceptions include the Byron Bethany Road and Del Puerto Creek siphons. The former has three barrel boxes that are 13 feet and 6 inches by 20 feet while the latter has three barrel boxes that are 15 feet and 6 inches by 15 feet and 6 inches. The Mountain House Road Siphon's single, cylindrical barrel that is 24 feet and 3 inches in diameter (**Photograph 22** - **Photograph 23**). The underground barrels convey the canal's flow to outlet transitions, which are approximately the same size as their respective inlet transitions, and from there the canal walls widen and revert from vertical to sloped. See **Table 4** for quantities and proportions among the different barrel groups.[7] As it is comprised entirely of unaltered original structures, the DMC siphon population retains a high degree of historic integrity of design, materials, workmanship, setting, location, association, and feeling.

2. Table 4: Dimensional Variation Among Siphon Barrel Groupings

Type	Siphon Totals	Percent of Total	Photographic Reference
Single-barrel	1	7.69%	Photograph 22 - Photograph 23
Three-barrel	8	61.54%	Photograph 18 - Photograph 19
Four-barrel	4	30.77%	Photograph 20 - Photograph 21
Total	**13**	**100%**	

[7] Bureau of Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction* (Denver, Colorado: Central Valley Project – California, June 1959), 59-65.

The above table does not include the siphon undercrossings, which transport preexisting waterways under the DMC. For a detailed discussion of these, see the "Siphon Undercrossings" typology discussion on the Continuation Sheet below.



Photograph 18: 3-barrel siphon inlet at M.P. 13.69; camera facing downstream from left bank, May 10, 2022 (A0039).



Photograph 19: 3-barrel siphon outlet at M.P. 79.72; camera facing upstream from right bank, June 14, 2022 (C0293).



Photograph 20: 4-barrel siphon inlet at M.P. 51.18; camera facing downstream from left bank, May 13, 2022 (A00940).



Photograph 21: 4-barrel siphon outlet at M.P. 16.34; camera facing upstream from left bank, May 10, 2022 (B00002).



Photograph 22: Mountain House Road Siphon's inlet headwall at M.P. 4.41; camera facing downstream from left bank, May 9, 2022 (A00216).



Photograph 23: Mountain House Road Siphon's outlet headwall at M.P. 4.49; camera facing upstream from left bank, May 9, 2022 (A00220).

2. Regulating Structures

Check Structures

There are 21 check structures along DMC. These check structures placed across the canal control the flow and depth of water in the upstream section of the canal. They are generally used to raise the water level in the canal in order to divert flow through lateral headgates on the upstream side, or to stop the flow of water further down the canal. All are either trapezoidal in cross section (**Photograph 24**) or rectangular in cross section (**Photograph 25**). Please see Linear Feature Records below for descriptions of each check structure.[8]



Photograph 24: Check No. 16 at M.P. 85.09; camera facing downstream from left bank, June 14, 2022 (C0333).



Photograph 25: Check No. 11 at M.P. 58.28; camera facing downstream from left bank, June 13, 2022 (C0084).

[8] Bureau of Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction*, 59-63; Bureau of Reclamation, "Concrete Checks," specification, on file at Reclamation Design Construction Library (1948).

3. Common Appurtenant Features

Check Buildings

There are currently 21 extant check buildings along the DMC. These structures house measuring and control equipment to regulate the flow of water through turnouts, wasteways, and check structures to provide consistent and accurate delivery of water to users. Each segment recorded on the Linear Feature Records has one check building. These masonry buildings are located on the left bank adjacent to its associated check structure (**Photograph 28**). Installation of the check buildings began in 1966 when a remote control-telemetering system was installed to control canal flows between the Tracy Pumping Plant and the O'Neill Pumping Plant. The equipment inside check buildings replaced the need for a worker to be stationed at check structures 24 hours a day, 7 days a week to manually monitor water levels and operate the gates and the buildings protect this equipment from the weather, particularly the extreme heat in summer and high humidity in winter.[9]

Built after the initial period of DMC construction (1947-1951), the population of check buildings consists of a single type, constructed of rusticated concrete blocks (**Photograph 26** and **Photograph 27**). These buildings are generally of the same standard design with slight dimensional or structural variation. All concrete-block check buildings have rectangular plans with a metal door and flat or slightly slanted roof. Concrete-block check buildings typically measure 6 feet x 8 feet.



Photograph 26: Check building at Check No. 1; camera facing northwest, May 10, 2022 (A00343).



Photograph 27: View of rusticated concrete block construction of check building at Check No. 2; camera facing northeast, May 10, 2022 (A00451).

[9] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, September 1971: 27-28.



Photograph 28: View of check building (left) in relation to associated check structure (Check No. 3, right) with a stilling well in the foreground (bottom right), May 10, 2022 (B00084).

Stilling Wells

There are 41 stilling wells along the length of the DMC. These features were originally installed in 1966, along with the check buildings, as part of a remote control-telemetering system used to control canal flows between the Tracy Pumping Plant at M.P. 2.53 and O'Neill Pumping Plant near the O'Neill/Volta Forebay facilities at M.P. 69.30. Stilling wells were installed close to the upstream and downstream ends of all check structures (**Photograph 29**). An exception to this is Check No. 1, which only has one stilling well associated with it, on the downstream side. The stilling wells are equipped with telemeter transmitters (digital encoders) and are located upstream and downstream at each check structure to provide water level indication. High and low water level alarm contacts are contained in the stilling wells. To prevent false readings or operations resulting from condensation on transmitter equipment, heater strips are provided in the encoder housings at the stilling wells.[10]

All stilling wells are short, concrete cylinders measuring 42-inches in diameter. Access to the equipment inside is gained through a metal hatch on the top (**Photograph 30**). These wells are set down the bank, close to the top of the canal lining, with a short span of metal-pipe handrailing between the well and the canal. If the bank is sloped there is a set of concrete steps with a metal pipe handrail leading from the road to the well. The vast majority (36 out of 41) are located on the left bank, but five of the stilling wells at the southern end of the canal are located on the right bank.

[10] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, September 1971: 2, 27-28.



Photograph 29: View of stilling well upstream of Check No; camera facing downstream from left bank June 13, 2022 (C0200).



Photograph 30: View of stilling well, access hatch, and stairs to access the stilling well from the road; camera facing upstream from left bank, May 11, 2022 (A00482).

Wasteways

There are five wasteway structures along the DMC that regulate the flow of water from the canal into creeks and rivers (**Photograph 31** - **Photograph 32**). These structures are usually used for one of two purposes, either to protect the canal from overtopping or dewater the canal system below in case of an emergency or for scouring out silt deposited in the canal above. Four of the wasteways (Westley, Newman, Volta, Firebaugh) are channels that receive water by radial gate turnouts from DMC and convey it one to six miles to the San Joaquin River. The other wasteway is an overspill apron on the right bank of the canal. Please see Linear Feature Records below for descriptions of each wasteway.[11]



Photograph 31: Newman Wasteway inlet structure; camera facing upstream from left bank, May 13, 2022 (A00994).



Photograph 32: View of Firebaugh Wasteway, showing where the stilling well transitions into the earth-lined canal; camera facing downstream from right bank, June 14, 2022 (C0484).

[11] Bureau of Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction*, 65, 70-76.

Turnouts

The DMC has 277 turnouts distributed throughout its course between M.P. 1.05 and 109.45. Turnouts are structures along the canal bank that divert and regulate water from the DMC to various water users. These facilities are operated by designated water and irrigation districts and other official users. See **Table 5** for the number of turnouts along each DMC segment as presented in the Linear Feature Records below. The following typology discussion does not attempt to provide an exhaustive inventory of DMC turnouts, but rather to give an overview of the historic and modern structural types and subtypes as observed during the current survey recordation and as compared with the historical record.

Table 5: Geographic Distribution of DMC Turnouts

DMC Segment No.	Turnouts Totals	Percent of Total
1	17	6.14%
2	15	5.42%
3	18	6.50%
4	12	4.33%
5	19	6.87%
6	16	5.78%
7	14	5.05%
8	18	6.50%
9	14	5.05%
10	13	4.69%
11	13	4.69%
12	12	4.33%
13	18	6.50%
14	10	3.61%
15	12	4.33%
16	13	4.69%
17	15	5.42%
18	14	5.05%
19	10	3.61%
20	4	1.44%
21	0	--
22	0	--
Total	**277**	**100%**

The original turnout population consists almost entirely of concrete barrel types (**Photograph 33** - **Photograph 34**). The forms of these barrel-type turnouts slightly vary but overall follow a standard design. The openings and water conduits are either box-shaped or round and vary in size from three to five feet in cross section. The openings are covered by metal grates or trash racks, which are typically angled to match the slope of the canal's walls but sometimes stand vertically. Just inside the openings, vertical or sloping lift gates slide up and down to control the flow of water into the concrete pipe and through the canal banks. A concrete hoist equipment deck sits above the gates, usually on the sloping canal bank just above its concrete lining, and concrete steps with a metal-pipe rail often provide access from the top of the levee while a similar metal railing lines the deck canal edge. Approximately 3-foot-tall cast-iron gate-hoist mechanisms to raise and lower the gates are mounted on the deck. Most have manual gear wheels on top. The bulk of these structures retain their original design features, but there

are some common alterations throughout the population (**Photograph 35**). The most common has been replacing the manual gate-hoists with automatic electronic gate-operating systems (**Photograph 36**).[12]

Some turnouts have been added along the DMC since its initial period of construction. Most of these structures have been constructed in accordance with Reclamation's original design specifications, following the basic form of concrete construction and vertical lift gates (**Photograph 37**), though some consist two or three barrels (**Photograph 38 - Photograph 39**). Additionally, some new turnouts consist of a basic steel pipe extending either through or over the canal lining (**Photograph 40**).[13]



Photograph 33: Concrete pipe turnout along the right bank at M.P. 49.56, showing the original, manual gate-hoisting equipment; camera facing from left bank, May 13, 2022 (A00911).



Photograph 34: Concrete pipe turnout along the left bank at M.P. 23.81, showing a slight variation from the turnout in **Photograph 33**; camera facing downstream from left bank, May 11, 2022 (A00465).

[12] Bureau of Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction*, 78; Bureau of Reclamation, "Concrete Pipe Turnouts," specification, on file at Reclamation Design Construction Library, (1948); Bureau of Reclamation, "18" Dia. Screw Lift Vertical Wedge Gate," specification, on file at Reclamation Design Construction Library, (1948); Bureau of Reclamation, "24" Dia. Screw Lift Vertical Wedge Gate," specification, on file at Reclamation Design Construction Library, (1948); Bureau of Reclamation, "Lateral Turnout," specification, on file at Reclamation Design Construction Library, (1946);

[13] Bureau of Reclamation, "Turnouts Along Delta-Mendota Canal" (n.d.).



Photograph 35: An original turnout that has been altered by a replacement screen at M.P. 38.14 (foreground) and an original concrete pipe turnout along the left bank at M.P. 38.15 (background) along left bank; camera facing downstream from the left bank, May 12, 2022 (B00289).



Photograph 36: Concrete pipe turnout altered by the addition of an automatic, electronic gate-operating system along the right bank at M.P. 61.37; camera facing from left bank, June 13, 2022 (C0118).



Photograph 37: An original turnout altered by the addition of an automatic, electronic gate-operating system (left) and a modern turnout (right) along the right bank at M.P. 90.53; camera facing from left bank, June 14, 2022 (C0365).



Photograph 38: Modern, two-barrel concrete pipe turnout along right bank at M.P. 78.56; camera facing from left bank, June 14, 2022 (C0270).



Photograph 39: Modern, three-barrel concrete pipe turnout along right bank at M.P. 81.08, camera facing left bank, June 14, 2022 (C0304).



Photograph 40: Modern overlining turnout along right bank at M.P. 81.80; camera facing southwest, June 14, 2022 (C0310).

4. Protective Structures

Overchutes

Overchutes are structures that carry water from larger streams and drainages over the DMC to prevent erosion and damage to the canal bank. There are 13 structures on the DMC identified as overchutes. They consist of an open concrete flume with flat bottoms and vertical sides that extends across the canal and concrete inlet and outlet structures constructed on the exterior sides of the canal's banks (
Photograph 41). They are designed so that the bottom of the concrete box sits above the canal's full water elevation. Most are reinforced with concrete crossbeams, but two of the thirteen are not (
Photograph 42 - **Photograph 43**). Outlets often have a stilling basin or riprap to prevent erosion (**Photograph 44**).[14]

[14] Bureau of Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction*, 78, 80-81; Bureau of Reclamation, "Quinto Creek Overchute," specification, on file at Reclamation Design Construction Library, (1948); Bureau of Reclamation, "Romero Creek Overchute: Inlet and Flume," specification, on file at Reclamation Design Construction Library, (1948); Bureau of Reclamation, "Quinto Creek Overchute: Outlet," specification, on file at Reclamation Design Construction Library, (1948).



Photograph 41: Concrete overchute at M.P. 7.25 looking downstream; camera facing downstream from left bank, May 9, 2022 (A00253).



Photograph 42: Overchute at M.P. 21.91, showing the reinforced box; camera facing right bank from left bank, May 10, 2022 (B00127).



Photograph 43: Overchute at M.P. 78.59, showing the unreinforced box; camera facing right bank from left bank, June 14, 2022 (C0275).



Photograph 44: Outlet of overchute at M.P. 66.70, with riprap to guard against erosion; camera facing right bank from left bank, June 13, 2022 (C0171).

Inlet Drains

Inlet drains are structures built into the canal wall that allow water to drain into the canal. The DMC currently includes several hundred inlet drains distributed throughout its span. All the DMC inlet drains, originally referred to as "drainage inlets" intercept and channel storm runoff from surrounding drainage areas for release into the canal. The following typology discussion does not attempt to provide an exhaustive inventory of DMC inlet drains, but rather to give an overview of the historic and modern structural types and subtypes as observed during the current survey recordation and as compared with the historical record.

The original population of inlet drains was principally comprised of reinforced concrete structures and, in general, one of two types, free-flowing or flap-gate. Free-flowing inlet drains were designed to drain areas that sit level or above the canal's designed water level. They typically consist of precast concrete pipes or concrete box-culverts that project from the top edge of the canal lining (**Photograph 45** - **Photograph 46**). Flap-gate inlet drains were designed to drain areas that sat at or below

the expected average operating water level but above its maximum designed water level. They typically consist of concrete box-culverts that pierce through the canal and metal flap gates that open to allow drainage into the canal but mostly remain closed to prevent reverse flow (**Photograph 47 - Photograph 48**). The number of flap gates varies between one and three. As with other minor appurtenant water conveyances, the dimensions of both types varied in consideration of the surrounding topography.[15]

Since its initial construction, the population of DMC inlet drains has been somewhat modified by alterations to the original structures or the addition of new types of inlet drains. Typical alterations included replacing the flap gates on a box-culvert type (**Photograph 49**), rebuilding a deteriorated concrete box-culvert (**Photograph 50**), replacing a deteriorated precast concrete pipe with a corrugated metal pipe (CMP), and deleting original flap-gate inlet drains (**Photograph 51**). Most new types of inlet drains were simple, unadorned corrugated metal pipes embedded in the embankment for discharge into the canal (**Photograph 52**). As with the original structures, these CMPs came in varying sizes, sometimes comprising multiple pipes. While basic CMP structures comprise the majority of new additions to the inlet drain population during this period, a few additional concrete structures were likewise added. Some of these drains resembled earlier reinforced concrete structures, as they feature sidewalls, and are built directly into the canal lining (**Photograph 53**). They are likewise outfitted with CMPs.



Photograph 45: Free-flowing inlet drain along the right bank at M.P. 67.66; camera facing from left bank, June 14, 2022 (C0349).



Photograph 46: Free-flowing inlet drain along the right bank at M.P. 77.58; camera facing from left bank, June 14, 2022 (C0261).

[15] Bureau of Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction*, 78, 83-85; Bureau of Reclamation, "Concrete Drainage Inlet," specification, on file at on file at Reclamation Design Construction Library (1946).



Photograph 47: Triple flap-gate inlet drain along the right bank at M.P. 76.64; camera facing from left bank, June 14, 2022 (C0253).



Photograph 48: Flap-gate inlet drain along the right bank at M.P. 76.64; camera facing from left bank, June 14, 2022 (C0253).



Photograph 49: Altered flap-gate inlet drain along the right bank at M.P. 8.01; camera facing from left bank, May 9, 2022 (A00266).



Photograph 50: Altered flap-gate style, concrete inlet drain along the right bank at M.P. 33.88; camera facing from left bank, May 11, 2022 (A00699).



Photograph 51: Deleted flap-gate inlet drain along the right bank at M.P. 20.71; camera facing from left bank, May 10, 2022 (B00070).



Photograph 52: CMP shoulder drain along the right bank at M.P. 7.29; camera facing from left bank, May 9, 2022 (A00258).



Photograph 53: Modern inlet drain along the right bank at M.P. 28.53; camera facing from left bank, June 14, 2022 (C0472).

5. Miscellaneous

Bridges

There are 120 extant bridge crossings associated with the DMC, including three (3) roadways located above sites where the canal is siphoned underground and 16 bridges constructed after the period of significance, post-1958, as replacements of existing bridges or to establish a bridge crossing where there was none[16]. This total does not include four pairs of bridge abutments where bridges have been demolished, but not replaced. As originally designed and constructed, the DMC included four distinct bridge types: Railroad Bridges, State Highway Bridges, County Highway Bridges, and Miscellaneous Bridges, which included Operating Bridges, Farm Bridges, and County Road Bridges. The only Railroad Bridge associated with the

[16] The three crossings over siphons included in the bridge population are identified as such because they are categorized as bridges within the *DMC Structures List* (2020).

DMC is located on the Westley Wasteway. Because this bridge is not located on the DMC itself, it is not included in the population of DMC bridges, however it is discussed in detail within the Linear Feature Record for DMC segment 6. Each of the original bridge types are still in use along the DMC, although Miscellaneous Bridges have since been reclassified as Farm Bridges or Operating Bridges, and County Road Bridges have been reclassified as County Highway Bridges. Bridges have also been raised in those concrete-lined sections of the DMC where the lining was raised, in the 1960s and 1970s. Most timber bridges crossing the canal were rehabilitated between 1964-70, by replacing their timber piers with concrete piers, while a few bridges were rehabilitated later in 1977.[17] The following discusses bridge typologies, sub-typologies, and common appurtenant features along the DMC as observed during the current survey recordation and as compared with the historical record. See **Table 6** for an inventory of bridge types appurtenant to the DMC.

Table 6: DMC Bridge Inventory

Bridge Type	Total	% of Total
County Highway Bridge	57	47.50
Farm Bridge	33	27.50
Operating Bridge	10	8.33
State Highway Bridge	4	3.33
Post-1958 Bridge	16	13.34
Total	120	100.00

County Highway Bridges

County Highway Bridges are the most prevalent of the bridge types appurtenant to the DMC, totaling 57 bridges or a plurality of about 47.50% of all bridges included in this inventory. The County Highway Bridge type may be further divided into five subtypes:

- Concrete Bridges with concrete piers or bents, totaling 47 or about 82.46% of all County Highway Bridges
- Wasteway Crossing Bridges integrated into forebay structure, totaling 4 or 7.02% of population; and
- Timber Bridges with replacement concrete piers, totaling 3 or 5.26% of population; and
- Roads crossing siphons, totaling 2 or about 3.51% of population; and
- A single Timber Bridge with timber bents, about 1.75%

Concrete Bridges make up the majority of the County Highway Bridge population. All County Highway Bridges were designed according to the "Standard Specifications for Highway Bridges," published by the American Association of State Highway Officials (AASHO). The Concrete Bridges all have concrete decks covered by asphalt-paved road, measuring from 16-feet-wide to 40-feet-wide, through the vast majority measure 24- or 20-feet-wide (**Photograph 54** and **Photograph 55**). Bridges of this subtype are all supported, as originally designed, by concrete piers or bents: sets of solid-type piers and sets of square, multi-columned bents (**Photograph 54** and **Photograph 56**). Most of the bridges located in the concrete-lined sections of the canal are supported by two piers or bents, while bridges located in the earth-lined and earth sections are supported by a set of three bents (**Photograph 57**). The exception to this is the bridge at M.P. 68.03, which is supported by three concrete solid-type piers (**Photograph 58**). Most of these Concrete County Highway Bridges were originally designed with, and retain, metal guard-rails secured to wooden posts embedded in the concrete curbs. Once again, an exception to this is the bridge at M.P. 68.03, which has concrete parapet walls integrated into the deck construction with short spans of steel guard-railing

[17] USDI, Reclamation, *Designers' Operating Criteria, Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 26; Structures List, 2000.

extending from both ends (**Photograph 58**). Generally, bridges in this subtype retain strong historic integrity of design, materials, workmanship, setting, location, association, and feeling.

Wasteway Crossing bridges are the second most common County Bridge subtype. Although these bridges are not included in the *DMC Structures List*, they are maintained by the County and thus included in the County Highway Bridge population for the purpose of this survey. These four bridges are integrated into the forebays of the Westley Wasteway at M.P. 34.32, the Newman Wasteway at M.P. 54.38, the San Luis Wasteway at M.P. 69.98, and the Firebaugh Wasteway at M.P. 111.22. They have concrete decks measuring approximately 20 feet wide x 120 feet long, supported by a single concrete pier that also divides the two bays of the inlet structures. Their abutments are the walls of the intake forebasy. All of these bridges have metal-pipe handrails, though the bridge at the Firebaugh Wasteway is outfitted with chain-link fencing in addition to these handrails (**Photograph 59** and **Photograph 60**).

The Timber Bridges are the third most common County Highway Bridge subtype. As discussed above, all County Highway Bridges were designed according to specifications drafted by the AASHO, and these Timber Bridges conform to the original design for County Road Bridges for two lanes of H15 loading.[18] These three timber bridges, located at M.P. 62.09, 72.33, and 77.63, were all rehabilitated in 1965-6, at which time the timber members of their decks were replaced, as needed, and the original timber bents were removed and replaced with sets of three solid-type concrete piers (**Photograph 61**). They have retained their timber decks, which measure 18- to 20-feet-wide. For a detailed discussion of the Farm Bridges' attributes, see discussion of "Farm Bridges" below.

This bridge type is comprised of two (2) roadways that traverse DMC siphons. The siphon crossing are asphalt paved roads that run across DMC siphons. The first is at M.P. 23.99, where Blewett Road crosses the DMC (**Photograph 62**). The second is at M.P. 110.99, where State Highway 33 crosses the DMC (**Photograph 63**).

The last subtype consists of a single Timber Bridge supported by timber bents (**Photograph 64**). This bridge is located at M.P. 0.33 along Lindemann Road, adjacent to the Tracy Fish Facility. The deck measures 28 feet wide. It has timber curbs and no handrails, but chain-link fence is secured to both sides along the full length of the deck. This is the only bridge within the whole DMC bridge population to retain its timber bents.

Farm Bridges

The second most prevalent bridge type appurtenant to the DMC is the Farm Bridge, totaling 33 bridges or approximately 27.50% of all bridges included in this inventory. As the DMC traversed vast agricultural acreage throughout its span, Farm Bridges were designed and constructed to allow adjacent farmers continued access to lands that construction of the DMC had bifurcated. Originally, virtually the entire Farm Bridge population was designed by Reclamation as standard timber bridges, with specifications similar to the original timber county road bridges. Their design included wood-plank decks, timber bents, and reinforced concrete abutments. A rehabilitation project from 1964-1970 replaced timber members of the decks, as needed, and replaced all timber bents with solid-type concrete piers. Two bridges within the Farm Bridge population were rehabilitated in 1977.[19] As a result, the modern DMC Farm Bridge type may be divided into three subtypes:

- Farm Bridges with replacement solid-type concrete piers that have retained their timber decks, totaling 29 or about 87.88% of all Farm Bridges;
- Farm Bridges with replacement concrete bents and timber-decks, totaling 3 or 9.09% of the population; and
- a single Farm Bridge with replacement concrete piers and replacement concrete deck, about 3.03%.

The majority of Farm Bridges are those that have retained their timber decks, which measure between 16-feet-wide and 30-feet-wide and are supported by three replacement solid-type concrete piers (**Photograph 65**). The exception to this is the

[18] *Delta-Mendota Canal-Station 2588+40.4, County Road Bridge*, Drawing No. 24, 214-D-15874
[19] USDI, Reclamation, Central Valley Project – California (CVP), "Delta Mendota Canal-Sta.4128+25, Timber Farm Bridge and 20" Irrigation Crossing" dwg. no. 214-215-4149, [date illegible]; USDI, Reclamation, *Designers' Operating Criteria, Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 26; Structures List, 2000.

bridge at M.P. 15.10, the deck of which measures 12 feet wide and is supported by four concrete piers (**Photograph 97**). Originally outfitted with timber handrails many Farm Bridges of this subtype have been subsequently modified by the installation of modern steel guard-railing (**Photograph 65**). A few bridges still retain their timber handrails, but these have been reinforced by the addition of modern steel guard-rails (**Photograph 66**). The timber handrails on one bridge, at M.P. 13.96, have been doubly reinforced by the addition of corrugated steel sheets and modern steel guard-railings **(Photograph 67**). There are also other bridges that do not possess any handrails, only wooden beam curbs, such as those at M.P. 85.47, 88.62, 90.91, 92.73, 95.45 (**Photograph 68**). The bridge at M.P. 93.24 has only one handrail, a modern steel guard-raid, on the upstream side (**Photograph 69**). A fire damaged bridge at M.P. 9.87, which has been cordoned off, still retains one of its original timber handrails (**Photograph 70**).

The second subtype of Farm Bridges also retain their timber decks, but they are supported by five concrete bents, square beams supported by multiple square columns. Two of these bridges, at M.P. 99.82 and M.P. 105.55, both of which were rehabilitated in 1969, measure 20-feet-wide and do not possess any handrails (**Photograph 71**). The bridge at M.P. 100.85, which measures 30-feet-wide, is outfitted with modern steel guard-rails (**Photograph 72**). The date of rehabilitation of this bridge is unknown.

The last subtype among the Farm Bridge population consists of a single Farm Bridge with replacement concrete deck and replacement concrete supports, located at M.P 98.74. The deck of this bridge is 30-feet-wide, supported by five square, multi-columned bents. It does not possess handrails of any kind (**Photograph 73**).

Operating Bridges

There are ten (10) Operating Bridges, or roughly 8.33% of all bridges included in this inventory. Operating Bridges comprise a small population of crossings for maintenance purposes, of which there are four subtypes:

- Timber Operating Bridges, totaling seven (7) or about 70.00% of this population;
- a single Concrete Operating Bridge crossing Del Puerto Creek, about 10.00%; and
- a single Siphon Crossing at Los Banos Creek, about 10.00%; and
- a single Wasteway Intake Bridge crossing the open intake channel to the O'Neill Pumping Plant, about 10.00% of this population.

The most common subtype among this population are the Timber Operating Bridges, which were designed according to similar specifications as the original timber farm and county road bridges. Located at the sites of appurtenant waterway crossings, three bridges of this subtype have 16-foot-wide timber decks, two have 20-foot-wide decks, and one has a deck 30-feet-wide (**Photograph 74, Photograph 75,** and **Photograph 76**). Individual lengths are determined by the width of the traversed waterway. A rehabilitation project from 1964-1970 replaced timber members of the decks, as needed, and replaced all timber bents with solid-type concrete piers (**Photograph 77**). All seven (7) of these bridges were rehabilitated in 1965-6. Every bridge of this subtype has replacement steel guard-railing, with the original timber railing removed at an unknown date (**Photograph 75**).[20] For a detailed discussion of the Farm Bridges' attributes, see discussion of "Farm Bridges" above.

The single Concrete Operating Bridge is located at M.P. 37.28, where it crosses Del Puerto Creek, adjacent to the siphon at this location (**Photograph 78**). This bridge has a concrete deck supported by concrete two bents. For a detailed discussion of the Concrete Operating Bridge, see Linear Feature Record for DMC Segment 7.

Another subtype is the roadway traversing the DMC siphon at Los Banos Creek, located at M.P. 79.69 (**Photograph 79**). This structure replaced the original Timber Operating Bridge at this location which carried the O&M road over the creek and siphon. Reportedly, the timber bridge burned and was replaced with a three-barrel corrugated metal pipe (CMP) arch culvert in the

[20] USDI, Reclamation, Central Valley Project – California (CVP), "Delta Mendota Canal-Sta.3535+75, Timber Operating Bridge" dwg. no. 214-D-16002, ca. 1949; USDI, Reclamation, *Designers' Operating Criteria, Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 26; *2020 Structures List*.

late 1970s, with additional modifications in the late-1990s and 2010s.[21] For a detailed discussion of the Los Banos Creek Siphon Crossing, see Linear Feature Record for DMC Segment 16.

The final subtype consists of a single bridge that spans the entrance to the open intake channel at M.P. 69.30, which leads to the O'Neill Pumping Plant and Reservoir (**Photograph 80** and **Photograph 81**). This bridge is concrete, and its deck measures approximately 20 feet wide x 135 feet long. It is supported by a single concrete solid-type pier in the center of the span and has metal guard-rails secured to timber posts embedded in concrete curbs. For a detailed discussion of the Wasteway Intake Operating Bridge, see Linear Feature Record for DMC Segment 13.

State Highway Bridges

State Highway Bridges comprise four (4) structures, or roughly 3.33% of all bridges included in this inventory and have no subtypes. These bridges (originally called "Highway Bridges") were designed according to AASHO standards for an H 20-S 16-44 loading, which called for concrete slab and beam construction with abutments and piers of reinforced concrete on spread footings.[22] Consequently, they feature wider roadways on average, typically measuring 26-feet-wide (**Photograph 82**). State Highway Bridges were originally designed with metal guard-rails, however, all but one State Highway Bridge at M.P. 71.31 (**Photograph 83**) has had their historic railings replaced with concrete parapets at an unknown date (**Photograph 84**). Some of the parapet walls have had metal-pipe railings or fencing added to them (**Photograph 82** and **Photograph 85**). All of the State Highway Bridges are supported by a pair of concrete solid-type piers.

Non-Original Bridge Types

The remainder of the DMC bridge population consists of 16 bridge crossings constructed after 1958 (the end of the period of significance) either to replace existing bridges or to establish a bridge crossing where there was none. This is roughly 13.34% of all bridges included in this inventory. Four (4) replacement County Highway Bridges, at M.P. 9.29, 10.28, 10.62, and 39.81, have concrete decks measuring 30-feet-wide with parapet walls, large abutments and no support piers (**Photograph 86**). The old abutments and footings of the demolished bridges are still present at these locations. Two (2) more replacement County Road Bridges, at M.P. 29.93 and 34.39, have concrete decks measuring 24-feet-wide, supported by three concrete solid-type piers, with steel guard-rails (**Photograph 87**). These two bridges were rebuilt by the County in 1965.

Also in 1965, seven (7) State Highway Bridges were built for Route 132 and Route 5, using the AASHO design standards for an H20-S16-44 loading.[23] Unlike the original State Highway Bridge design, the concrete decks of these bridges are supported by steel stringers reinforced with interior steel trusses (**Photograph 88**). On five (5) of these bridges the deck extends beyond the stringer to abutments set further back in the embankment (**Photograph 89**). The decks of these bridges measure either 26-feet-side (two spans) or 50-feet-wide (4 spans). However, the abutments bridge for Interstate 5 at M.P. 72.80 sit right next to the canal lining and the stringers are embedded in the abutments (**Photograph 90**). At another bridge for Interstate 5, at M.P. 65.89, the abutments on the right bank sit directly next to the canal and support the stringers, while on the left bank, the stringer terminates at a monolithic concrete pier, while the deck extends over the O&M road adjacent to the canal and terminates at an abutment further up the embankment (**Photograph 91**). Both of these bridges have decks measuring 39-feet-8-inches-wide. All of these State Highway Bridges have steel-pipe handrails embedded in concrete curbs.

Two (2) replacement Farm Bridges, at M.P. 102.03 and 106.58, constructed in 2014 and 2004, respectively, have concrete decks that measure 22-feet-wide and 20-feet-wide, respectively, supported by five concrete bents, with steel guard-rails (**Photograph 92**). The last replacement bridge, constructed in 1998 to replace a Timber Operating Bridge, is located at M.P. 33.29, and has a timber deck, measuring 16-feet-wide, supported by three concrete piers, with modern steel guard-rails (**Photograph 93**).

[21] *Design Summary, Road Crossing Replacement at Los Banos Creek Check and Siphon*, 2001, 2; Google Earth
[22] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*, 1959: 88.
[23] USDI, Reclamation, *Designer's Operating Criteria*, 1971: 26

Common Appurtenant Features

Metal cattleguards are a common appurtenant feature to the DMC Farm Bridge population. Reclamation adapted designs first employed along the Contra Costa Canal to accompany some Farm Bridges along the northern reaches of the DMC, where hilly ranchland surrounds the winding canal (**Photograph 94**). Cattle guards are simple structures, with each consisting of a shallow, concrete-lined, 12-foot x 8-foot depression in the roadway topped by a grid of steel pipe rails spaced approximately eight inches apart and secured by steel stringers. All cattle guards are flanked on either side by triangular metal sideguards (**Photograph 95**).

The other common feature among the whole DMC bridge population is pipe crossings, appended to bridges where they span the canal width. For a detailed discussion of pipe crossings, including those attached to bridge crossings, see typology discussion of "Pipe Crossings" in P3a. Description on Continuation Sheets.



Photograph 54: View of 20-foot-wide County Highway Bridge with concrete deck and solid-type concrete pier supports at M.P. 24.48 along Koster Road; camera facing downstream from left bank, May 11, 2022 (A00490).



Photograph 55: View of 30-foot-wide County Highway Bridge with concrete deck at M.P. 39.21 along Rogers Road; camera facing upstream from left bank, May 12, 2022 (B00336).



Photograph 56: Detail view of concrete bents supporting County Highway Bridge with concrete deck at M.P. 53.43 along Shiells Road; camera facing upstream from left bank, May 13, 2022 (A00979).



Photograph 57: View of 26-foot-wide County Highway Bridge with concrete deck supported by three (3) concrete bents at M.P. 105.03 in earth-lined section of DMC along Jerrold Avenue; camera facing upstream from left bank, June 14, 2022 (C0454).



Photograph 58: View of 24-foot-wide County Highway Bridge at M.P. 96.28 along McCabe Road, with three concrete piers and concrete parapet walls with metal guard-rail extensions on both ends; camera facing downstream from left bank, June 13, 2022 (C0178).



Photograph 59: Deck of Wasteway bridge at Newman Wasteway forebay, M.P. 54.38; camera facing downstream on left bank, May 13, 2022 (A00988).



Photograph 60: View of chain-link fence and metal-pipe handrails on Firebaugh Wasteway bridge at M.P. 111.22, as well as central pier and left abutment/wall of forebay; camera facing southwest, June 14, 2022 (C0485).



Photograph 61: View of County Highway Bridge with timber deck supported by three concrete piers at M.P. 72.33 along Hilldale Avenue; camera facing downstream from left bank, June 14, 2022 (C0243).



Photograph 62: View of Blewett Road crossing the DMC siphon at M.P. 23.99; camera facing upstream from left bank, May 11, 2022 (A00475).



Photograph 63: View of State Highway 33 crossing the DMC siphon at M.P. 110.99; camera facing upstream from left bank, June 14, 2022 (C0479).



Photograph 64: View of County Highway Bridge with concrete deck supported by timber bents, at M.P. 0.33 along Lindemann Road, next to the Tracy Fish Facility; camera facing upstream from left bank, May 9, 2022 (A00158).



Photograph 65: View of Farm Bridge at M.P. 12.31 with 16-foot-wide timber-deck, replacement concrete piers, and modern steel guard-rails; camera facing upstream from left bank, May 10, 2022 (A00365).



Photograph 66: Detail view Farm bridge with timber deck at M.P. 5.67, with its original timber handrails reinforced by the addition of modern steel guard-rails; camera facing west from the left bank, May 9, 2022 (A00232).



Photograph 67: Detail view of Farm Bridge with timber deck at M.P. 13.96, with its original timber handrails reinforced by the addition of corrugated steel sheets and modern steel guard-railings; camera facing southwest from left bank, May 10, 2022 (A00397).



Photograph 68: View of Farm Bridge with timber deck at M.P. 85.47, where original timber handrails have been removed and not replaced; camera facing downstream from left bank, June 14, 2022 (C0338).



Photograph 69: : View of Farm Bridge with timber deck at M.P. 93.24 which has only one modern steel guard-rail on the upstream side, but no handrail on the downstream side; camera facing downstream from left bank, June 14, 2022 (C0384).



Photograph 70: View of fire-damaged Farm Bridge at M.P. 9.87, with timber deck and timber railing on upstream side; camera facing southwest from left bank, May 9, 2022 (A00297).



Photograph 71: View of 20-foot-wide Farm Bridge at M.P. 99.82, with original timber deck supported by five replacement concrete bents, with no handrails; camera facing downstream from left bank, June 14, 2022 (C0428).



Photograph 72: View of 30-foot-wide Farm Bridge at M.P. 100.85, with original timber deck supported by five replacement concrete bents, with modern steel guard-rails; camera facing downstream from left bank, June 14, 2022 (C0436).



Photograph 73: View of 30-foot-wide Farm Bridge at M.P. 98.74, with replacement concrete deck supported by five replacement concrete bents, with no handrails; camera facing downstream from left bank, June 14, 2022 (C0422).



Photograph 74: View of 16-foot wide Timber Operating Bridge at M.P. 16.65 along with replacement concrete piers and modern steel guard-rails; camera facing upstream from left bank, May 10, 2022 (B00007).



Photograph 75: Detail view of Timber Operating Bridge with 20-foot-wide deck at M.P. 34.89, with modern steel guard-rails; camera facing west from left bank, May 12, 2022 (A00807)



Photograph 76: Detail view of Timber Operating Bridge with 30-foot-wide deck at M.P. 36.81, with steel guard-rails; camera facing west from left bank, May 12, 2022 (B00226).



Photograph 77: Detail view of replacement concrete piers on Timber Operating Bridge at M.P. 36.81; camera facing southwest from left bank, January 16, 1948 (B00225).



Photograph 78: View of Concrete Operating Bridge at M.P. 37.28 crossing over the Del Puerto Creek culvert; camera facing south from left bank, May 12, 2022 (B00257).



Photograph 79: View of Operating Bridge roadway traversing DMC siphon at Los Banos Creek, M.P. 79.69 along Raines Road; camera facing downstream from left bank, June 14, 2022 (C0280).



Photograph 80: View of open O'Neill forebay intake channel with bridge crossing it at M.P. 69.30; camera facing right bank from left bank, June 13, 2022 (C0189)



Photograph 81: View of bridge across open O'Neill forebay intake channel at M.P. 69.30; camera facing right bank from left bank, June 13, 2022 (C0190).



Photograph 82: View of 26-foot-wide State Highway Bridge at M.P. 6.6 along Old Highway 50, with replacement parapet walls with additional metal-pipe railing on top; camera facing upstream from left bank, May 9, 2022 (A00245).



Photograph 83: View of State Highway Bridge at M.P. 71.31 along Jensen Road / State Route 207, with original steel guard-railing; camera facing downstream from left bank, June 13, 2022 (C0210).



Photograph 84: View of State Highway Bridge at M.P. 75.84 along State Highway 152, with replacement concrete parapet walls; camera facing upstream from left bank, June 13, 2022 (D2237).



Photograph 85: Detail view of State Highway Bridge at M.P. 7.67 along Interstate 205, with replacement concrete parapet walls with additional metal fencing on top; camera facing downstream from left bank, May 9, 2022 (A00261).



Photograph 86: View of replacement County Highway Bridge at M.P. 9.29, along International Parkway, with 30-foot-wide concrete deck, original piers and abutments visible just upstream of current bridge; camera facing downstream from left bank, May 9, 2022 (A00287).



Photograph 87: View of replacement County Road Bridge at M.P. 29.93, along McCracken Road, with 24-foot-wide concrete deck, supported by three concrete solid-type piers, and steel guard-railing; camera facing upstream from left bank, May 11, 2022 (A00612).



Photograph 88: Detail view of steel stringers and interior trusses on non-original (post-1958) State Highway Bridge at M.P. 22.73, along State Highway 5 Northbound; camera facing south from left bank, May 10, 2022 (B00165).



Photograph 89: View of non-original (post-1958) State Highway Bridge at M.P. 22.73, along State Highway 5 Northbound, with 50-foot-wide concrete deck supported by a steel stringer strung between two monolithic concrete piers, abutments further back in embankment; camera facing downstream from left bank, May 10, 2022 (B00162).



Photograph 90: View of non-original (post-1958) State Highway Bridge at M.P. 72.8, along Interstate 5 Westbound, 39-foot-8-inch-wide concrete deck on steel stringer strung directly between abutments; camera facing upstream from left bank, June 15, 2022 (D2206).



Photograph 91: View of non-original (post-1958) State Highway Bridge at M.P. 65.89, along Interstate 5, with steel stringers strung between the abutment on the right bank and a monolithic concrete pier on the left bank, while the deck extends over the O&M road adjacent to the canal and terminates at an abutment further up the embankment; camera facing upstream from left bank, June 13, 2022 (C0164).



Photograph 92: View of replacement Farm Bridge built in 2004 at M.P. 106.58, with 20-foot-wide concrete deck, supported by five concrete bents; camera facing downstream from left bank, June 14, 2022 (C0460).



Photograph 93: View of replacement Timber Operating Bridge, constructed in 1998, at M.P. 33.29, with a 16-foot-wide timber deck supported by three concrete piers, with steel guard-rails; camera facing downstream from left bank, May 11, 2022 (A00684).



Photograph 94: View of cattle guards (left) adjacent to Farm Bridge (right) at M.P. 13.96; camera facing downstream on left bank, May 10, 2022 (A00396).



Photograph 95: Detail view of cattle guard adjacent to Farm Bridge at M.P. 50.53; camera facing downstream on left bank, May 13, 2022 (A00927).

Pipe Crossings

The DMC currently includes 67 pipe crossings distributed throughout its span.[24] Pipe crossings transport or divert irrigation water, natural gas, oil, and fuel. The following typology discussion does not attempt to provide an exhaustive inventory of DMC pipe crossings, but rather to give an overview of the historic and modern structural types and subtypes as observed during the current survey recordation and as compared with the historical record.

[24] The DMC Structures List refers to pipe crossings as either irrigation crossings and utility crossings.

The original population of pipe crossings was principally comprised of thin-walled steel pipes ranging from 4 to 20 inches in diameter that moved irrigation water over the canal (**Photograph 96**). This population was originally referred to as irrigation crossings. Most are mounted on support piers rising from the canal, but some are mounted atop check structures or along the sides of bridges (**Photograph 97**). Typically, they consist of a single pipe but a few triple-pipe irrigation crossings span the DMC (**Photograph 98**). Additional pipe crossings for moving natural gas, oil, and fuel were installed either during or after the initial period of construction. This varying population was originally referred to as utility crossings. They, too, principally consist of steel pipes ranging from 18 to 26 inches (**Photograph 99**), and most are mounted on support piers rising from the canal while some are mounted within steel truss structures (**Photograph 100** - **Photograph 101**).[25]

Since its initial construction, the population of DMC pipe crossings has been modified by the addition of both metal and PVC pipes. All PVC pipe crossings were added at various dates and are typically attached to bridge curbs. Modern metal pipe crossings were added at various dates after the initial period of construction and typically follow Reclamation's original design specifications.



Photograph 96: Irrigation crossing at M.P. 101.27 (left), shown alongside a well discharge (right); camera facing right bank from left bank, June 14, 2022 (C0439).



Photograph 97: Irrigation crossing attached to the downstream side of bridge at M.P. 15.10; camera facing upstream from left bank, May 10, 2022 (A00426).

[25] Bureau of Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction* (Denver, Colorado: Central Valley Project – California, June 1959), 74, 77-78; Bureau of Reclamation, "16" Irrigation Pipe Crossing," specification, on file at Reclamation Design Construction Library (1949).



Photograph 98: Triple-pipe irrigation crossing at M.P. 90.57 (right); camera facing right bank from left bank, June 14, 2022 (C0370).



Photograph 99: Two oil utility crossings at M.P. 16.78; camera facing right bank from left bank, May 10, 2022 (B00009).



Photograph 100 Modern, high pressure oil utility crossing at M.P. 71.59; camera facing downstream from left bank, June 14, 2022 (C0237).



Photograph 101: Modern, gas utility crossing at M.P. 71.69, with abandoned oil utility crossing in the foreground; camera facing downstream from left bank, June 14, 2022 (C0238).

Siphon Undercrossings

There are 28 identified siphon undercrossings distributed throughout the DMC. Siphon undercrossings convey natural drainage channels and preexisting water courses underneath the DMC. All siphon undercrossings inventoried here, originally called "siphon crossings" in the *Delta-Mendota Canal Technical Record of Design and Construction* and alternately called "culvert crossings" or "siphon crossings" in the Delta-Mendota Canal Structures List, use gravity to carry established irrigation water conveyances under the canal. See

Table 7 for an inventory of the geographic distribution of siphon undercrossings as sorted by JRP-designated DMC segment numbers.

Table 7: Geographic Distribution of DMC Siphon Undercrossings

DMC Segment No.	Siphon Undercrossing Totals	Percent of Totals
1	5	17.9%
2	1	3.6%
3	0	--
4	0	--
5	0	--
6	1	3.6%
7	0	--
8	1	3.6%
9	1	3.6%
10	2	7.1%
11	3	10.7%
12	0	--
13	2	7.1%
14	2	7.1%
15	0	--
16	0	--
17	0	--
18	0	--
19	6	21.4%
20	4	14.3%
21	0	--
22	0	--
Total	**28**	**100%**

While individual siphon undercrossing lengths and slopes are principally determined by the surrounding topography, their standard designs are generally uniform, with only slight dimensional or structural variation. All the siphon undercrossings inventoried here are either steel pipes encased in concrete, concrete pipes, or reinforced concrete-box siphons that include one, two, or three barrels. The inlets and outlets of the concrete-box siphons are framed by concrete wingwalls, which may consist of either flat or curved walls with angled transitions back to the watercourse (**Photograph 102** - **Photograph 103**). The dimensions of the siphon inlets and outlets are likewise determined by the surrounding topography as well as the hydrological properties of the water source being conveyed, with greater water volume necessitating large siphons.[26]

[26] Bureau of Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction*, 74, 78-79.



Photograph 102: Two-barrel siphon undercrossing outlet at M.P. 45.75 (left); camera facing southeast, May 12, 2022 (B00475).



Photograph 103: Three-barrel siphon undercrossing outlet at M.P. 30.63; camera facing south, May 11, 2022 (A00633).

Culverts

There are 32 identified culverts distributed throughout the DMC. Culverts, along with wash overchutes and drainage inlets, convey natural drainage channels and preexisting water courses underneath the canal. See

Table 8 for an inventory of the geographic distribution of culverts as sorted by DMC segments recorded on Linear Feature Records below.[27]

Table 8: Geographic Distribution of DMC Culverts

DMC Segment No.	Culvert Totals	Percent of Total
1	7	21.87%
2	2	6.25%
3	0	--
4	0	--
5	0	--
6	1	3.12%
7	0	--
8	1	3.12%
9	1	3.12%
10	2	6.25%
11	3	9.38%
12	0	--
13	2	6.25%
14	3	9.38%
15	0	--
16	0	--

[27] Most of the culverts inventoried here were heavily obscured by vegetative overgrowth or otherwise inaccessible from the FKC embankments at the time of recordation. Structural information was chiefly derived from engineering drawings, final reports, and structures inventories.

17	0	--
18	0	--
19	6	18.76%
20	4	12.50%
21	0	--
22	0	--
Total:	**32**	**100%**

While individual culvert lengths and slopes are principally determined by the surrounding topography, their basic designs are generally uniform, with only slight dimensional or structural variation. All of the culverts inventoried here are reinforced concrete box culverts with cutoff collars, which were historically constructed to include one, two, or three barrels (**Photograph 104**). The number of barrels and the dimensions of the box culvert inlets and outlets are likewise determined by the surrounding topography as well as the hydrological properties of the water source being conveyed, with greater hydro volume necessitating large, multi-barreled culverts. Inlets and outlets are framed by concrete wingwalls, which may consist of either flat walls that extend at right angles or curved walls with angled transitions back to the conveyed watercourse.[28]



Photograph 104: Culvert channeling the O'Neill Forebay Wasteway beneath the DMC at M.P. 69.62; camera facing northwest, June 13, 2022 (C0214).

Well Discharges

There are dozens of well discharges along DMC, concentrated primarily in segments 18 to 21. They are all very similar in appearance and consist of metal pipes projecting from the canal wall with an upward bend at its outlet. They are all modern additions.

[28] Bureau of Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction*, 78.



Photograph 105: Well discharge at M.P. 90.39; camera facing right bank from left bank, June 14, 2022 (C0364).

DMC Signs

There are 6 signs along DMC, typically adjacent to major roadways (**Photograph 106**). They are all very similar in appearance and are either single or double sided, constructed of horizontal wood planks affixed to square wood posts.



Photograph 106: Delta-Mendota Canal, Central Valley Project sign at M.P. 1.41; camera facing west, May 9, 2022 (A00152).

B9b. Builder (continued):

Builder	Canal Segment(s)	Completion Date	Description of Work
Hubert H. Everist, Sr.	M.P. 27.00 – 39.88	November 13, 1948	Earthwork, concrete lining, and structures and Westley wasteway
Morrison-Knudsen Co., Inc., / M. H. Hasler	M.P. 3.51 – 13.66	March 9, 1949	Earthwork, concrete lining, and structures

Morrison-Knudsen Co., Inc. / M. H. Hasler	M.P. 13.66 – 27.00	August 31, 1950	Earthwork, concrete lining, and structures
Hubert H. Everist, Sr.	M.P. 39.88 – 54.45		Earthwork, concrete lining, and structures, and timber operating bridge
Western Contracting Corp.	M.P. 54.43 – 70.04	July 5, 1951	Earthwork, concrete lining, and structures
Morrison-Knudsen Co., Inc./ M.H. Hasler	M.P. 70.04 – 90.54	July 8, 1951	Earthwork, concrete lining, and structures
Morrison-Knudsen Co., Inc./ M.H. Hasler	M.P. 90.54 – 98.64	July 5, 1951	Earthwork, concrete lining, and structures
United Concrete Pipe Corp., and Vinnell Co., Inc.	M.P. 98.64 – 116.59	November 30, 1951	Earthwork and structures, Delta Mendota Canal, and Firebaugh wasteway
A. Teichert and Sons, Inc.	M.P. 0.03 – 1.48	October 27, 1951	Newman wasteway
United Concrete Pipe Corp., and Vinnell Co., Inc.	M.P. 1.48 – 8.20 M.P. 0.027 – 2.81	November 3, 1951	Newman wasteway, earthwork, concrete lining and structures, and service lateral
Western Contracting Corp.	M.P. 0.06 – 11.88	April 9, 1952	San Luis wasteway and holding reservoir dike
Johnson Western Constructors			Columbia Pumping Plant No. 1, Mowry Pumping Plant and delivery systems
Plainview Water District/ Stolte, Inc.		1954	Earthwork, pipelines, and structures including pumping plants, laterals 8.7 to 20.0, inclusive, and sublaterals
Crest Contracting Co.	M.P. 58.18 - 96.62		Pump turnouts
Hubert Sykes	M.P. 12.99 – 25.88		Furnishing, hauling and placing gravel
E.A. Pollard			Erection of right-of-way fence
M.J. Ruddy and Son	M.P. 3.50 – 14.96 M.P. 17.99 – 24.02 M.P. 12.29 – 13.05		Furnishing or processing, hauling and placing gravel
H. Sykes	M.P. 25.80 – 36.56 M.P. 38.16 – 40.72		Furnishing or processing, hauling and placing gravel
Claude C. Wood Co.			Furnishing or processing, hauling and placing gravel

B10. Significance (continued):

Historic Context

When viewing a topographic map of California, one particularly outstanding geographic feature presents itself above all others: an immense oblong alluvial plain in the interior of the state that extends nearly 500 miles from north to south and varies from about 60 to 100 miles in width (Figure 1). This Great Central Valley Basin occupies more than one-third of the entire state. It covers 18,810 square miles and is bounded on the east by a pair of formidable mountain ranges and on the west by a less

imposing coastal mountain range. The valley itself contains three major drainage areas. The northern one-third is drained by the southerly flowing Sacramento River and its tributaries. The Sacramento is the longest river in the state and the largest, contributing about one-third of the total outflow of all river systems in the state. The southern and largest portion of the valley is drained by the San Joaquin River and its tributaries. The San Joaquin River flows west and north and drains a larger, but much more arid region. The two major rivers converge in the "Sacramento-San Joaquin Delta," a 153 square-mile labyrinth of reclaimed tule islands, river channels, and sloughs. The Delta also receives freshwater inflows directly from other rivers draining the imposing central region of the Sierra Nevada range to the east. These watercourses include the Cosumnes, Mokelumne and Calaveras rivers along with numerous other minor rivers and creeks. The flow from all of these waterways move westerly through the Delta, entering Suisun Bay and, together with the Sacramento and San Joaquin rivers, flow through Carquinez Straits into San Francisco Bay, a salt water tidal basin, and ultimately through the Golden Gate into the Pacific Ocean.

California's water supply and development challenges stretch back to the mid-nineteenth century gold rush decade when gold miners in the mountains and foothills of the Sierra Nevada began diverting water from streams to expose placer deposits in streambeds and to process gold using a variety of hydraulic methods. The gold rush caused many significant changes in riverine ecosystems of the Central Valley. Hydraulic mining destroyed miles of riparian vegetation and habitat. Debris formed sandbars in streams, impaired navigation, and elevated riverbeds leading to massive flooding and destruction of thousands of acres of agricultural land, while in the mountains and foothills the hydraulic giants left behind barren amphitheaters and miles of waste tailings. Nevertheless, mining remained the most important economic use of water in California for some three decades following the mass migration of gold miners from around the world to California starting in 1849.[29]

Even during the height of the gold rush, some Californians already had begun to dream of converting the Central Valley into an agrarian wonderland. The Central Valley was a phenomenally rich and broad alluvial plain and was destined to become the state's most productive agricultural center. It was watered by streams flowing from the Sierra Nevada on the east and the coastal ranges on the west, but water was in short supply when needed the most during the rainless summer growing season. As a result, during the gold rush decade, open range grazing of sheep and cattle remained the principal land use on the natural pasture lands of the Great Central Valley.

In the middle to late 1860s, wheat culture emerged as an increasingly prominent land use and contributed to the decline, and later demise, of the open range cattle industry in the Central Valley in the ensuing decades. When planted in the fall and harvested in the spring, winter wheat and barley were two of only a handful of crops that could be successfully raised in the Central Valley without irrigation. All that was needed was access to a navigable stream or a railroad line to ship the grain to market and intermittent rainfall from November through April. In the San Joaquin Valley fifteen inches of rain produced bumper crops, although ten inches, if properly distributed, was enough to yield an acceptable harvest. The Great Valley offered rich, flat land that required little preparation, and grain farmers needed little farming experience because wheat or barley was easy to plant and virtually took care of itself. In many cases, grain farming did not even require a house, barn, or quarters. A remarkably diverse group of migrant workers, including down on their luck miners, performed the greatest portion of the required agricultural work. They were needed for only a span of three or four weeks during winter plowing and sowing and again in the summer for threshing and harvest. Most of these workers packed the necessities of life in a bindle and drifted between farms and agricultural districts. The wheat barons themselves mostly resided in the state's urban centers – Sacramento, Stockton, Oakland, and San Francisco – and left the comfort of their homes and families only to supervise the annual harvest or planting.[30]

[29] Robert Kelley, *Gold vs. Grain: The Hydraulic Mining Controversy in California's Sacramento Valley* (Glendale, CA: Greenwood Press, 1979).

[30] Richard Allen Eigenheer, "Early Perceptions of Agricultural Resources in the Central Valley of California" (PhD dissertation in Social Geography, University of California, Davis, 1976), 325-349; David Igler, *Industrial Cowboys: Miller & Lux and the Transformation of the Far West, 1850-1920* (Berkeley: University of California Press, 2001); Richard S. Street, *Beasts of the Field: A Narrative History of California Farmworkers, 1769-1913* (Stanford, California: Stanford University Press, 2004), 89-177.

Land speculators like E. H. Miller, George D. Roberts, William S. Chapman, Isaac Friedlander, Miller & Lux, and a host of others used generous federal and state land laws to monopolize land ownership in the Central Valley. For about three decades wheat was king in the valley, but its reign ended abruptly in the 1890s. Historians have identified numerous factors that explain the sharp decline of the California wheat industry, among them increasing competition in the international wheat market, soil exhaustion, new superior varieties of wheat, the increasing value of farmland devoted to irrigation and horticulture, and growing opposition to "land monopoly."[31]

As wheat production declined, farmers turned increasingly to irrigated crops. Irrigation grew steadily in California from 60,000 acres in 1860 to nearly 400,000 acres in 1880, and by the early years of the twentieth century it had become the dominant feature of California's agriculture with more than 2,644,000 acres under irrigation.[32] The Central Valley developed a virtual monopoly on several irrigated crops: cotton in the arid southern portion of the San Joaquin Valley; rice in the clay soils of the trough lands of the Sacramento Valley; vineyards or orchards on the alluvial fans on the east side of the Great Valley where water was accessible; truck crops in the Delta peat soils; grapes in eastern Fresno County and nuts and olives in the Sacramento Valley; and orange groves occupied the sheltered coves on alluvial fans up and down the eastern edge of the Great Valley.[33]

The greatest problems with agriculture in the Central Valley were two-fold: the regional unevenness of water supply and the Mediterranean-type of climate characterized by prolonged dry summers that required irrigation of summer maturing crops. The San Joaquin Valley has a hot desert climate, accentuated near the southern end, where there is a mean annual precipitation of less than five inches. Northward, rainfall increases through a transitional zone to a Mediterranean climate in the Sacramento Valley with hot summers. Exposed to cooling summer west winds through Carquinez Straits, the Delta has a cooler Mediterranean climate. A decrease in rainfall from north to south is also a prevailing condition of climate in California and this differential is exaggerated in the Central Valley. A rain shadow is also associated with the Coast Ranges, resulting in the eastern margins of the valley receiving on average 50 percent more precipitation than the west side of the valley. The regional distribution of streamflow is even more unequal because of the high elevation and long slope of the Sierra Nevada on the east side of the valley compared to the short slope of the lower Coast Ranges on the west side. These factors make it imperative that any valley-wide plan for irrigation development needed to store surplus winter water and make it available in the summer months, and that surplus northern and eastern water needed to be made available for use in the southern and western portions of the valley, if irrigation of irrigable land was to be maximized in the Central Valley.[34]

Irrigation developed initially in the Central Valley under private initiative and financing, using the natural flow of local streams. These early projects were concerned with relatively small tracts of land and not with the valley, or even an entire watershed, as a unit. In general, irrigation grew earlier and was more extensive in the southern portion of the San Joaquin Valley where growing crops without the benefits of irrigation was more tenuous. Settlers along the south bank of the Merced River began to irrigate alfalfa land, vineyards, and orchards in the vicinity of Snelling in the early 1850s. Ditches on Mill Creek and the Kaweah River irrigated grain fields and gardens as early as 1853. Settlers along the Tule River constructed several small ditches between 1859 and 1865. Once the Southern Pacific Railroad laid its tracks down the east side of the San Joaquin Valley in the early 1870s more extensive irrigation development ensued and company officials became avid promoters of irrigation as an essential component of economic development and land subdivision. The first large regional diversion project to be constructed was the San Joaquin and Kings River Canal (1871) that ran northwest from the bend of the San

[31] Eigenheer, "Early Perceptions of Agricultural Resources in the Central Valley of California," 325-349; Igler, *Industrial Cowboys*, 60-91; William L. Preston, *Vanishing Landscapes: Land and Life in the Tulare Lake Basin* (Berkeley: University of California Press, 1981), 85-120.

[32] Harding, *Water in California*, 80; Donald J. Pisani, *From the Family Farm to Agribusiness: The Irrigation Crusade in California and the West, 1850-1931* (Berkeley: University of California Press, 1984), 54-77.

[33] Joseph A. McGowan, *History of the Sacramento Valley*, 3 vols. (New York: Lewis Publishing Company,1961); J. J. Haley, "California's Change to Irrigation from Dry Farming," *Western Construction News*, 3 (February 1928): 83-84; William Reich, "King Cotton in California," *Land* 9 (Spring 1950): 65-71; William S. Richards, "Geographical Aspects of Rice Cultivation in California" (M.A. thesis, University of California, Berkeley, 1969).

[34] Peveril Meigs, "Water Planning in the Great Central Valley, California," *Geographical Review* 29, no. 2 (April 1939): 252-273.

Joaquin River where it turns northward. The plan included subsequent construction phases that would extend the canal to Suisun Bay and utilize Tulare Lake as a reservoir connecting to the canal by way of Fresno Slough. Just a few years later Charles Crocker, one of the founders of the Central Pacific Railroad that built the western portion of the transcontinental railroad, invested his private capital in the Crocker-Huffman Land & Water Company's irrigation and land subdivision project utilizing water from the Merced River to irrigate more than 20,000 acres in the vicinity of the town of Merced. In 1880 when State Engineer William Hammond Hall conducted the first statewide irrigation survey in California, it showed that the San Joaquin Valley with 188,000 acres was the most heavily irrigated region of the state with forty-seven percent of the irrigated acreage statewide. In contrast, the wetter Sacramento Valley remained mostly dry farmed with only 13,400 acres irrigated.[35]

Irrigation in the San Joaquin Valley proceeded under many forms of organization using surface water supplies flowing in creeks and rivers, artesian waters, and groundwater. While irrigation was achieved on a small scale within land colonies organized by land speculators, large areas of land were also amassed within former Mexican-era land grants, as swamp and overflowed land, railroad grant land, by use of land script, and a host of other methods under the public land laws. In the 1870s and 1880s, private irrigation companies developed the San Joaquin and Kings River Canal along San Joaquin River, along with canals diverting water from the Kern, Kings, and Merced rivers. The companies that succeeded in delivering water to farmers frequently did so at the price of creating unpopular land and water monopolies. Some farmers, with the encouragement of private canal companies, experimented with creation of "mutual water companies," owned by the farmers themselves who raised money and acquired rights to use water through the purchase of company "stock."[36]

Private irrigation companies enjoyed only limited success during the latter decades of the nineteenth century and the largest projects undertaken inevitably failed. These institutional efforts at planning and financing irrigation projects fell into four general categories: private water companies; land colonies, mutual water companies, and irrigation districts.[37] The economic turmoil of the era and high rate of failure of these irrigation efforts helped popularize other institutional alternatives, including a proposal for a unique unified, coordinated, and centralized canal network designed to be built and operated by the state. Efforts by private investors to build mammoth irrigation schemes such as the San Joaquin and Kings River Canal aroused the interest of Congress and in 1873 an act was passed directing the War Department to appoint an investigating committee to examine irrigation. "The Alexander Commission," led by Lieutenant Barton Stone Alexander, an U.S. Army Engineer, was organized in 1873 to conduct the first federally funded irrigation survey and plan for coordinated irrigation development of the Central Valley. This federal irrigation commission carried out what State Engineer Edward Hyatt, "father of the State Water Project," later called "one of the earliest attempts at water resources planning on a regional scale." As detailed surveys were lacking, the report was a mere sketch of a development plan. However, the first state water agency, the State Engineers Office under William Hammond Hall, labored from 1878 to 1888 to implement many of the basic recommendations suggested by the Alexander Commission.[38]

The Alexander Commission's federal irrigation survey was grossly underfunded and was conducted over a scant six weeks in the field, but the report contained much valuable information and captured the imagination of future generations of water resources planners in California. The Commission predicted that 8.5 million acres could be irrigated in the Central Valley and 12 million if the low foothills surrounding the valley were included. The Commission proposed a complex network of canals.

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[35] William Hammond Hall, *The Irrigation Question in California: Appendix to the Report of the State Engineer to His Excellency George C. Perkins, Governor of California* (Sacramento: California State Printing Office, 1881).

[36] Harding, *Water in California*, 79-83; JRP Historical Consulting Services and California Department of Transportation, *Water Conveyance Systems in California: Historic Context Development and Evaluation Procedures* (Sacramento: California Department of Transportation Environmental Program, Cultural Studies Office, December 2000), 8-15.

[37] Of these institutional models, the quasi-public irrigation district proved the most successful in development of large-scale irrigated tracts in California, but only a few of the irrigation districts organized under the original Wright Act of 1887 survived into the twentieth century. Changes in irrigation district law in 1911, gave these districts greater financial stability and irrigation districts had much greater success in the twentieth century.

[38] Edward Hyatt, "National Broadcast on California Agricultural Programs, Under the Auspices of the State Grange, NBC Studios, San Francisco, November 10, 1939," Edward Hyatt Papers 2, Water Resources Collection and Archives, University of California, Riverside.

On the west side of the Central Valley, a north-south canal was suggested leaving the Sacramento River near Red Bluff, following the foot of the Coast Range to Fairfield with several west-east laterals irrigating land as it passed through Yolo County. From Antioch, the canal was to run south along the west side of the San Joaquin Valley connecting to Tulare, Buena Vista, and Kern lakes, three natural bodies of water fed by creeks, sloughs and rivers in Tulare and Kern counties. Because of the many streams flowing out of the Sierra Nevada, the commission did not favor a continuous canal down the east side of the Central Valley as the cost of siphons or aqueducts to bridge these streams was prohibitive. The report also paid little attention to construction of storage reservoirs, but did advocate damming many westerly flowing Sierra streams to raise water over the river bank into east-west distribution ditches running across the valley floor.

Because of the state's limited population and tax base, the Alexander Commission predicted that progress toward full construction of the massive water project would undoubtedly proceed at a slow pace and that it might take as long as 50 years to achieve full implementation. In other respects, the report was also prescient. The commissioners predicted that water conflicts would occur and require settlement before construction of any comprehensive water system and that the state needed to institute legal mechanisms to regulate the acquisition and distribution of water; that farmers be limited to "reasonable use" to reduce water waste; that drainage canals accompany construction of irrigation canals; and that a topographic and hydrologic survey precede adoption of a system of reclamation for the Central Valley. Finally, the Commission was prophetic in recognizing the fundamental principal behind the future State Water Project proposed in the late 1920s and the CVP launched by the federal government in the 1930s -- the need to transfer water from the water rich Sacramento Valley to the water deficient San Joaquin Valley.[39]

At the state level, the California legislature passed an act in 1878 providing for investigation regarding irrigation and appointment of a State Engineer. William Hammond Hall, another former officer in the U.S. Army Engineering Corps with experience as a hydrographer, draftsman and field engineer, was appointed California's first State Engineer. Over the next decade, Hall proposed an increasingly activist stance by the state in navigation improvement projects, flood control, water storage, irrigation and drainage, compilation of statewide data on rainfall and streamflow, public ownership and control of navigable waterways, and proposed regional and statewide water planning for development of water resources. In 1880, Hall published a report on the subject of irrigation that described the principal irrigation districts of the state and made recommendations on legislation to promote irrigation development in California, including recommendations for an "irrigation district bill." Hall also prepared the first detailed map of the Central Valley (like the later one shown in Figure 1) depicting every stream correctly located, the topography of adjacent foothills, and the slope and fall of the plains where irrigation would occur. He also prepared a more detailed map of the San Joaquin Valley in ten sheets displaying every ditch and irrigation canal in the San Joaquin Valley and the extent of actual irrigation.[40]

Hall was reappointed four times as State Engineer serving until his resignation in 1889 when he was appointed Supervising Engineer of the United States Irrigation Investigation (predecessor of Reclamation), within the U.S. Geological Survey. The U.S. Geological Survey carried on the vital work of stream gauging and topographic mapping in the Central Valley. Following Hall's departure, Robert B. Marshall, an experienced California geographer, became the chief champion of a statewide water program during the late nineteenth and early twentieth centuries. Marshall outlined a plan for the coordinated development of the Central Valley with a series of dams, canals, and aqueducts to bring water to twelve million acres of land. Marshall was

[39] B. S. Alexander, C. H. Mendell, and George Davidson, *Report of the Board of Commissioners on the Irrigation of the San Joaquin, Tulare, and Sacramento Valleys of the State of California*, House Executive Document No. 290, 43rd Cong. 1st Sess. (serial no. 1615) (Washington, D.C.: Government Printing Office, 1874), 16-38; Pisani, *From the Family Farm to Agribusiness*, 102-128; W. Turrentine Jackson, Rand F. Herbert, and Stephen R. Wee, "Introduction," *Engineers and irrigation: Report of the Board of Commissioners on the Irrigation of the San Joaquin, Tulare, and Sacramento Valleys of the State of California, 1873: Engineer Historical Studies No. 5* (Fort Belvoir, Virginia: Office of History, U.S. Army Corps of Engineers, 1990), 1-36.

[40] William Hammond Hall, "Statement of William H. Hall of the U.S. Geological Survey, Supervising Engineer for the Pacific Coast, U.S. Irrigation Survey," Report of the Special Committee of the U.S. Senate on the Irrigation and Reclamation of Arid Lands: Report of Committee and Views of the Minority, 51st Cong., 1st Sess., Senate Report No. 928 (Washington, D.C.: Government Printing Office, 1890), 208-220.

determined to submit a plan that demonstrated its feasibility from an engineering perspective and spent twenty-five years perfecting his comprehensive state water development plan, gathering survey data and mapping proposed canals and reservoir locations.

Marshall arrived in California in 1891 and surveyed continuously in the state for the U.S. Geological Survey until 1903 when he was given administrative charge of topographic work in California. His duties spread to other arid western states working on proposed reclamation projects in Arizona, Oregon, Nevada, Washington, Idaho, and Utah. By 1908, at age 40, he had reached the pinnacle of his profession being appointed Chief Geographer in charge of the Topographic Branch of the U.S. Geological Survey with administrative charge of the entire United States. For years he directed the expenditures of the United States government in its geological surveys of California methodically putting together a plan of construction for his proposed system of canals and reservoir sites. Working co-operatively with the State of California, the U.S. Geological Survey, under Marshall's guidance, precisely mapped the Sacramento and San Joaquin valleys, co-operatively gauged streams, made profiles, and surveyed reservoir sites along the larger principal streams of the state, gathering all the field data necessary to begin the construction work. In the fall of 1919, he announced the main outlines of his one great comprehensive plan for statewide water development, including reclamation of the Central Valley of California:

From a high dam to be built across the Sacramento River near Red Bluff water will be carried in large canals down each side of the Sacramento Valley and thence up each side of the San Joaquin Valley. These main canals will operate by gravity, siphons, or pumps, or through tunnels. . . . On the main West Side Canal . . . a large supply will be diverted for the use of the "San Francisco and Bay Cities Unit.". . . The main East Side Canal will be twice dropped and twice again started at new and higher levels on the east side of the San Joaquin Valley. . . . Separate in construction and operation from the two Valley of California Systems as above referred to, but necessarily co-operative in a State-wide sense, is a third system . . . "the Los Angeles unit." This system must always be dependent upon the Kern River, which will be diverted through a long tunnel for use in southern California. To offset the diversion of the Kern River waters from the San Joaquin Valley the Klamath River will be diverted below Klamath Falls and carried into the upper Sacramento River near Shasta Springs. Above all these grand canals the tributary streams will be drawn upon through reservoirs, to be built along their courses, and further flexibility of the total flow will be provided by additional storage below the canals.[41]

California and planning for irrigation therein changed greatly during the first decades of the twentieth century. Growing migration into the state brought increased tax revenue and an expanded political bureaucracy. Having suffered the effects of a succession of drought years from 1917-1920, California state government exhibited an interest in comprehensive water planning. In 1921, the governor directed the State Engineer to come up with a statewide water management proposal addressing conservation, flood control, storage, distribution, and uses for California water and an estimated cost for implementation of the plan. The legislature appropriated funds to investigate a statewide water resources development and management plan. While the initial report was completed in 1923, it was the more than a dozen detailed engineering reports on various aspects of water management and control made by State Engineer Edward Hyatt between 1920 and 1932 that formed the basis of what became known as "The State Water Plan." During this period, shifts in water use included increasing numbers of water storage and power projects in the Sacramento Valley and the northern portion of the San Joaquin Valley, while further south complex water rights issues and lack of surplus water available for storage led irrigators to substitute groundwater storage for on-stream surface storage in reservoirs.[42]

The expansion of irrigated acreage in the early twentieth century was achieved by using surface water supplies and groundwater. By the mid-1920s water shortages had initiated several privately funded storage projects paid for by the irrigators

[41] Col. Robert Bradford Marshall, *Irrigation of Twelve Million Acres in the Valley of California* (Sacramento: California State Irrigation Association, 1919), 6-12.

[42] Paul Bailey, *Supplemental Report on Water Resources in California, Bulletin No. 9*, California Department of Public Works, Division of Engineering and Irrigation (Sacramento: California State Printing Office, 1925); Paul Bailey, *Summary Report on the Water Resources in California and a Coordinated Plan for their Development, Bulletin No. 12*, California Department of Public Works, Division of Engineering and Irrigation (Sacramento: California State Printing Office, 1927).

themselves on irrigation projects in the San Joaquin Valley, such as in the Modesto, Turlock and Merced irrigation districts. As a by-product of storage, these districts were able to generate hydroelectric power to pay for construction costs and expansion of their distribution systems. Storage and power development in the 1920s, however, did not extend to the southern portion of the valley. From the San Joaquin River south, the water rights situation was more complicated as streams had been developed early by multiple diverters complicating adjustment of water rights and financing of storage facilities. Furthermore, there was less unused surplus surface water and more of the Sierra Nevada's runoff reached the irrigated lands on the valley floor as groundwater. Realization that productivity of agriculture could be greatly increased by utilization of groundwater, the US Geological Survey and Reclamation issued a preliminary report in 1908 on the quality, occurrence, accessibility, character, and proper use of groundwater in the San Joaquin River basin.[43]

In the early twentieth century, underground water sources were used for an increasing amount of irrigation in California. From 1909 to 1919, land irrigated by these sources increased from 32,539 acres to 299,841 acres in the state. Many of the farms in what later became the Friant Division of the CVP were irrigated using a combination of groundwater and the limited supplies from local rivers and creeks. From 1919 to 1929 groundwater use in the southeastern San Joaquin Valley nearly tripled, increasingly relying on the capacity of pumped wells. With the exception of the Kern River and its alluvial fan, from the Kaweah River south and in the area from Mendota to Kettleman City, available local surface water supplies were negligible. Water for irrigation was primarily achieved through drilling thousands of large and deep irrigation wells. By 1930 overdraft on groundwater supplies and major land subsidence had become widespread along the eastside of the valley. A bit later subsidence became an issue on the westside of the San Joaquin Valley as much of its agricultural land came to rely on groundwater or conjunctive use of surface water and groundwater to meet irrigation needs.[44]

The nearly complete use of natural streamflow and overdraft of groundwater in areas not replenished from streamflow, focused local interests on more comprehensive plans for importing additional water supplies. Water shortages in the San Joaquin and Sacramento valleys had caused the State of California to initiate planning for major reservoir projects on the Kings, Tuolumne, San Joaquin, Kern, Merced, and Sacramento rivers between 1917 and 1924.[45] Legislative investigations of the State Water Plan that had begun in 1921 aimed to obtain a comprehensive inventory of water resources and an estimation of probable future water requirements in the Central Valley. As noted, this plan was first completed in 1923, and after further financial

[43] W. C. Mendenhall, *Preliminary Report on the Groundwater of the San Joaquin Valley, California: U.S. Geological Survey Water Supply Paper No. 222* (Washington, D.C.: Government Printing Office, 1908); W. C. Mendenhall, *Report on the Groundwater in the San Joaquin Valley, California: U.S. Geological Survey Water Supply Paper No. 398* (Washington, D.C.: Government Printing Office, 1916).

[44] Poland, J. F., and Evenson, R. E., "Hydrology and Land Subsidence, Great Central Valley, California," in Bailey, E. H., ed., *Geology of Northern California,* Vol. 2. (Sacramento: California Division of Mines and Geology, Bulletin 190, 1966), 239-247; Mitten, H. T., *Groundwater Pumpage in San Joaquin Valley, California* (U.S. Geological Survey, Open-file Report, 1967-68); N.P. Prokopovich and D.J. Hebert, "Land Subsidence Along the Delta-Mendota Canal, California," *Journal American Waterworks Association*, 60, n. 8 (Aug. 1968): 915-920. Water levels in wells within the future service area of the Friant Kern Canal declined from 1921 to 1951 but showed signs of substantial recovery over the next two decades as a reduction of pumping within the canal's service area through imported supplies delivered by the canal caused a reduction in groundwater pumping and increased recharge of the aquifer. A number of U.S.G.S. Professional Papers have been published on the land subsidence issue in the San Joaquin Valley. Two examples of investigations valley-wide in scope that address the early beneficial impacts of the Friant Kern Canal are: J. F. Poland, G. H. Davis, and B. E. Lofgren, "Progress Report on Land Subsidence Investigations in the San Joaquin Valley, California, through 1957," (U.S. Geological Survey, 1958) and J. F. Poland, B. E. Lofgren, R. L. Ireland, and R. G. Pugh, *Land Subsidence in the San Joaquin Valley, California, As of 1972. USGS Survey Professional Paper 137-11* (Washington, D.C., United States Printing Office, 1975). Other studies are narrower in scope focusing on specific regions within the valley such as B. E. Lofgren and R. L. Klausing, *Land Subsidence Due to Groundwater Withdrawal, Tulare-Wasco Area, California. USGS Survey Professional Paper 437-B* (Washington, D.C., United States Printing Office, 1969). This study notes that within the southeastern portion of the study area subsidence nearly stopped in the late 1950s, as water levels recovered some 130 feed in response to reduced pumping and groundwater recharge from imported water delivered by the Friant Kern Canal.

[45] William L. Kahrl, *The California Water Atlas* (Sacramento: California Office of Planning and Research, Department of Water Resources, 1979).

studies, the plans were revised in 1925, 1927 and 1929. These investigations led the state to consider plans for a coordinated water management and development program that resulted in the adoption of the CVP in the 1930s.[46]

The story of the development, planning, political background, and construction of the CVP is well known and often told. The CVP is widely recognized as one of the greatest pieces of water planning, engineering, and conservation development ever undertaken and represents one of the most ambitious and successful water development projects ever built. It significantly altered California's natural hydrologic system in order to enhance water supplies for irrigated agriculture, municipalities, and hydroelectric power. Within the contexts of hydraulic engineering, the politics of public works, state-federal conflict over reclamation policy, and the economics of large-scale irrigation, the CVP is recognized as a great achievement on the national and even the international scale, although every component of the CVP is located within the boundaries of California.

The concept of a CVP was originally devised by the State of California to resolve chronic intra-state water shortage problems, but ultimately it was built by the federal government. The "State Water Plan" that resulted from the studies undertaken by State Engineers Edward Hyatt and Paul Bailey between 1927 and 1930 called for a vast system of canals, massive dams, and reservoirs throughout the state, and a massive north to south water transfer plan including most of what became the CVP. The essential units of the Central Valley portion of the plan included Shasta dam and reservoir (originally called Kennett Dam) on the Sacramento River, one of the highest overflow dams in the world with a storage capacity of 4.5 million acre feet; a 50-mile long industrial and irrigation conduit in the Delta diverting water to supply areas in Contra Costa County; a cross canal in the Sacramento-San Joaquin Delta; pumping plants and canals in the San Joaquin River and valley; Friant Reservoir on the San Joaquin River in the foothills north of Fresno and canals running north from the reservoir to supply lands in Madera County and south to irrigate lands between the reservoir and Kern River. To implement the plan the state needed to purchase the so-called "grass land" water rights of riparian owners on the lower San Joaquin River between Friant and the mouth of Merced River. With these water rights of early priority and large quantity satisfied, practically the whole flow of the San Joaquin River at Friant would become available for diversion to other water deficient areas of the valley. Thus, the implementation of the initial Central Valley unit of the State Water Plan entailed these fundamental requirements: regulation of stream flow by means of storage, exportation of water between watersheds, and exchanges of existing water supplies for imported water. Subsequent units of the ultimate State Water Plan would be adopted over time as demand for additional water warranted.[47]

In 1933, California voters approved the "Central Valley Project" portion of the State Water Plan, but the state needed the federal government to bring this project to life. With the depressed financial circumstances of the period, the state was unable to borrow money at a low enough interest rate to market the bonds necessary to fund the plan. California officials responded by lobbying the federal government to undertake the project as a federal reclamation project. Up until this point, federal reclamation had little impact on California agriculture or state water policies. Now after nearly three decades, Reclamation finally got the chance to build the largest integrated water and power project ever undertaken in California. This occurred just as the doctrine of multiple use emerged, wherein federal agencies were mandated to serve various interests simultaneously,

[46] California Department of Public Works, Division of Engineering and Irrigation, *Water Resources of California: A Report to the Legislature of 1923, Bulletin No. 4* (Sacramento: California State Printing Office, 1923); Bailey, *Supplemental Report on Water Resources of California: A Report to the Legislature of 1925, Bulletin No. 9*; Paul Bailey, State Engineer, *Summary Report on the Water Resources of California and a Coordinated Plan for their Development: A Report to the Legislature of 1927, Bulletin No. 12*, California Department of Public Works, Division of Engineering and Irrigation (Sacramento: California State Printing Office, 1927); Edward Hyatt, State Engineer, *Report to the Legislature of 1931 on State Water Plan, Bulletin No. 25,* California Department of Public Works (Sacramento: California State Printing Office, 1930).

[47] Pisani, *From Family Farm to Agribusiness*, 381-439; Norris Hundley, Jr., *The Great Thirst: Californians and Water, 1770s-1990s* (Berkeley: University of California Press, 1992), 232-248; Hyatt, *Report to the Legislature of 1931 on State Water Plan, Bulletin No. 25,* 177-180; Edward Hyatt, State Engineer, *Sacramento River Basin, 1931, Bulletin No. 26*, California Department of Public Works, Division of Water Resources, Sacramento (Sacramento: California State Printing Office, 1931); Edward Hyatt, State Engineer, *San Joaquin Basin, 1931*, *Bulletin No. 29*, California Department of Public Works, Division of Water Resources (Sacramento: California State Printing Office, 1931).

which freed Reclamation to build and operate the project for a wide variety of water interests both urban and rural. By 1935, the state and federal governments reached an agreement and Reclamation was charged with construction of the CVP.[48]

President Franklin D. Roosevelt, amenable to almost any job creation proposal that would diminish the severity of the Great Depression, was responsive to California's appeal for assistance in funding the proposed CVP. In 1935 President Roosevelt approved the Secretary of the Interior's feasibility report and released federal emergency relief funds in order to initiate survey and investigations of proposed project works.[49] What had begun as a state project now became a federal undertaking under the auspices of the Secretary of the Interior and Reclamation. During 1936 Reclamation established its administrative headquarters at Sacramento and three field division offices at Redding (Kennett Division) covering works on the upper Sacramento River; at Antioch (Contra Costa / Delta Division) covering surveys for the Contra Costa Canal; and Friant (Friant Division), located 20 miles northeast of Fresno, covering the Friant dam/reservoir site and surveys for the Madera and Friant-Kern canals. A year later, Congress gave Reclamation final authority to take over control of the construction of the massive public works project. Construction of the federal project proceeded on a piecemeal basis.[50]

Reclamation designed the CVP with five fundamental units, operating as an integrated system: Shasta Dam, Delta-Mendota Canal, Friant Dam, the Madera and Friant-Kern Canals, and the Contra Costa Canal. The smallest of the canals, the Contra Costa Canal in eastern Contra Costa County, provided irrigation and industrial water for the area south of Suisun Bay between Antioch and Martinez. In 1937, the canal was the first facility to be undertaken and the 48-mile canal was completed by Reclamation in 1939. The core of the system, however, involved the coordinated operation of the other four units for the purposes of delivering Sacramento River water to the arid San Joaquin Valley and to impound the flow of the upper San Joaquin River for distribution on the east side of the San Joaquin Valley.[51]

Reclamation designed the project's main four units to operate in two groups of works. Shasta Dam and Delta-Mendota Canal operated together to store and deliver Sacramento River water on the westside of the San Joaquin Valley as far south as Fresno County, to irrigate new areas and to supply water for San Joaquin River diverters with riparian and senior appropriative water rights. Friant Dam, located on the San Joaquin River 25 miles northeast of Fresno, conserved and stored flood flows in Millerton Lake for release and diversion into the Madera and Friant-Kern canals. These three water-storage and conveyance features operated together to store and divert San Joaquin River water as far as the southern extremes of the San Joaquin Valley near Bakersfield (through the Friant-Kern Canal) and north to Ash Slough near Chowchilla (through the Madera Canal). As noted, these units worked in conjunction with one another, the Shasta Dam/Delta-Mendota Canal system providing "replacement water" to west side "Exchange Contractors" (senior holders of water rights from the San Joaquin and Kings River Canal and Irrigation Company and Miller & Lux's corporate descendants) for that which was transported southward

[48] Erwin Cooper, *Aqueduct Empire: A Guide to Water in California, Its Turbulent History, and Its Management Today* (Glendale, California: A. H. Clark Co., 1968); Hundley, *The Great Thirst, 243-252*.

[49] The proposed construction project by the federal government stirred up controversies over the Reclamation's 160-acre limitation imposed under the 1902 Federal Reclamation Act, ownership of water rights, public vs. private hydroelectric power generation, as well as state vs. federal ownership and operation of the project. Given the early history of the Central Valley as an area dominated by large cattle ranches and bonanza wheat farms, the 160-acre limitation was deemed as particularly egregious where, as one landowner's attorney noted, "10 per cent of the ranches contain 80 per cent of the land," "Big Water 'Transfusion' Operation Taking Shape: World's Longest Canal to Carry Much Needed Moisture Through Central Valley," *Los Angeles Times," March 16, 1947;* and Bassett, "Water Limit Fight Stirs San Joaquin: Controversy Over How Much Land One Owner May Irrigate Features Valley Project Work," *Los Angeles Times*, March 17, 1947.

[50] Pisani, *From Family Farm to Agribusiness*, 416-438; Hundley, *The Great Thirst*, 252-262; "Active Construction Nears on Central Valley Project," *Western Construction News*, January 1937, 22.

[51] U.S. Department of the Interior (USDI), Reclamation, Central Valley Projects: Issues and Legislation, October 15-2018 – June 21, 2019, https://www.everycrsreport.com/reports/R45342.html#_Toc12259578.

and northward on the east side of the San Joaquin Valley by the Friant Dam/Friant-Kern Canal/Madera Canal system. Reclamation completed these five major units of the CVP by the early 1950s.[52]

Groundwater issues quickly became part of the Delta Division's management. As noted, much of the agricultural land in western San Joaquin Valley had relied upon groundwater or conjunctive use of surface water and groundwater to meet their irrigation needs before the CVP was built. According to one U.S. Geological Survey study in the mid-1950s, about 4,500,000 acres of land in the San Joaquin Valley was irrigated, with 50% of that land supplied solely with groundwater from wells and land subsidence had been noted.[53] Thus, almost immediately after water was turned in the newly completed Delta-Mendota Canal, land subsidence began to impact the structure, especially the downstream 40 miles, causing the need for repairs and extensive modifications to raise the height of canal structures.[54]

Reclamation designed Delta-Mendota Canal to carry out one of the key features of the CVP, exchanging water from the Sacramento River basin to the San Joaquin River basin. Delta-Mendota Canal was built to convey water from the Sacramento-San Joaquin Delta in a southerly direction along the west side of the San Joaquin Valley, replacing flows in the San Joaquin River to permit diversion of San Joaquin River water at Friant Dam for delivery in Madera Canal and Friant-Kern Canal. It was designed to serve a total of approximately one million acres of irrigable land on the west side of the San Joaquin Valley in San Joaquin, San Benito, Stanislaus, Merced, and Fresno counties. Reclamation designed DMC to deliver water to Mendota Pool and the planned San Luis Reservoir, as well as to water users along its route. At the upstream end, the canal was designed with a maximum capacity of 4,600 cubic feet per second, diminishing as it traverses the valley to its southern terminus. Original plans called for a series of lifts to advance the water south up the valley; however, Reclamation modified the design to a single pumping plant that lifted the water approximately 200 feet before discharging it into DMC. The north portion of the canal is lined with concrete and the sound is compacted earth. DMC was built with repetitive structure types like concrete checks, concrete siphons, culverts and overchutes, drainage inlets, irrigation turnouts, canal crossings, wasteway turnouts, highway and farm bridges, and much smaller number of discrete, specialized structures. For most of the major structures like wasteways and siphons, Reclamation engineers prepared site-specific designs and drawings. For structures installed repetitively along the canal like culverts, inlet drains, and farm bridges, Reclamation prepared standardized drawings for multiple applications. Through the DMC, availability of a more reliable water supply to parts of the San Joaquin Valley contributed significantly to the success of agriculture and industry in the region.[55]

When completed, Delta-Mendota Canal was instrumental in accomplishing the goals of the CVP and it was second largest capacity canal in the state after the All-American Canal, which was an 80-mile-long aqueduct built in the 1930s conveying Colorado River water to Imperial Valley and several Southern California cities. Engineering and constructing Delta-Mendota Canal was a monumental task because of the natural and built features it had to traverse over a long distance: the alignment crossed multiple waterways, major roadways, and transmission lines; existing irrigation structures had to be tied in or crossed; and road and farm bridges, and major canal water control features like check structures and wasteways had to be built. In addition to the engineering challenges, Reclamation also had to negotiate the sale of project water delivered by Delta-Mendota Canal with various water users and address a complex right-of-way acquisition. Water first entered the canal for delivery to downstream users in 1951 but was not officially complete until April 9, 1952.[56]

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[52] L. B. Christiansen and R. W. Gaines, *Central Valley Project: Its Historical Background and Economic Impacts* (Sacramento, California: USDI, Reclamation, Mid-Pacific Region, 1981).

[53] G.H. Davis, J. H. Green, F.H. Olmstead, and D. W. Brown, *Groundwater Conditions and Storage Capacity in the San Joaquin Valley California.* Geological Survey Water Supply Paper 1469 (Washington, Government Water Supply Paper No. 1469, 1959), III, 4, 8-10, 114-124, 129-131.

[54] N.P. Prokopovich and D.J. Hebert, "Land Subsidence Along the Delta-Mendota Canal, California," *Journal American Waterworks Association,* 60, n. 8 (Aug. 1968): 915-920.

[55] USDI, Bureau of Reclamation, *Delta-Mendota Canal,* Technical Record of Design and Construction (Denver: 1959), 1 and 13.

[56] "First Contract on Friant-Kern Canal," *Western Construction News* (Sept 1945): 112-113; US Department of the Interior, Bureau of Reclamation, *Delta-Mendota Canal,* Technical Record of Design and Construction (Denver: 1959), 5.

One of the most renowned engineers employed by the Bureau of Reclamation, Oscar Boden spent sixteen years out of his forty-year-long tenure with the Bureau working in the Central Valley. Boden undertook the role of construction engineer for the Delta Division of the Central Valley Project (CVP) from 1935 until his death in June 1951. Born in 1885 in Kellogg, Iowa, Boden studied civil engineering at Iowa State University, graduating in 1910. Boden started at the Bureau of Reclamation in 1911 performing operation and maintenance work for the first five years of his career. From there, he moved on to survey work, lateral design, and lay-out of several irrigation projects in Wyoming and Nebraska. He also worked on projects in Idaho, Oregon, and Washington where he served as head of construction of various irrigation distribution systems. Dubbed "Mr. Canal" for his work supervising the construction of 76 miles of main canal and 200 miles of laterals for the Kittitas Project near Yakima, Washington in 1926, Boden's prowess as a team leader eventually led him to the Central Valley. At the request of the supervising engineer for the CVP, Boden relocated to California in 1935, serving as the project's first government construction engineer. Boden engineered surveys for the Friant-Kern and Contra Costa canals and led the construction of the Contra Costa Conduit. Boden's acclaim increased during his role as engineering administrator who oversaw the construction of Delta-Mendota Canal structures and the Tracy pumping plant. Additionally, Boden took charge of the investigations, planning, and lay-out necessary for Delta-Mendota Canal's features. Posthumously, Boden received nomination into the Reclamation's Hall of Fame. In total, Boden is credited with the construction of 1500 miles of canal.[57]

Delta-Mendota Canal's concrete lining extends down to Milepost 98.64. This portion of the canal has a 48-foot bottom width. The approximately 18 miles of canal between that point and the outfall at Mendota Pool are compacted earth-lined with bottom widths of 60, 62, and 84 feet at different reaches. After Tracy Pumping Plant lifts the water 200 feet, the water is moved down the canal at a gentle grade of 3 inches per mile, controlled by concrete check structures (**Figure 1**).[58] Specifications called for the concrete to be 4 inches thick and placed on the canal's 1 ½:1 side slopes. Check structures, placed an approximately 5-mile intervals along the canal, are composed of two standardized types. Three of the check structures are rectangular and the rest are trapezoidal in cross section.[59]

57 D. L. Goodman, "Oscar G. Boden – Builder of Lifelines," *Reclamation Er*a vol. 38 (February 1952), 30-31, 38; "'Mr. Canal' Builds Miles of Them in His Life Project," *Stockton Record* (California), May 15, 1951; "Pittsburg Ends 3 Dates of Fete," *Stockton Record* (California), October 15, 1940; "Boden Ranked High Among Canal Builders," *Tracy Press* (California), April 9, 1951.
58 Martin H. Blote, "Water Runs Uphill," *Reclamation Era* (October 1947): 213.
59 US Department of the Interior, Bureau of Reclamation, *Delta-Mendota Canal*, Technical Record of Design and Construction (Denver: 1959), 1.

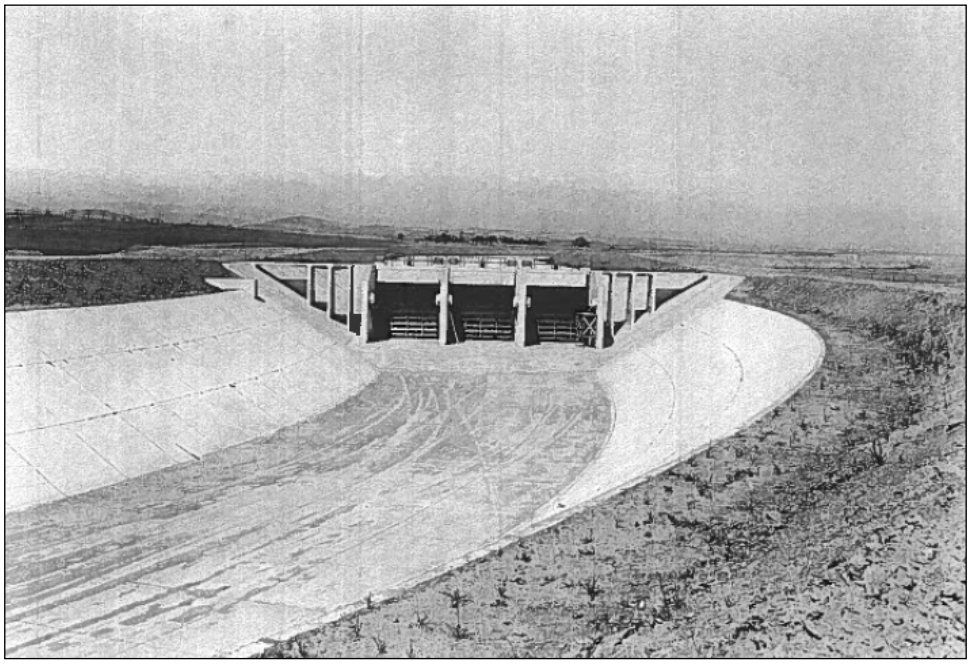


Figure 1: Complete check No. 1 (M.P. 11.35), camera facing upstream, April 18, 1949.[60]

Along its course, Delta-Mendota Canal is siphoned across streams, railroads, and irrigation canals. Siphons convey the water across seven streams, three railroad crossings, two highway crossings, one combined highway and railroad crossing, and one irrigation canal. The single siphon under an existing irrigation canal (Miller & Lux Outside Canal) was unique because all other existing irrigation ditches were siphoned under Delta-Mendota Canal. The Mountain House Road Siphon carried Delta-Mendota Canal 1,200 feet through a monolithic concrete structure with an inside diameter of 24 feet 3 inches (**Figure 2**). Morrison-Knudsen and Hasler constructed the siphon under specifications No. 1435.

Wasteways to carry flood water out of Delta-Mendota Canal and to the San Joaquin River channel are among the largest appurtenant structures to the canal and were designed and constructed as part of the canal. Reclamation designed the canal's four wasteways to handle the full capacity of Delta-Mendota Canal at the turnouts into the wasteways in the event of flooding or canal failure. Studies of the topography and disposal of canal water informed the site selection of the wasteways. The wasteway turnouts were designed with radial gates to allow the flow of water into the channels. Westley Wasteway is a 3.9-mile long, mostly concrete-lined trapezoidal channel. Newman Wasteway is approximately 8.2 miles long, about 1.5 miles of which are concrete lined. Volta Wasteway (originally known as San Luis Wasteway) is 11.9 miles long and Firebaugh Wasteway is the shortest at 1.1 miles long.[61]

[60] Morrison-Knudsen Company, Inc. and the M. H. Hasler Construction Company, *Final Report Contract No. I2r-16675 – Specifications No. 1435, Delta-Mendota Canal – Central Valley Project*, 1949, 22.
[61] USDI, Reclamation, *Friant-Kern Canal: Technical Record of Design and Construction*, 12; "Friant-Kern Canal – Myriad of Huge Structures Involved," *Western Construction News* (May 1948): 93.



Figure 2: Construction of Mountain House Road Siphon showing concrete placement in progress, October 24, 1948.

Delta-Mendota Canal and all of its appurtenant structures were constructed by five contractors under 10 major construction specifications, starting in 1946 and completed in 1951. Hubert Everist, Sr. won the first contract and began work in June 1946. Each of the major contractors engaged many subcontractors to supplement their own work forces.

On April 30, 1946, bids opened for Specifications No. 1183, which comprised of two schedules including earthwork, concrete lining and structures (schedule one) and the construction of the Westley wasteway (schedule two). Everist placed the lowest bid, winning the contract for both schedules on June 14, 1946. His firm also served as the contractor for Specification 2460, the earthwork, concrete lining and structures from M.P. 25.88 to M.P. 40.72, and the timber operating bridge at M.P. 23.28. Educated as an engineer at Purdue Univeristy, Everist came from a family of leaders in the construction industry. Born in Beardstown, Illinois but raised in Sioux City, Iowa, Everist played an instrumental role in the growth of his family's company, L.G. Everist, Inc., as well as the establishment of two other businesses: Western Contracting Corp. based in Sioux City and Intercontinental Engineering and Manufacturing Corp. of Parkville, MO. Branches of all three businesses existed in the West. At the time of the bidding for Delta-Mendota Canal, Everist lived in San Francisco.[62]

On December 30, 1946, Morrison-Knudsen Company, Inc., partnering with the Los Angeles-based M.H. Hasler Construction Company, won the first of its four contracts for "earthwork, canal lining, and structures" along Delta-Mendota Canal. This first contract included a segment measuring approximately 11.15 miles, completed on April 18, 1949. Between October 1949 and April 1951, Morrison-Knudsen Co. and M.H. Hasler engaged in three other contracts pertaining to Delta-Mendota Canal. All the work involved earthwork, concrete lining and structures (**Figure 3**). The Morrison-Knudsen Company, headquartered

[62] US Department of the Interior, Bureau of Reclamation, *Delta-Mendota Canal*, Technical Record of Design and Construction (Denver: 1959), 103; "Hubert H. Everist Sr Obituary," *Sioux City Journal*, July 20, 1990; L.G. Everist, Inc., "Company Overview," https://www.lgeverist.com/companies.php.

in Boise, Idaho, specialized in construction of large civil and military projects. Founded in 1912 by Harry W. Morrison and Morris H. Knudsen, the firm had become the preeminent dam-building company after its successful contribution to the construction of Hoover Dam, contracted in 1931. In the ensuing decades, Morrison-Knudsen emerged as one of America's largest civil engineering contractors. The company's portfolio of work went on to include some of the world's biggest dams and bridges. During World War II, the company was in prime position to take on large contracts for construction of military bases and airfields. After the war, the company embraced opportunities created by the expansion of the American military presence overseas, as well as the push to rebuild and expand American infrastructure at home. By the end of the 1950s, the company had diversified and expanded to various worldwide locations. Morrison-Knudsen's work along Delta-Mendota Canal is illustrative of the company's participation in domestic infrastructure expansion in the post-war period.[63]

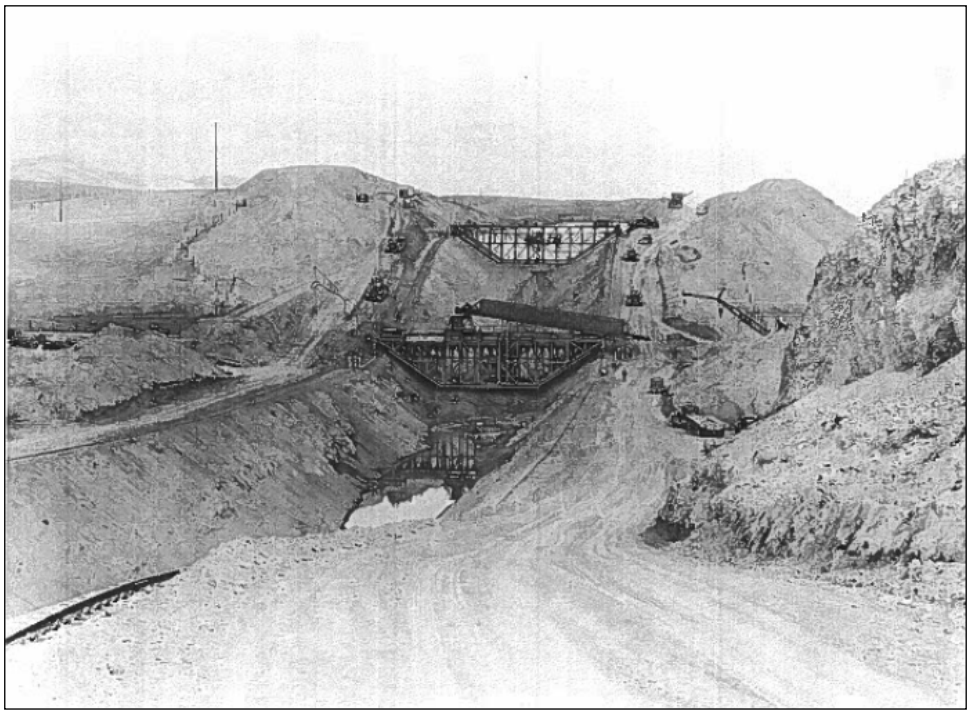


Figure 3: Morrison-Knudsen Company, Inc. and the M. H. Hasler Construction Company operating canal trimmer and slip form at Mountain House Road Siphon excavation, June 10, 1948.[64]

In addition to constructing four segments of Delta-Mendota Canal under Specifications 1435, 2197, 2732, and 2799, the Morrison-Knudsen Company, Inc. and the M.H. Hasler Construction Company also collaborated on multiple segments of the Central Valley Project's Friant-Kern Canal. In the late 1930s, M.H. Hasler also assisted Morrison-Knudsen in the construction of the All-American Canal and its branch Coachella Canal. Morrison-Knudsen and Hasler built over 75 miles of the 122-mile-

[63] Donald E. Wolf, *Big Dams and Other Dreams: The Six Companies Story* (Norman: University of Oklahoma Press, 1996), 204, 254-265; "Earth Mover," *Time* (May 3, 1954): 86, 90-93; "Morrison Knudsen Corporation," Jay P. Pedersen, ed., *International Directory of Company Histories*, vol. 28 (Detroit, Michigan: St. James Press, 1999); "Morrison-Knudsen Company, Inc.," Harvard Business School Baker Library Historical Collections, Lehman Brothers Collection, Twentieth-Century Business Archives; "Top Twelve Hit Over $100 Million," *Engineering News-Record*, July 2, 1964, 53; "Construction's Man of the Year," *Engineering News-Record*, February 17, 1966, 99-106; David P. Billington and Donald C. Jackson, *Big Dams of the New Deal Era: A Confluence of Engineering and Politics* (Norman: University of Oklahoma Press. 2006).

[64] Morrison-Knudsen Company, Inc. and the M. H. Hasler Construction Company, *Final Report Contract No. I2r-16675 – Specifications No. 1435, Delta-Mendota Canal – Central Valley Project*, 1949, 12.

long Coachella Canal between 1939 and 1941, including construction of 14 siphons, 31 double siphon boxes, one round barrel siphon, five checks, four automatic spillways, and five drainage inlets. During World War II, Hasler worked with the U.S. Army Corps of Engineers in building air bases at Blythe, Reno, and Kingman. The company's collaborative work on four segments of Delta-Mendota Canal between 1946 and 1951 appears to be illustrative of the general work performed by the M. H. Hasler Construction Company during this period.[65]

Another of Hubert Everist Sr.'s companies, Western Contracting Corporation, won the contract for earthwork, concrete lining, and structures for a 15.61-mile-long segment of Delta-Mendota Canal on June 22, 1949. The company completed the work on June 1, 1951. Additionally, on June 29, 1950, Western Contracting Corporation bid on and received Contract No. I2r-19060, for construction of the San Luis Wasteway and holding reservoir dike, split into two schedules (**Figure 4**). Western Contracting Corporation completed the work on April 9, 1952, and June 14, 1951, respectively. Everist established Western Contracting in 1917, headquartered in Sioux City, Iowa. For the work on Delta Mendota, the corporation operated out of an office in Westley, California. Today, the company predominantly constructs Army Corps of Engineer flood control, and wetland and river mitigation projects in the Midwest.[66]

In 1946, Reclamation Commissioner Straus authorized a contract of $5,888,000 for the two and a half mile long Delta-Mendota Intake Canal, which included the Tracy Pumping Plant (later renamed C.W. Bill Jones Pumping Plant) (**Figure 5** - **Figure 6**). Located nine miles northwest of Tracy, California, the pumping plant was to "lift water from the Delta-Mendota Intake Canal to a height of 200 feet and send it flowing for a distance of 120 miles" through the DMC to the west side of the San Joaquin Valley utilizing six 22,500 horsepower motors (**Figure 7**). With these motors, the plant had the capacity to lift 4,600 cubic feet of water per second. Construction of the pumping plant began September 2, 1947, through a joint venture between Stolte Inc., United Concrete Pipe Corporation, Duncanson-Harrelson Company, and Ralph A. Bell. The companies, all of which consolidated and operated under S.U.H.B. Company, completed the work on December 30, 1949. Construction engineers included Bureau of Reclamation's Oscar Boden and C.H. Spencer, both of whom spent a considerable portion of their careers working on the Central Valley Project. However, the location of the Tracy Pumping Plant created a unique problem for Reclamation; it aligned with the route that young salmon and bass are swept along by the early spring runoff in their migration towards the ocean. To prevent a detrimental loss in fish population, the Bureau of Reclamation and the U.S. Fish and Wildlife Service experimented to find the most promising solution. This experimentation resulted in a diversion using a series of vertical louver structures, which transferred the young fish to holding tanks and then onto tank trucks to be hauled "about 50 miles to waters destined for the ocean" (**Figure 8**). By 1959, the Tracy Pumping Plant operators collected and transported upwards of 250,000 fish a day, and a record 12 million for the entire year.[67]

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[65] Eric A. Stone (edited by Brit Storey), *All-American Canal: Boulder Canyon Project,* (Denver: United States Bureau of Reclamation, December 2009), 6-28; USDI, Reclamation, *Technical Record of Design and Construction, Delta-Mendota Canal: Constructed 1946-1952, Central Valley Project – California* (Denver, June 1959), 103; "M. H. Haslers of Laguna Buy Walter Botthof Home," *Desert Sun (Palm Springs)*, May 19, 1950, 5.

[66] US Department of the Interior, *Delta-Mendota Canal:* Technical Report, 104; Associated General Contractors of Iowa, "Western Contracting Corporation," http://www.agcia.org/memberDetails.asp?memberID=19795.

[67] USDI, Bureau of Reclamation, "Final Construction Report on Delta-Mendota Canal Intake and Tracy Pumping Plant and Discharge Lines," *Specifications No. 1810* – Central Valley Project (Denver: March 1952); USDI, Reclamation, "Commissioner Authorized to Award Top Value Contracts," *Reclamation Era* vol. 33, January 1947; USDI, Reclamation, "Fish and the Tracy Pumping Plant," *Reclamation Era* vol. 36, January 1950; USDI, Reclamation, "Well Worth Celebrating," *Reclamation Era* vol. 37, January 1951; USDI, Reclamation, "Reclamation Pioneers in Fish Conservation Techniques," *Reclamation Era* vol. 42, January 1956; USDI, Reclamation, "C.H. Spencer Succeeded by B.P. Bellport," *Reclamation Era* vol. 43, January 1957; USDI, Reclamation, "A Story about the USBR and Millions of Fish," *Reclamation Era* vol. 46, January 1960; "Construction Begins on Huge Central Valley Pump Plant," *Western Construction* vol. 22, no. 11, November 1947.

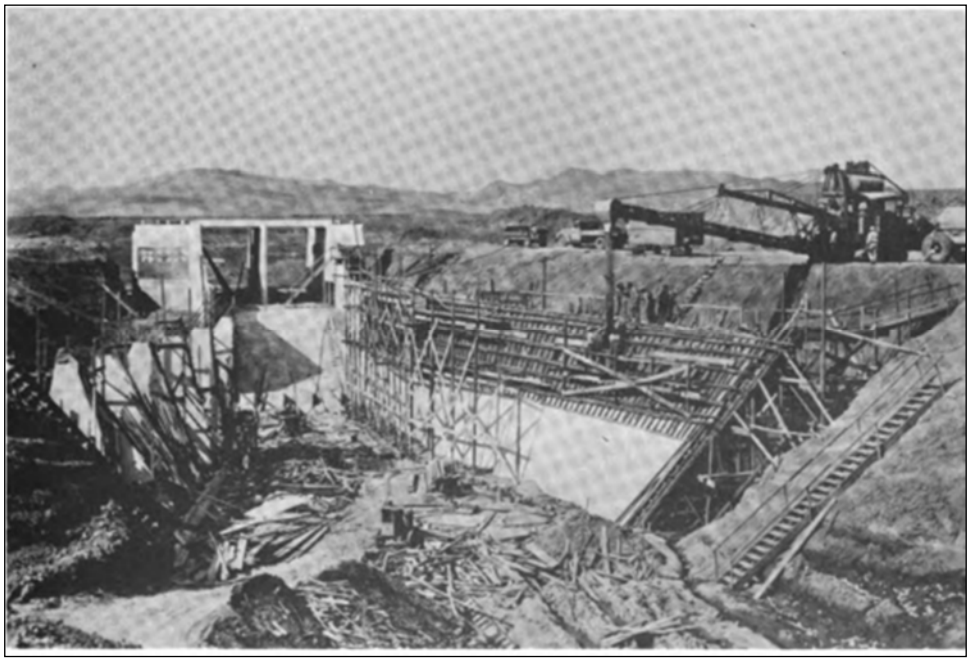


Figure 4: Placing concrete in transition walls of San Luis wasteway turnout, July 26, 1950.[68]

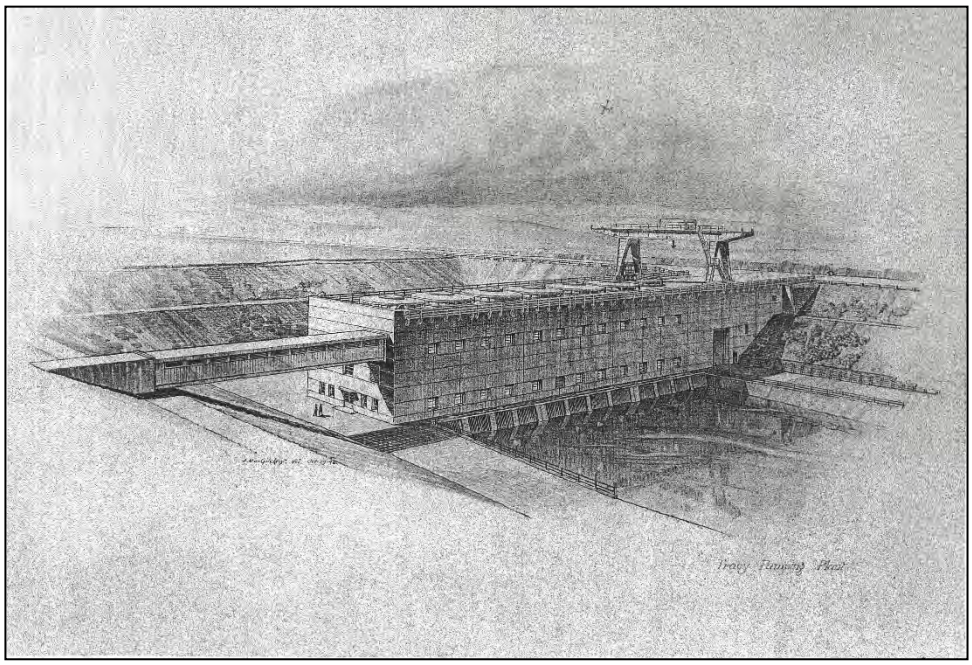


Figure 5: Artist rendering of Tracy Pumping Plant, 1948.

[68] [Photograph], DM-889-CV in USDI, Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 123; At left are counterforts which were placed independently of the warped walls.



Figure 6: Tracy Pumping Plant, January 1951.[69]



Figure 7: One of six 84-in. vertical shaft bottom suction twin volute centrifugal pumps.[70]

[69] [Photograph] USDI, Reclamation, "Well Worth Celebrating," *Reclamation Era* vol. 37, January 1951.
[70] [Photograph] "A Pictorial Review of Tracy Pumping Plant Construction," *Western Construction News* vol. 26, no. 5, May 1951.

On January 18, 1950, United Concrete Pipe Corporation and Vinnell Co. entered a joint contract to construct the earthwork and structures along Delta-Mendota Canal from M.P. 85.89 to M.P. 109.89, which spanned approximately 17.95 miles, and the Firebaugh wasteway, located at M.P. 98.50 (**Figure 9**). The government accepted the completed work on November 30, 1951. The two companies also worked together on the earthwork, concrete lining and structures, and service lateral, and part of the Newman Wasteway. They won this second contract on May 16, 1950 and finished the work on April 4, 1852. United Concrete Pipe Corporation can trace its origins to 1919 in Ventura, California. Serbia native Tom Polich started the company, first naming it Polich Construction Company until 1924, when he partnered with Steve Krai and B.J. Ukropina. Polich came to the United States in 1905 at the age of 17, and first entered the concrete business under the employ of Bent Brothers. Polich's first self-employed contract involved the installation of an irrigation system for the California Packing Corporation at their orchard at Tuttle. United Concrete Pipe Corporation went on to complete projects in Merced County such as the John Muir school building, concrete bridges and highways, sanitary sewers, and irrigation for the Merced Irrigation District. For this project, the Vinnell Company operated from a plant in Baldwin Park. Originally founded in 1931 by Allan S. Vinnell in Alhambra, the company began as a hauling and excavating contractor. The Vinnell Co. also constructed roads, buildings, portions of the Pan-American Highway and the Grand Coulee Dam. By the 1960s, the United States government employed Vinnell as contractors in Vietnam.[71]

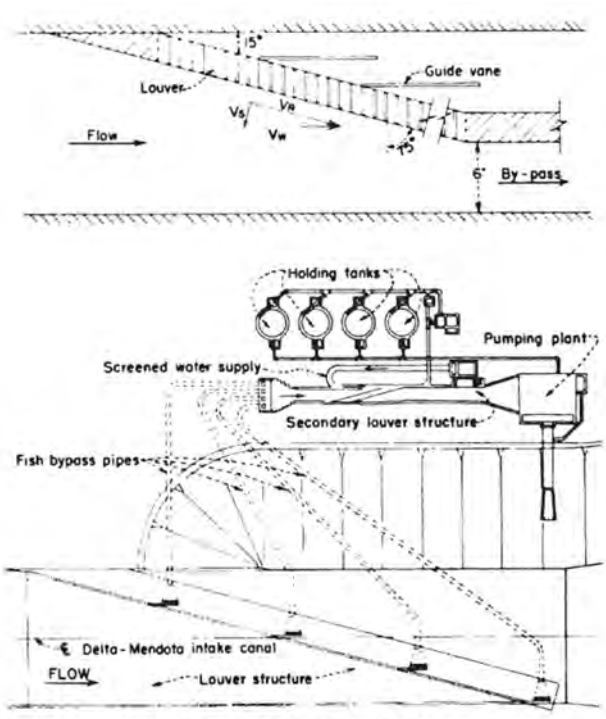


Figure 8: Fish Collecting Facilities at Tracy Pumping Plant, January 1956.[72]

[71] *Delta-Mendota Canal:* Technical Report, 105; John Outcalt, "Merced-Ventura-Los Angeles County CA Archives Biographies: Polich, Tom (Merced: 1925); "Dirt Lined Section of Delta-Mendota Canal Progresses," *Fresno Bee*, November 27, 1950.

[72] [Photograph] USDI, Reclamation, "Reclamation Pioneers in Fish Conservation Techniques," *Reclamation Era* vol. 42, January 1956; drawing at the top shows plan arrangement of louvers or slats; drawing at the bottom shows layout of permanent structure.

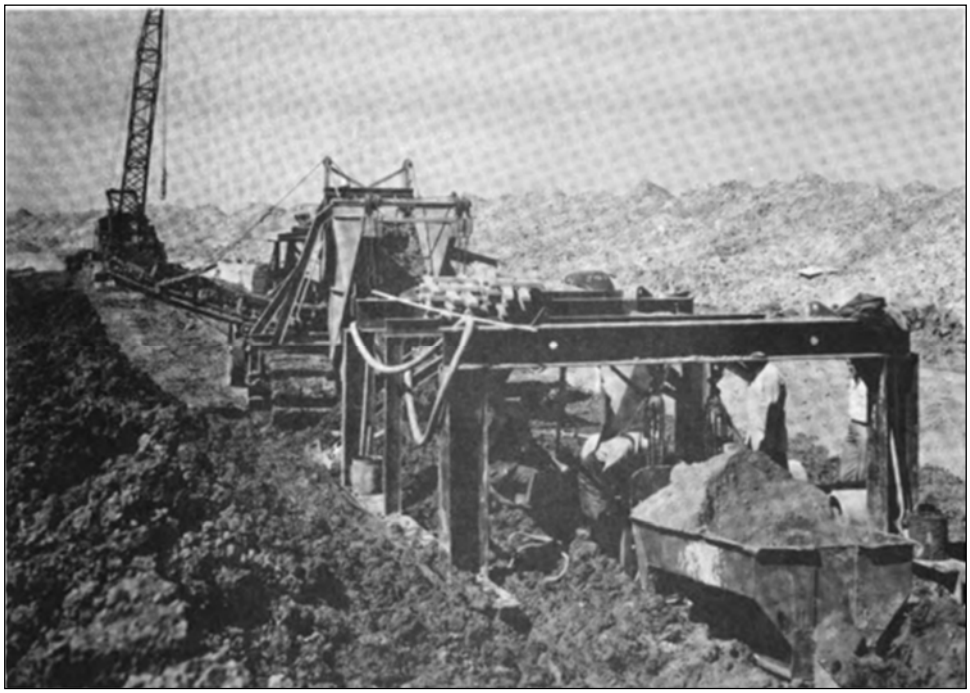


Figure 9: Converted ditcher and pipe laying machine used by United-Vinnell Co., March 1951.[73]

Construction of another small part of Newman wasteway and its service lateral went to A. Teichert and Sons, Inc., of Sacramento, California. The government awarded the contract on May 16, 1950, and Teichert completed the work on June 29, 1951. Both Teichert and United Concrete Pipe Corporation and Vinnell Company's portions of the Newman Wasteway fell under Specification 2951, albeit separate schedules. Teichert lined the wasteway by hand methods given the small size of the job (**Figure 10**). The company's founder, Adolph Teichert, immigrated to the United States in 1866 from Germany, finding success as a craftsman in San Francisco. He started his own business, Artificial Stone: Adolph Teichert, in 1887 in Sacramento. In 1912, Adolph Teichert Jr. joined his father as a partner in the concrete paving business under the name, A. Teichert and Son. The company played an integral role in the development of the road and highway system in Northern California, employed by the likes of the State of California Highway Department (later Caltrans) and the cities of Sacramento, Davis, Woodland, Placerville, and Fresno. In addition to paving roads, Teichert expanded its repertoire to include the production of rock product and ready-mixed concrete and the construction of dams, beginning with the North Fork Dam on the American River in 1938. A. Teichert and Son also partook in joint ventures with companies like United Concrete Pipe and Ralph A. Bell. In 1939, the companies worked together to construct tunnels and relocate telephone and railroad lines around the Shasta Dam. During World War II, A. Teichert and Son supported the war effort through the construction of airports; ammunition storage facilities; runways; and water, light, and fuel systems. By the early 1950s, the company's growth spurred the establishment of district offices in the Woodland/Davis area and in Stockton.[74]

[73] [Photograph,] DM-1471-CV in USDI, Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal,* 115; Machine used for laying drains in the lower reaches of canal. The machine digs a trench and men working inside shield lay the drain pipe which is covered by gravel from the hopper.

[74] *Delta-Mendota Canal:* Technical Report, 105; "Our History," *Teichert Way,* file:///J:/22-015%20Delta-Mendota%20Canal%20Subsidence/Research/Contractors/A.%20Teichert%20&%20Sons/Our%20History%20-%20Teichert.html.



Figure 10: Placing alternate panels of reinforced concrete in Newman wasteway, April 1951.[75]

On November 8, 1951, Johnson Western Constructors won the bid for construction of structures for distribution to water agencies along the canal rouate. The firm built the Columbia Pumping Plant No. 1, Mowry Pumping Plant, and their respective delivery systems. The work was broken into two schedules under Specification DC-3989. Headquartered in San Pedro, Johnson Western had additional offices in San Diego and Oakland. The company specialized in heavy engineering construction, waterfront construction, and gunite construction. Born in 1885, William Arthur began his career at age 21 at a small pipe company, working on construction projects there until he became president of the National Bank of Riverside. Johnson stayed at the National Bank from 1918 to 1923, at which time he established the Hall Johnson Company. Throughout his career, Johnson started numerous firms, including American Pipe, Johnson, Inc., and Johnson Western Constructors. His companies helped construct the Shasta Dam from 1938 to 1944. At the time of the construction of Delta-Mendota Canal, Larry Sullivan of San Pedro served as president of Johnson Western.[76]

The government awarded Plainview Water District and Stolte Inc. Contract No. 14-06-D-542 which "covered construction of earthwork, pipelines, and structures, including pumping plants, laterals 8.7 to 20.0 inclusive, and sublaterals" on September 1, 1953. Divided into three schedules, the contract with Stolte, Inc. allocated $441, 893.11 for the work, but only "a portion of the costs [$81, 686.99] was chargeable to Delta-Mendota Canal." Plainview Mutual Water Company is based in Strathmore, California, and had been one of the first companies formed with the aim of negotiating with the Central Valley Project for irrigation water. At the time of the bidding, Plainview Water District fell under the Delta-Mendota Canal distribution system. The company formed in 1950, with an irrigation request of about 4,200 acres. Stolte Inc. can trace its origins to Ferdinand Charles Stolte, whose dreams of becoming a gentleman farmer were foiled by the stock market crash of 1929. Based in Alameda, Stolte Inc. began with specializing in homebuilding, but expanded to include work on hotels, medical facilities, high-rise commercial construction, and heavy construction like dams and tunnels. In 1932, engineer George Loorz joined

[75] [Photograph], DM-1496-CV in USDI, Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal,* 128.
[76] Technical Report, 106; "Johnson, Shasta Dam Builder, Dies," *News Pilot,* San Pedro: May 11, 1956; "William A. Johnson, 71, Industrialist, Succumbs," *San Bernadino County Sun* May 11, 1956; "San Pedran Elected President of Johnson Western Company," *News Pilot,* December 2, 1950.

Stolte Inc. as a partner, and the company went on to build Hearst Castle for William Randolph Hearst. In 1976, National Medical Enterprises purchased Stole Inc.[77]

Crest Contracting Company won the contract for construction of pump turnouts from mile 58.18 to mile 96.62 on May 2, 1958. Floyd Hardwick, a former Rio Vista city administrator, owned the company. While working on the Dela-Mendota Canal, Crest Contracting also undertook projects constructing culverts for Merced County.[78]

Contracts for "furnishing, hauling, and placing gravel" from various stations along Delta-Mendota Canal and the Westley wasteway were awarded to H. Sykes Construction Company. Under Specification R2-32, Sykes's company performed work along M.P. 12.99 to M.P. 25.88 and the start of the Westley wasteway to M.P. 0.37. The company specialized in road oiling, paving, and ready-mix concrete. Hubert Sykes headquartered his company in Patterson, California. Born in England in 1895, Sykes came to Patterson in 1919, having become a naturalized US citizen in 1918.[79]

E.A. Pollard won the contract for the "erection of right-of-way fence," which cost the government $5,407. Prior to his work on the Delta Mendota Canal, Pollard and his employees worked in Martinez, constructing a bridge across Marsh Creek on County Road E-44 and in Mendocino, grading and improving roads in Wages Creek. Born in 1897 in Oregon, it is not clear when Pollard came to California and established a home in Richmond. He operated his business out of Fairfax.[80]

To aid in the furnishing, processing, hauling, and placing of gravel along stations, the government also developed contracts with M.J. Ruddy and Son of Modesto, California (**Figure 11**). The company emphasized the "prompt delivery" of sand and gravel, including washed concrete sand and crushed rock. Though the company's establishment dates to the 1930s, it did not file as a stock corporation until October 15, 1954. Other work done by M.J. Ruddy and Son involved highway bridges and overpasses from Firebaugh throughout the San Joaquin Valley, and paving on the Tuolumne-Sonora Road. At the time the government accepted the bid for the Delta Mendota Canal, M.J. Ruddy and Son's managers included M.J. Ruddy, Jr, project manager; Fred Sattler, chief engineer; Warren Shields, project superintendent; and Paul Snyder, office manager.[81]

The Claude C. Wood Company also won a bid for "furnishing or processing, hauling and placing gravel" for Delta-Mendota Canal. Based in Lodi, California, Claude C. Wood Co. operated a gravel plant which manufactured rock, sand, and gravel and offered ready-mix concrete for purchase. The company also provided asphalt road oils to eliminate dust on driveways along farmland. During World War II, the Claude C. Wood Co. supported the war effort by assembling parts for floating drydocks, operating under a sub-contract for the United States Navy. Wood himself led an active role in his community; he served as secretary-treasurer for the Turlock Exchange Club in the 1920s and served on the board of trustees for Galt High School in the 1940s. Trained as an engineer, Wood came to California from Wisconsin in 1905 at the age of 20.[82]

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[77] Technical Report, 106; "County Ok's Tax Rate for New Plainview District," *Tracy Press*, May 4, 1951; "More Acreage Wanted in New Water District," *Tracy Press* October 2, 1950; Evelyn De Wolfe, "San Simeon Builder's Forgotten Notes : Cache Enriches Castle Lore," *LA Times*, January 25, 1985; "Carol Louise Stolte Paden," *Alameda Sun*, May 14, 2020.

[78] Technical Report, 106; "New Southbay Business Licenses," *The Redondo Reflex*, April 16, 1948; "Gasoline, TV Thefts Reported," *Merced Express*, January 29, 1959.

[79] Technical Report, 147; "Advertisement," *West Side Index*, June 2, 1960; United States Federal Census, "Hubert Sykes," 1940 and 1950.

[80] Technical Report, 146; United States Federal Census, "E A Pollard," 1940; "Official Report of the Board of Supervisors," *Contra Costa Gazette*, May 6, 1949; "Mendocino Beacon Files," *Mendocino Coast Beacon*, January 2, 1959.

[81] Technical Report, 146; "Modestan's Bid On Road Work is Low," *Modesto Bee*, February 24, 1939; "Advertisement," *Modesto Bee*, February 26, 1947; "Supervising the Jobs," *Western Construction*, vol. 32 (Cornell: King Publications, Jan. 1957); Gene Phillips, "Obituary- Cirgus H. Rumbaugh," *Rogers County Archives*, November 28, 2006.

[82] Technical Report, 146; "Neel Re-elected Club President," *Modesto Bee*, July 2, 1926; "Farmers and Grape Growers Attention," *Lodi News-Sentinel*, April 27, 1943; "Wood Given Contract to Assist Navy," *Lodi News-Sentinel*, June 18, 1943; United States Federal Census, "Claude C. Wood," 1940; US City Directories, 1822-1995, "Claude C. Wood," 1905.

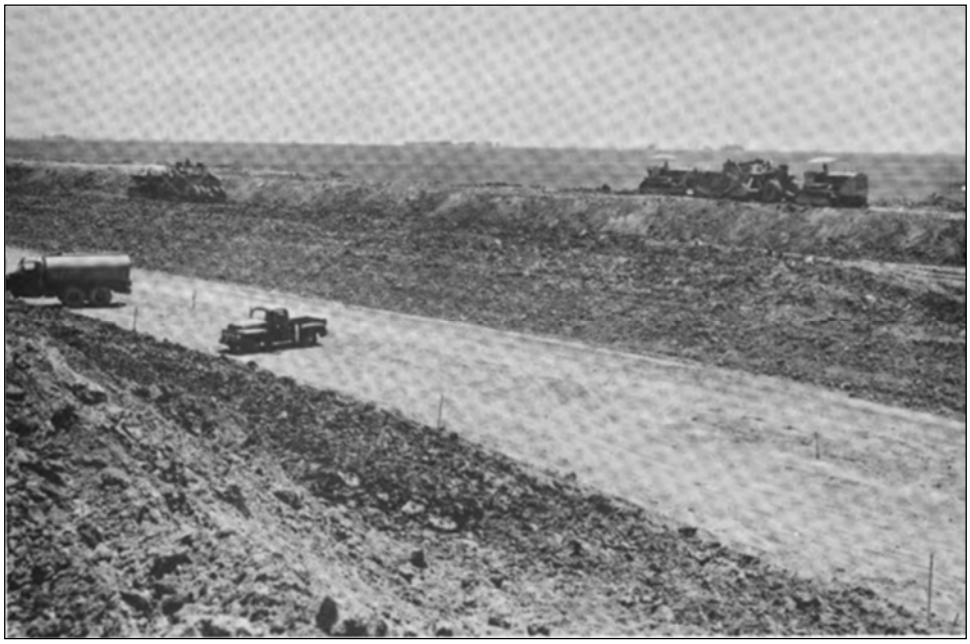


Figure 11: Placing and compacting lining material on side slope of canal, July 26, 1950.[83]

The high groundwater level, some large storms, and labor issues were among the biggest obstacles during construction. The high groundwater table caused water intrusion into the canal excavations and required contractors to de-watered those areas moving the water into a pilot ditch or other drain structures. Heavy storms in November and December 1950 also slowed progress when the deluge caused high water in Los Banos and San Luis creeks, which both breached constructed portions of Delta-Mendota Canal, causing damage to the canal and to some of the siphons. The storms also caused excess water in Garzas Creek to undermine an overchute pier and damaged some of the canal lining. After the delays caused by the storms and the subsequent repairs, a series of labor strikes in May 1951 halted constructed for about two weeks. Once the workforce returned the main branch of the canal was completed in summer 1951, but Delta-Mendota Canal was not considered complete until April 1952 when the San Luis Wasteway was completed (later renamed Volta Wasteway).[84]

Completion of the CVP was an economic boon to the Central Valley. In 1953, two years after the major canals of the project were complete, the project provided 1,500,000 acre-feet to irrigate nearly 720,000 acres of land. That year, the project delivered 134,000 acre-feet of irrigation water along Delta-Mendota Canal to districts composed of almost 120,000 acres. Reclamation planned for ultimate development of 225,000 acres in the Delta-Mendota service areas to be achieved upon the completion of Folsom Dam (1956) on the American River in Sacramento County and the Trinity Division in Trinity County (1959-1967), which transfers water from the Klamath River Basin into the Sacramento River Basin.[85]

Completion of the CVP also came with controversy. The century or so after California's Gold Rush witnessed exploitation of the Delta not only for irrigation purposes, but for other water resources, including chinook salmon. Canneries appeared in Sacramento as early as 1864, but the California Fish Commission noted a severe decline in fish populations by 1880 – attributed to overfishing and the prevalence of sediment in spawning beds from hydraulic mining. As detrimental as overfishing and mining were to the salmon runs, the most adverse effects came from the changes in the Delta landscape and ecosystem from the Central Valley Project and the State Water Project. Delta-Mendota Canal provided water to the west side

[83] [Photograph], DM-895-CV, in USDI, Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal,* 141.
[84] USDI, Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal,* 142-144.
[85] USDI, Reclamation, "The Contribution of Irrigation and the Central Valley Project to the Economy of the Area and the Nation," (Government Printing Office: Washington, 1956), XIII, 21.

of the San Joaquin Valley, but left "the 59-mile stretch of the river from Mendota upstream to Friant Dam with little water, and within this reach, the 23 miles directly above Mendota were completely dewatered." The dry river channel and the 319-foot-high concrete dam rendered the salmon helpless, with no way to continue their traditional migration and spawning runs. Not until 2009 did legislation pass to provide "substantial river channel improvements and sufficient releases from Friant Dam" to sustain the fish population from downstream to the Merced River, allowing water to flow freely through the San Joaquin River. The impacts of this San Joaquin River Restoration Settlement Act are still being observed.[86]

Further negative effects on the fish populations of the San Joaquin River system have been caused by altered hydrology, recirculation of water, and poor water quality caused by polluted runoff and dissolved oxygen. Though fish are entrained at the C.W. Bill Jones Pumping Plant (formerly Tracy Pumping Plant) to mitigate impact on the fish population, increased pumping alters the hydrodynamic conditions of the water, creating problems for fish who rely on habitat condition indicators to make their run. The Central Valley Project Improvement Act of 1992 allocated 800,000 acre-feet per year of CVP water "dedicated for anadromous fish enhancement and wildlife purposes," managed by the Sacramento division of the U.S. Fish and Wildlife department. A portion of this water is reserved to reduce pumping from the Jones plant, as efficient fish diversion via entrainment continues to decrease.[87]

By 1959 when Reclamation published its final report on Delta-Mendota Canal's construction, entitled *Delta-Mendota Canal Technical Record of Design and Construction*, most of the turnouts supplying water to individual water districts had been completed, nearly all according to Reclamation's standardized specifications. A few more, also designed according to specifications, were over the next several decades.[88] Individual water districts are responsible for maintaining turnouts into their own distribution systems and adding turnouts from Delta-Mendota Canal as needed and approved by Reclamation. Most of the physical changes made to Delta-Mendota Canal since its completion fall into five categories 1) maintenance, 2) capacity correction, 3) water district turnout additions and changes, 4) drainage / erosion control, 5) automation. Since October 1992 San Luis & Delta-Mendota Water Authority (Authority) has been responsible for maintenance of Delta-Mendota Canal.

The Authority is responsible for maintaining the concrete lining of the canal. Natural processes including land subsidence and soil characteristics cause deterioration of the concrete panels that line the canal. As noted, land subsidence and the damage it caused to Delta-Mendota Canal became apparent almost as soon as Reclamation turned water into the canal. Writing retrospectively about subsidence in 1968, geologist N.P. Prokopovich, and engineer D.J. Hebert noted that the most widespread soil bed in the upper part of the San Joaquin Valley was an "ancient lake bed known as the Corcoran or Blue Clay," in which a substantial storage of artesian groundwater lays. This groundwater reserve constituted a large portion of the irrigation supply before the CVP and continued to be a source even after the canal was built. Since 1960, the Bureau of Reclamation recognized a phase of subsidence caused by well-developed ground water overdraft, denoting it as "prominent and publicized." However, a different phase of subsidence called "lag," which occurs even when the area experiences little or no pumping of groundwater, and despite a decrease or disappearance of overdraft.[89]

Prokopovich and Hebert explained that the last 30-40 miles of Delta-Mendota Canal offer a remarkable example of lag subsidence (**Figure 12**). Preconstruction and construction surveys had not recognized any land subsidence in the lower reaches of the DMC, and any changes in elevation were attributed to earthquakes. By 1952, however, professionals identified

[86] Philip Garone, "Managing the Garden: Agriculture, Reclamation, and Restoration in the Sacramento-San Joaquin Delta," in in Delta Protection Commission, Delta Narratives: Saving the Historical and Cultural Heritage of the Sacramento-San Joaquin Delta, prepared by the Center for California Studies, California State University, Sacramento (West Sacramento: Delta Protection Commission, 2015), 77-86.

[87] USDI, Bureau of Reclamation, "Delta-Mendota Canal Recirculation Feasibility Study – Plan Formulation Report," (Sacramento: September 2010), 58-62; USDI, Reclamation, "Delta-Mendota Canal/California Aqueduct Interie – Final Environmental Impact Statement, vol 1: Main Report," (Sacramento: November 2009), 99-102.

[88] USDI, Reclamation, *Delta-Mendota Canal: Technical Record of Design and Construction;* USDI, Reclamation, "Milepost at Structure Sites Delta-Mendota Canal," 1985.

[89] N.P. Prokopovich and D.J. Hebert, "Land Subsidence Along the Delta-Mendota Canal, California," *Journal (American Water Works Association)* vol. 60, no. 8, August 1968.

subsidence as responsible for past changes in elevation. At the time of article, Prokopovich and Hebert noted that 22 miles of the concrete-lined section and all 18 miles of earth-lined section were affected by subsidence, causing the linings to become submerged below the water. Bridges and pipe crossings showed extensive effects of subsidence, where their clearance to the water was reduced sometimes to within inches or none at all. In some cases, the subsidence caused timber bridges and pipe crossings to flood (**Figure 13**). Prokopovich and Hebert stated that subsidence had not negatively affect the capacity of the canal, nor was there damage to either canal linings or structures. Despite the lack of impacts to the canal's capacity and its linings and structures, subsidence caused enough of a maintenance and operations problem to warrant a plan to rehabilitate the canal that was proposed for the 1968-1969 fiscal year. Reclamation staff estimated that the lag subsidence would increase up to two feet a year.[90]

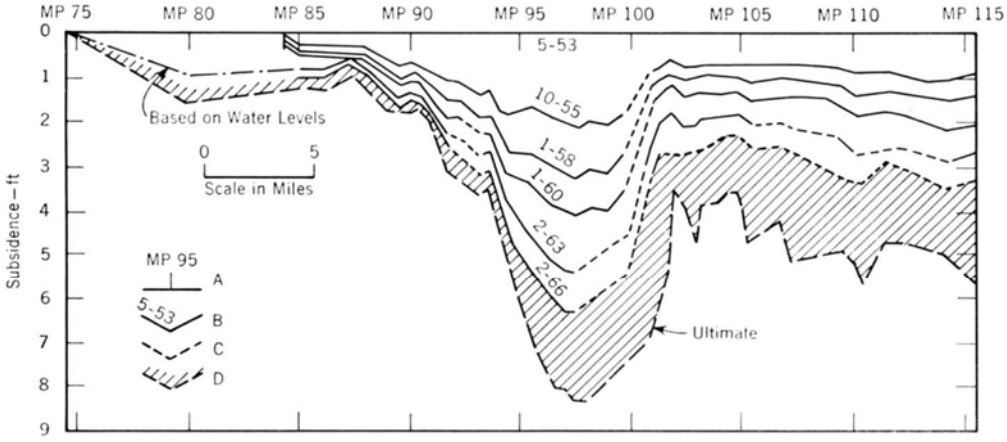


Fig. 5. Past and Future Land Subsidence in Downstream Reaches of the Delta-Mendota Canal

A is mile post (distance from intake); B is date of survey data; C is interpolations to bridge data gaps; D is predicted ultimate subsidence.

Figure 12: From Prokopovich and Hebert, graph showing past and future subsidence, 1968.[91]

[90] N.P. Prokopovich and D.J. Hebert, "Land Subsidence Along the Delta-Mendota Canal, California," *Journal (American Water Works Association)* vol. 60, no. 8, August 1968.

[91] [Photograph] in Prokopovich and Hebert, "Land Subsidence Along the Delta-Mendota Canal, California," 917.



Fig. 7. Effect of Subsidence on Bridge at Near Capacity Flow

This is a partially submerged timber bridge at Mile Post 98.21, in an area affected by deep subsidence. Concrete lining of the canal is completely flooded.

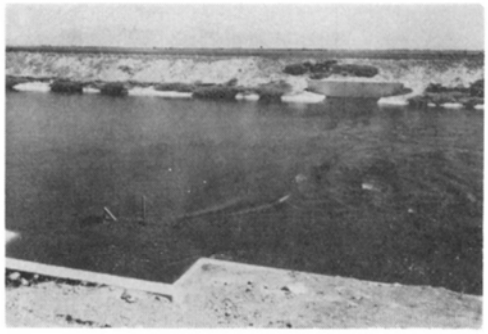


Fig. 9. Effect of Subsidence on Pipe Crossing at Near Capacity Flow

This is a submerged pipe crossing at Mile Post 91.71 in an area affected by deep subsidence.

Figure 13: Effects of subsidence on DMC, 1968.[92]

In December 1952, members of the canal's Central Valley Project Operations and Tracy Operations divisions conducted a biennial inspection of Delta-Mendota Canal, the first of which took place in October 1951, just a few months after the canal first delivered water. The report contained comments on the intake structure and intake canal; concrete and earth lining; and structures. It also provided recommendations and a general remark noting that "this was the first time the upper 100 miles of canal has been [dewatered] since water was turned in the canal in July 1951." The inspectors noted minor bank erosion and beaching on a curve of the canal near M.P. 0.5, no leakage in the discharge lines, and concrete and earth linings in good condition aside from "minor trouble spots" such as bulging and cracking and settlement of berms (**Figure 14**). Concerning the structures, the inspectors observed problems like leakage in the Mountain House Road siphon, canal silting at M.P. 42, drain pumps out of service, and inaccurate measurements from sparling meters.[93]

In June 1965, the Bureau of Reclamation Chief of Engineers received a report on the condition of Delta-Mendota Canal, including Tracy Fish Collecting Facilities and Tracy Pumping Plant. Overall, the canal appeared to be in excellent condition at the time, including its structures, gates, and operating roads. Subsidence was described as "slow and not yet stabilized." At the time of the inspection, no maintenance issues caused by the subsidence presented themselves; therefore, no corrective action occurred. The report also mentioned that several bridges had been replaced, with others needing replacement as well, such as the bridge at M.P. 90.56 (**Figure 15**). The turnouts and gates and wasteways looked to be in good condition, only requiring minor aesthetic maintenance. The inspectors observed the Tracy Pumping Plant to be well-maintained and in excellent condition, but did note a horizontal crack in the wall along the construction joint on the discharge side of the motor room. However, the inspectors found no evidence of leakage. Regarding cross drainage siphons and channels, the examination team noticed some leakage that seems to decrease as the weather and water warm. To mitigate this leakage and degradation, baffled-apron drops were under construction (**Figure 16**). The report concluded with the recommendation that the unwatered canal be watched during the winter of 1965-1966 to determine the necessity of repairing the flap-valve underdrain outlets

[92] [Photograph] in Prokopovich and Hebert, "Land Subsidence Along the Delta-Mendota Canal, California," 918.
[93] United States Department of the Interior, Bureau of Reclamation, Divisions of Design and Construction Operation and Maintenance, *Report on Inspection of Friant-Kern, Madera, Contra Costa, and Delta-Mendota Canals, 1-5.*

because that winter would likely be the last year of the "normal operating procedure" because once the San Luis Unit began operations (built in the early 1960s), the canal would be in continuous use. [94]

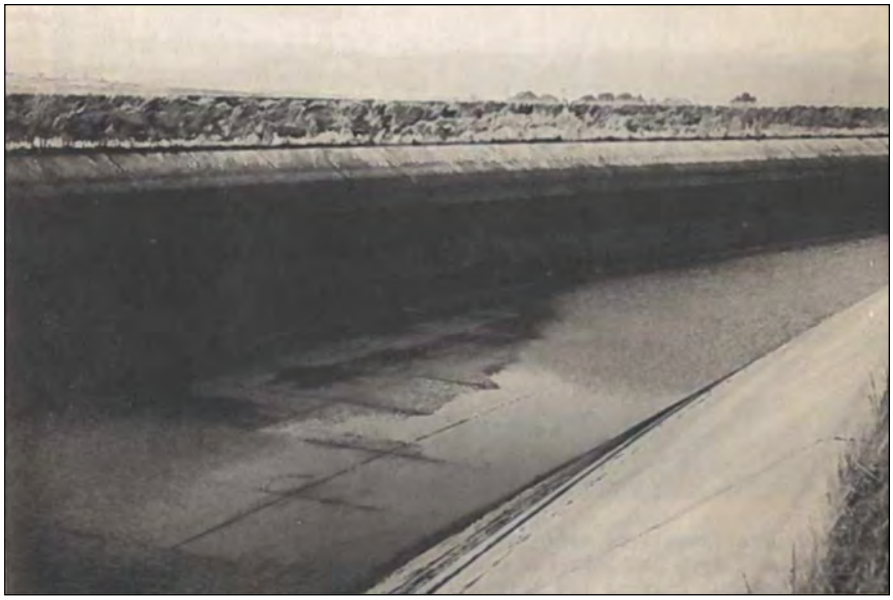


Figure 14: M.P. 11.15, concrete lining and heaving of bottom slab.[95]



Figure 15: Bridge, Mile 90.56, scheduled for replacement. May 14, 1965.[96]

[94] United States Department of the Interior, Bureau of Reclamation, *Condition of Major Irrigation Carriage Systems and Appurtenant Features – Central Valley Project* (Denver: June 21, 1965), 3-8.
[95] [Photograph], DM 2294 in USDI, Divisions of Design and Construction Operation and Maintenance, *Report on Inspection of Friant-Kern, Madera, Contra Costa, and Delta-Mendota Canals.*
[96] [Photograph], Photo No. 5, P214-D-48741 NA, in USDI, Reclamation *Condition of Major Irrigation Carriage Systems and Appurtenant Features,* 20.



Figure 16: Baffled apron drop under construction, May 12, 1965.[97]

The Bureau of Reclamation authored a similar report on June 5, 1970, examining "major irrigation structures and facilities operated and maintained by Tracy Field Division, Central Valley Project." Overall, the structures were found to be in good condition. The most pressing concern was the prevalence of people and expanding use of the canals for recreational activities like fishing. On Delta-Mendota Canal, the inspectors noted some erosion in the earth-lined section, but the concrete-lined sections appeared to be in excellent condition. As stated in previous inspection reports, some cracking in the lining on Mile 75 was evident but did not seem to be increasing. The examination team commented on the disruption of the canal by the public, including agricultural pipe crossings on the canal or farmers who discharged barnyard waste into the canal (**Figure 17**). The report recommended fencing around the checks to prevent fishing and any risk of people falling into the canal and drowning. The team found the overall condition of the canal's radial gates and turnouts and drain inlets to be satisfactory and without need for repair but recommended the removal of cottonwood trees growing in the San Luis wasteway channel.

The 1970 inspection report did, however, note some issues concerning subsidence, seepage, and silt deposits. The team noticed subsidence in the lower reaches of the canal, below M.P. 70. At the time of the inspection, the reach was already scheduled for a lining raise, to alleviate the effects of future subsidence. The team also witnessed significant seepage at two locations

[97] [Photograph], Photo No. 9, P214-D-48732 NA, in USDI, Reclamation *Condition of Major Irrigation Carriage Systems and Appurtenant Features*, 21; baffled apron drop under construction to control retrogression at Coral Hollow Creek Siphon.

along the canal, with the most detrimental between M.P. 56 and 57. According to the report, a prior inspection observed seepage; thus, the maintenance division added a layer of butyl rubber over the concrete lining sometime in 1966. This remedy proved to be insufficient and a plan to completely replace the concrete lining was in development. Silt deposits became more prevalent after the construction of the O'Neill Pumping Plant (at B.F. Sisk Dam and part of the San Luis Unit) and with the "increased operation of the check gates" downstream of the Tracy Pumping Plant (**Figure 18**). Due to a lack of funding for studies, no sufficient method of removing sediment existed in 1970 for the Tracy Field Division.[98]



Figure 17: Discharge of barnyard manure into the canal, May 16, 1970.[99]

[98] United States Department of the Interior, Bureau of Reclamation, *Condition of Major Irrigation Structures and Facilities – Central Valley Project – Report of Examination* (Denver 1970).
[99] [Photograph], 5-70-49D in USDI, Reclamation, *Condition of Major Irrigation Structures and Facilities – Central Valley Project – Report of Examination*, 14; government is starting legal action if this is not stopped by July.



Figure 18: Note rough silty water below gates at Check No. 19, May 16, 1970.[100]

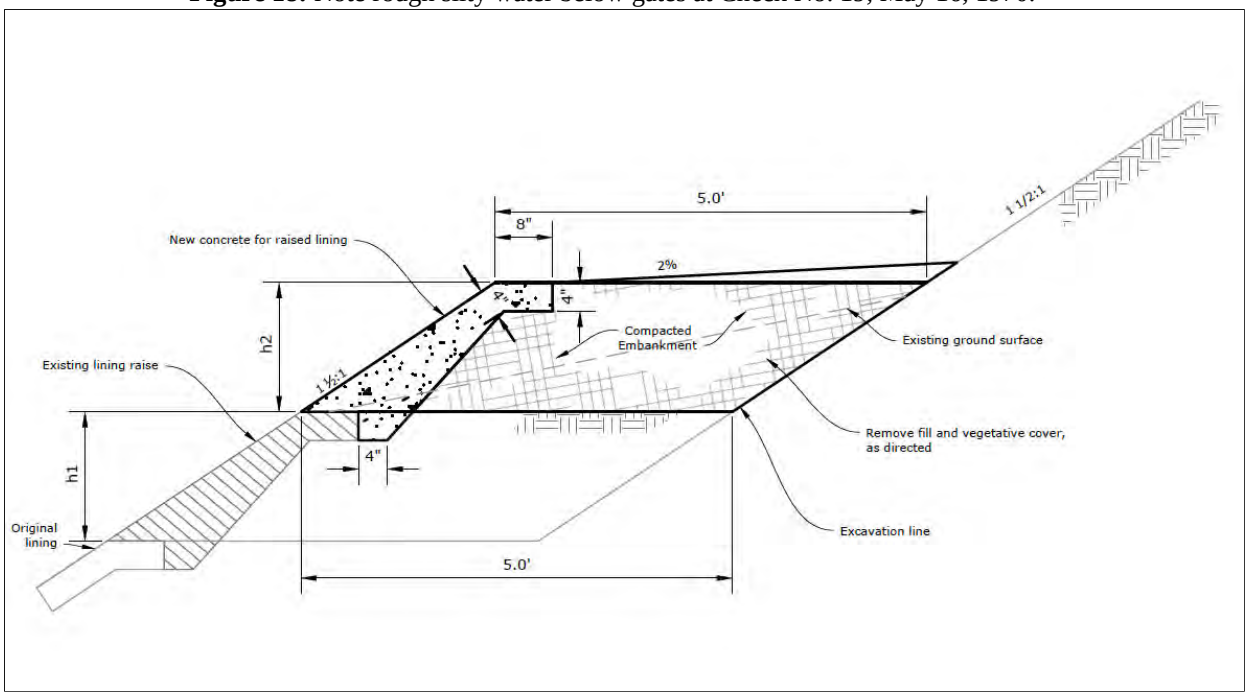


Figure 19: DMC typical cross section showing placement of original concrete lining, previous lining raise, and proposed lining raise.

[100] [Photograph] 214-D-67155 in USDI, Reclamation, *Condition of Major Irrigation Structures and Facilities – Central Valley Project – Report of Examination*, 16; gate pins partially submerged.

Over time various points along the canal have required modifications to correct the carrying capacity of the canal. Reclamation undertook one of the earliest, and most extensive capacity corrections in 1969, raising approximately 70 miles of the concrete-lined canal 18 inches and 24 inches.[101]

Wet conditions and soil characteristics make drainage and erosion control a perpetual issue that requires maintenance, the placement of drains where needed, and abandonment of drains that have become obsolete. As farming intensified around the canal following its completion, drainage water diminished as it was captured by surrounding farmlands. Many original concrete inlet drains have either become obsolete or have deteriorated.

Other changes have taken place to structures that span the canal like bridges and pipe crossings / overchutes since completion of Delta-Mendota Canal. In the 1960s, Reclamation undertook a bridge rehabilitation project that converted timber farm bridges piers from wood to concrete. Pipe crossings are changed frequently, and Reclamation maintains separate license agreements with utility companies for each crossing of water, oil, gas, transmission lines etc. Pipelines are removed, replaced with a new type of pipe, and added at new locations as dictated by local demand.

The massive length and capacity of Delta-Mendota Canal has largely been an obstacle to execution of a comprehensive modernization or upgrade plan because the cost would be prohibitive. Instead, the original design specifications have continued to serve as the basis for maintaining the canal, which has resulted in a high retention of many of the features and the overall character of Delta-Mendota Canal.

[101] USDI, Reclamation, *Designer's Operating Criteria*, 1971: 4-5, 26; Grimsley, J. O. and M. L. Barmettlor, *Condition of Major Irrigation Structures and Facilities*, Region 2, 1970, Appendix I – 3, 6.

NRHP / CRHR Evaluation

Criteria for Evaluation

The eligibility criteria for designating historic properties under federal and state criteria are essentially the same. The criteria for listing properties in the National Register of Historic Places (NRHP) are codified in 36 CFR 60 and expanded upon in numerous guidelines published by the National Park Service. Buildings, structures, objects, sites, and districts listed in, eligible for listing in, or that appear eligible for listing in the NRHP are considered historic properties under the regulations for Section 106 of the National Historic Preservation Act (NHPA). Eligibility for listing buildings, structures, objects, sites, and districts (i.e., historic properties) in the NRHP rests on twin factors of *historic significance* and *integrity*. A resource must have both significance and integrity to be considered eligible. Loss of integrity, if sufficiently great, will overwhelm the historic significance a property may possess and render it ineligible. Likewise, a property can have complete integrity, but if it lacks significance, it must also be considered ineligible. Historic significance is judged by applying the NRHP criteria, identified as Criteria A through D. The NRHP guidelines state that a historic property's "quality of significance in American history, architecture, archeology, engineering, and culture" must be determined by meeting at least one of the four main criteria. Properties may be significant at the local, state, or national level. The NRHP criteria are:

Criterion A: association with "events that have made a significant contribution to the broad patterns of our history;"

Criterion B: association with "the lives of persons significant in our past;"

Criterion C: resources "that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values;"

Criterion D: resources "that have yielded, or may be likely to yield, information important to history or prehistory."[102]

Integrity is determined through applying seven factors to the historic resource: location, setting, design, workmanship, materials, feeling, and association. These seven can be roughly grouped into three types of integrity considerations. Location and setting relate to the relationship between the property and its environment. Design, materials, and workmanship, as they apply to historic buildings, relate to construction methods and architectural details. Feeling and association are the least objective of the seven criteria and pertain to the overall ability of the property to convey a sense of the historical time and place in which it was constructed.

Central Valley Project Draft Multiple Property Listing

In 2009 Reclamation prepared a *Draft National Register of Historic Places Multiple Property Documentation Form: Central Valley Project* (CVP MPL), and updated it in 2018.[103] The CVP MPL identifies the period of significance for the CVP as 1935 when the project received its first authorizations to 1956 when the last of the major project components was completed. The document provides registration criteria regarding NRHP significance and integrity. The subsections of the registration requirements relied upon for this evaluation of Friant-Kern Canal for individual eligibility for listing in the NRHP are the subsection for "Main Canals," and for "Appurtenant Canal Features," as quoted below. The NRHP and CRHR evaluation of Friant-Kern Canal contained in this report utilizes the framework provided in the CVP MPL.

[102] USDI, National Park Service, *Guidelines for Applying the National Register Criteria for Evaluation, National Register Bulletin 15* (Washington, D.C.: USDI, National Park Service, 1990, rev. 1997).
[103] Jim Bailey, "National Register of Historic Places Multiple Property Documentation Form, Central Valley Project: Planning and Construction of the First Four Divisions, 1935-1956," draft prepared for Reclamation, 2009, updated 2018.

The following is excerpted from the CVP MPL:

Main Canals

Construction on the first main canal of the CVP, the Contra Costa Canal of the Delta Division, commenced in 1937 and was completed in 1948. In 1940, construction began on the Madera Canal of the Friant Division, with construction completed in 1945. In 1945, construction on the Friant-Kern Canal began. The following year, construction on the Delta-Mendota Canal commenced. Finally, in 1950, construction on the Delta Cross Channel began. The Friant-Kern Canal, Delta-Mendota Canal, and Delta Cross Channel were all completed in 1951. The longest main canal is the Friant-Kern Canal at 151.8 miles, while the shortest is the Delta Cross Channel at 1.2 miles. All main canals are located on Reclamation fee title or easement land.[104]

Significance

In conjunction with the storage and diversion dams, canals form the CVP's backbone. They provide the means to transfer, transport, and deliver water through the system and ultimately to the water users. Traversing across hundreds of miles, the canals form a significant feature of the physical landscape and define the geographical limits of the project. In keeping with the original CVP plan of large-scale water transfers, canals are the primary means behind the geographical redistribution of fresh water from the valley's wetter northern reaches to the drier southern stretches.[105]

Registration Requirements for CVP Canals

The period of significance for historic water conveyance structures begins in 1937 with the initial construction of the first CVP canal, the Contra Costa Canal, and ends in 1951 with the completion of the Friant-Kern, Delta-Mendota, and Delta Cross Channel canals. Like the dams, these canals are part of the initial CVP authorizations. The main canals within the period of significance for this historic context are all considered individually eligible because of their primary role in operating the CVP. The main canals can be individually eligible for the National Register under one or more of the criteria, as follows:[106]

Criterion A: They have had a significant impact on the settlement, agricultural economy, or development patterns of the project area; they have been defining elements in the evolution of the cultural landscape; they are directly associated with important events.

Criterion B: They are the result of the direct efforts of a prominent individual associated with the CVP and are the most prominent feature associated with that individual.

Criterion C: They represent the distinctive characteristics of Reclamation canal design and/or methods of construction used on the CVP; they involved challenging engineering design problems due to topography, grade, length, natural obstacles, and resulted in complex or innovative solutions; they are among the best or a rare surviving example of a distinctive type of water conveyance structure; they represent the evolving technology in the engineering, design, and construction of water conveyance structures; they were identified during the construction period as an individually significant feature; or they embody the work of a significant engineer or builder.

Criterion D: They have the ability to yield information important to understanding the history of the CVP.[107]

Integrity

The need for continual maintenance and repairs to canals requires special consideration of integrity. Irrigation systems are constantly evolving as features are upgraded, repaired, or replaced. Alterations made to canals during the period of significance, and even subsequent **thereto**, may not nullify eligibility if a canal retains certain key qualities. Most important are integrity of location, association, and overall design configuration of the conveyance prism (i.e. depth and width) and water

[104] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 106.
[105] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 106.
[106] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 107.
[107] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 108.

control features. A canal which has retained its original form and associated appurtenant features has a high degree of integrity. It is not uncommon for canal lining to be replaced, or for previously unlined segments to be lined. Such changes may not preclude a canal's eligibility if replacement features are in-kind, or they do not significantly damage the canal's historic association or its overall design. If in addition to integrity of association, location, and overall design, the historical setting and feeling of a canal are maintained, then the likelihood is even higher that an altered canal could remain eligible. On the other hand, if an entire canal is piped, it would no longer convey any of its original design, workmanship, materials, or historical association and would not be contributing. Conversely, partial piping of a significant canal may not preclude eligibility if a majority of a canal is still open and intact.[108]

Appurtenant Canal Features

Although appurtenant canal features are all operationally and thematically related to canals, each feature type serves a specific purpose. These features can be divided into five categories of structures: conveyance, regulating, protective, water measurement, and bridges. The first four of these types were built to function as part of the canal, while the bridges were built to function independently of the canal.[109]

1. *Conveyance Structures*

Conveyance structures are features such as inverted siphons, drops, chutes, flumes, tunnels, and pipelines that are used to safely transport water from one location to another traversing various existing natural and manmade topographic features along the way. There are two types of pipelines, those that carry water below ground and those that transport water above ground.[110]

2. *Regulating Structures*

Regulating structures are used to raise, lower, or control the release and volume of the water flow. Regulating structures that are located at the source of the water supply include headworks and turnouts. Headworks control the release of water into the canal, and are often located downstream from a major diversion or storage facility. Regulating structures located along the course of a canal include turnouts, checks, check-drops, radial gates, reservoirs, and diversion structures. The smaller regulating structures like checks and turnouts are basic components of an irrigation system.[111]

3. *Protective Structures*

Protective structures protect the canal system and adjacent property from damage which would result from uncontrolled storm runoff or drainage water, or an uncontrolled excess of flow within the canal. Several different types of structures perform this function, including overchutes, drainage inlets, siphon spillways, and wasteways.[112]

4. *Water Measurement Structures and Objects*

Water measurement structures are used to gauge water flow and ensure its equitable distribution. Many different types of water measurement structures are used in irrigation systems. The type most commonly used in Reclamation's systems are Parshall flumes, weirs, open-flow meters, and constant head orifices.[113]

5. *Miscellaneous Structures*

a. Bridges

Bridges crossing CVP canals range from single lane bridges, multi-lane highway bridges, farm bridges, pedestrian bridges, and maintenance bridges. Most of the bridges constructed within the period of significance were built by Reclamation

[108] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 108-109.
[109] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 109.
[110] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 109.
[111] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 109-110.
[112] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 110.
[113] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 111.

according to standard designs. Ownership of the bridges were turned over upon their completion to other entities, including city, county, or state transportation agencies. There are also many bridges not constructed by Reclamation that have been added over CVP canals and were built outside the period of significance for this historic context. Additionally, some original bridges built by Reclamation have been replaced.[114]

b. Gauging or Recording Stations

Several types of small structures were built in association with gauging or recording stations to measure canal flows. The most common are small circular plan, sheet metal structures called "tin whistles" or "silver bullets" that provide enclosure for recording devices. A second type of shelter is small reinforced concrete "houses." When gauging or recording stations are located over the canal, simple wooden footbridges with wood handrails were constructed to permit the taking of measurements. In some cases, the original bridges have been replaced with concrete or metal ones, which are easier to maintain. Many of the gauging or recording structures are built on concrete pads, adjacent to the canal, on the canal berm.[115]

Significance

Secondary to the canals in distributing water are the thousands of appurtenant features. With the exception of bridges, these appurtenant features are important to the overall operation of the main canals, yet are too small in size and repetitive in design to merit individual eligibility.

Even though bridges cross canals and can be physically tied to the canal prism, bridges have no connection to the operation of the CVP and therefore merit separate evaluation from other appurtenant features. In addition, most of the bridges were either constructed by Reclamation and ownership was turned over to a different entity or they were constructed by a different entity. Because of these reasons, bridges would rarely be individually eligible for the National Register in association with this historic context.[116]

Registration Requirements

The period of significance for historic appurtenant canal features begins in 1937 with the initial construction of the first CVP canal, the Contra Costa Canal, and ends in 1951 with the completion of the Friant-Kern, Delta-Mendota, and Delta Cross Channel canals. CVP appurtenant canal features can be eligible for the National Register for the following reasons:[117]

Criterion A: They are directly associated with important events that occurred along canals;

Criterion B: not applicable;

Criterion C: They are among the best or a rare surviving example of a distinctive type of appurtenant canal feature; they represent the evolving technology in the design of appurtenant canal features; they represent a unique design solution developed in response to a difficult engineering challenge; they were identified during the construction period as an individually significant feature;

Criterion D: They have the ability to yield information important to understanding the history of the CVP.[118]

[114] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 111.
[115] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 111.
[116] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 112.
[117] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 112.
[118] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 112-113.

Integrity

As with canals, many appurtenant features are upgraded, altered, or even replaced over time due to the constant ongoing maintenance needs. Integrity of a structure's historic materials, workmanship and design is essential for National Register eligibility under any criterion. Because location is of primary importance under Criterion A, a structure will rarely qualify under this criterion if it does not remain on its historic site along its associated canal. Location can also have importance under Criterion C, but this association is less vital.[119]

Evaluation

The following evaluates Delta-Mendota Canal for individual eligibility for listing in the NRHP and CRHR under the theme presented in the draft CVP MPL.

Portions of Delta-Mendota Canal and some of its appurtenant features have been subject to previous NRHP evaluations. In 2009, Reclamation historian Jim Bailey prepared a draft NRHP nomination form that concluded that Delta-Mendota Canal meets NRHP Criterion A with a period of significance from 1946-1951. Bailey also evaluated Tracy Pumping Plant in 2009, concluding that it meets NRHP Criterion A and C with a period of significance of 1951. Other appurtenant features of the canal that have been previously evaluated are listed in Table 9 below with the updated status codes provided by this evaluation.[120]

Table 9: Previously evaluated segments and appurtenant features of Delta-Mendota Canal.

Primary String	Resource Name	Status Code – Previous	Status Code – Updated by this evaluation	County
P-10-005165	Delta-Mendota Canal Bridge	3D	6Z	Fresno
P-10-006215	Sierra Avenue Bridge (42C0281); Sierra Avenue Bridge over Delta-Mendota Canal	3D	6Z	Fresno
P-10-006649	Bridge 42C0074; Nees Avenue Bridge over Delta-Mendota Canal	3D	6Z	Fresno
P-24-001703	Delta Mendota Canal	2S2	2S2	Merced
P-24-001848	San Luis Wasteway (part of Delta-Mendota Canal)	2S2	2S2	Merced
P-39-000089	Delta Mendota Canal	3D	2S2	San Joaquin
P-50-001904	Delta Mendota Canal	2S2	2S2	Stanislaus

[119] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 113.
[120] California Historical Resource Status Codes.
2S2: Individual Property determined eligible determined eligible for NR by a consensus through Section 106 process. Listed in the CR.
3D: Appears eligible for NR as a contributor to a NR eligible district through survey evaluation.
3S: Appears eligible for NR as an individual property through survey evaluation.
6Z: Found ineligible for NR, CR, or Local designation through survey evaluation.

Primary String	Resource Name	Status Code – Previous	Status Code – Updated by this evaluation	County
P-01-010442	Tracy Pumping Station (No. 11a)	3S	2S2	Alameda
P-07-002983	Tracy Fish Collection Facility	6Z	6Z	Contra Costa

The following presents the evaluation of Delta-Mendota Canal for individual eligibility for listing in the NRHP and CRHR under the theme presented in the draft CVP MPL.

Criteria A and 1

The CVP fundamentally altered California's landscape and economy by moving water over a long distance from basin to basin and providing more reliable irrigation water to regions previously prone to scarcity of both surface water and groundwater. Delta-Mendota Canal, an integral component of the Delta Division of the CVP, allowed continued delivery of water to irrigators on the San Joaquin River so that water could be diverted further south to areas with a lower water supply. While its benefits to agriculture cannot be overstated, Delta-Mendota Canal is also at the center of the controversy over replacing impounded and re-routed San Joaquin River water that no longer flows through historic salmon and steelhead spawning grounds.

Whether viewed as beneficial or harmful, Delta-Mendota Canal is an instrumental component in accomplishing the objective of the CVP, bringing irrigation water from the wetter northern state to the arid regions of the San Joaquin Valley. At 116 miles long, stretching from C.W. Bill Jones Pumping Plant (Tracy Pumping Plant) in the Delta to Mendota Pool on the San Joaquin River, Delta-Mendota Canal demonstrates the purpose of the CVP, and the scale of the transformation it generated. The canal has had a lasting legacy on California agriculture, providing a reliable water source to support immensely successful agricultural enterprises. Delta-Mendota Canal meets NRHP Criterion A and CRHR Criterion 1 at the state level because of its primary role in accomplishing the visionary goals of the CVP to transfer a substantial portion of the San Joaquin River water supply from its historical route to the arid lands of the southern San Joaquin Valley. Delivery of San Joaquin River water away from its historical water users was not a tenable proposition without the provision for replacement water delivered by Delta-Mendota Canal. The period of significance under these criteria is from the awarding of the first construction contract in 1946 to 1951 when water was first turned down the canal to provide a replacement supply of water.

Criteria B and 2

The CVP was the result of the efforts of many individuals and agencies over many years and no one person or group of people rises in the historical record as playing a direct role in its implementation in a way that would be best demonstrated by Delta-Mendota Canal; therefore, Delta-Mendota Canal is not individually eligible for listing in the NRHP under Criterion B or in the CRHR under Criterion 2.

Criteria C and 3

Delta-Mendota is individually eligible for listing in the NRHP and CRHR under Criterion C and Criterion 3 because its size, scale, and purpose demonstrate the magnitude of the CVP's engineering and construction accomplishment. The largesse of the vision required an outsized engineering effort and no other component part of the CVP better demonstrates the vision than Delta-Mendota Canal, designed to provide water to replace the flow of the San Joaquin River. Construction of any long-distance linear infrastructure requires extensive planning and engineering, large-scale construction, and coordination among jurisdictions and agencies. As one contemporary observer noted, the "quantity of earth moved is equivalent in mass to more than three times that of Grand Coulee Dam – world's largest concrete structure – and the quantity [*sic.*] of concrete placed for the 97-mi. concrete-lined portion of the canal is more than sufficient to build a sidewalk 3 ft. wide and 4in. thick between San

Francisco and New York City."[121] The scale of the project and the sheer number of obstacles present along the 116-mile alignment made its design and construction a monumental undertaking. The canal's significance, however, is not tied to the engineering or construction of any of its individual components or appurtenant parts, but rather to its ability to demonstrate the scale of the project by the long-distance conveyance of water for the purpose of transferring water between watersheds. Delta-Mendota Canal is individually eligible at the state level under NRHP Criterion C and CRHR Criterion 3 because it demonstrates the visionary engineering achievement that redistributed the flows of major rivers between basins in California. The period of significance under these criteria is the period of construction of Delta-Mendota Canal, 1945-1951.

Morrison-Knudsen Company, Inc., who won four construction contracts for Delta-Mendota Canal in partnership with M.H. Hasler Construction Company, built the largest share of the canal. Morrison-Knudsen should be considered a master builder for their large body of work and extensive experience with large infrastructural construction projects both in the United States and worldwide since the 1930s that included among other civil and military works, very large dam projects like Hoover Dam on the Colorado River. While construction of Delta-Mendota Canal was a large undertaking for the company, it does not best represent their body of work. They were most known during the pre- and post-World War II period for construction of military installations, bridges, and large dams. Delta-Mendota Canal would not best represent the work of any of the other contractors who won contracts for the canal because their contributions to the project were only to a small fraction of the overall project.

Delta-Mendota Canal also meets NRHP Criterion C and CRHR Criterion 3 because of its direct association with the contributions of renowned Reclamation engineer Oscar Boden who headed the investigation, planning, and siting of the Delta Division of the CVP, including Delta-Mendota Canal. Delta-Mendota Canal, a principal element of the CVP, is an historically important example of this master engineer's work. The period of significance for this canal is its period of construction, 1946-1951.

Criteria D and 4

Delta-Mendota Canal is not eligible under NRHP Criterion D or CRHR Criterion 4 for information potential because it was designed and built according to well-documented practices, and the project is well documented through drawings, textual records, and photographs.

In general, the character-defining features of Delta-Mendota Canal are its location, its relationship to C.W. Bill Jones Pumping Plant (Tracy Pumping Plant), the size, shape, and dimensions of the canal prism, its lining material (approximately 95 miles of concrete and 18 earthen miles), and the direction of water flow from C.W. Bill Jones Pumping Plant downstream to Mendota Pool. Individual elements that contribute to the significance of Delta-Mendota Canal along its 116.4 miles are those structures that are directly related to its significance under NRHP Criterion A / CRHR Criterion 1 and NRHP Criterion C / CRHR Criterion 3, i.e., structures that directly relate to the conveyance of CVP water from the pumping plant to Mendota Pool. Structures like C.W. Bill Jones Pumping Plant, check structures and siphons that convey and control the water's southerly flow from the pumping plant, and structures like turnouts that direct the water to users along its route and wasteways the control excess flows all relate directly to the canal's significance and purpose and therefore contribute to the significance of the historic property. Structures that accommodate pre-existing uses or conditions like pipe crossings, siphon undercrossings, culverts, drains, overchutes, and most bridges do not contribute to the historic significance of this linear historic property because they are not directly related to the conveyance of CVP water, and instead serve ancillary purposes. Similarly, ancillary features like gauging stations or salinity stations do not relate to the historic significance and are not character defining. Operating bridges that are used specifically for the operation of the canal, as opposed to farm bridges or county road bridges that simply cross the canal and have no relationship to its functioning as a CVP water conveyance, have potential to contribute to Delta-Mendota Canal's significance; however, none of this category of bridges crossing Delta-Mendota Canal retain historic integrity. See **Table 5** below and **Appendix C** for contributing status of component elements of Delta-Mendota Canal.

[121] "Concrete Lining Complete for Delta-Mendota Canal," *Western Construction* 25, n. 12 (Dec. 1950), 81.

Table 10: Contributing Status of Component Parts of Delta-Mendota Canal.

Structure Type	Contributing Status
Farm Bridges	Non-Contributing
Railroad Bridge	Non-Contributing
Pipe Crossings	Non-Contributing
County Highway Bridges	Non-Contributing
Overchutes	Non-Contributing
Inlet Drains	Non-Contributing
Road Drains	Non-Contributing
Culverts	Non-Contributing
Cattle Guards	Non-Contributing
Pumps	Non-Contributing
Ladders	Non-Contributing
Gauging Stations	Non-Contributing
Gates	Non-Contributing
Check Structures	All are Contributing
Siphons	All are Contributing
Wasteways	4 are Contributing, 1 is not – see Master Table in **App. D**
CVP Signs	All are Contributing
Lining / Prism	Lining to original specifications is Contributing
O&M Roads	Contributing (roads on canal embankments)
Operating Bridges	Non-contributing; integrity loss
Turnouts	Some are contributing – see Master Table in **App. D**
Pumping Plants	C.W. Bill Jones Pumping Plant is Contributing

The character-defining features and integrity of contributing elements are discussed below, followed by a discussion of the overall integrity of Delta-Mendota Canal. See **Appendix C** for the contributing status of individual components of the historic property.

Canal Prism, Embankments, Maintenance Roads

The character-defining features of Delta-Mendota Canal prism are its original material composition, and original design. Specifically, this includes: its concrete- and earth-lined construction; its original dimensions – height, width, and shape, side slopes, embankments, and O&M roads; and its alignment (**Figure 20**- **Figure 23**).

Those sections of Delta-Mendota Canal prism that have a high degree of integrity and, therefore, contribute to the significance of the historic property are those that retain all or most of their character-defining features. While some concrete-lined stretches of the canal have been altered by the raising of the lining, this modification only constitutes a minor loss of integrity of design, as the work included appropriate materials (concrete) and the elevated extensions were clearly differentiated from the original by a concrete seam above the original lining. As such, these alterations were made in accordance with standards set forth by the *Secretary of the Interior's Standards for the Treatment of Historic Properties* and do not disqualify those sections with raised concrete lining from contributing to the significance of Delta-Mendota Canal.[122] Similarly, those originally earth-lined

[122] Kay D. Weeks and Anne E. Grimmer, *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings*, revised by Anne E. Grimmer (Washington D.C.: USDI, National Park Service, Technical Preservation Services, 2017).

sections that have been altered by the addition of rip-rap only suffer slightly diminished loss of integrity of designs or materials; however, the rip-rap itself is considered a non-contributing element.[123] While the majority of the surrounding setting remains rural in nature as it was at the time of Delta-Mendota Canal's period of significance, 1946-1951, suburban development radiating out from Mountain House, Tracy, and Patterson have started to alter the characteristic setting. The canal itself in these areas retains its other character-defining features and thus contributes to the significance of Delta-Mendota Canal as a whole. As Delta-Mendota Canal has remained in its original alignment, it retains a high degree of integrity of location throughout the entirety of its alignment.



Figure 20: View of concrete-lined section of canal from approximately M.P. 91.36; camera facing upstream from left bank, June 14, 2022.

[123] The *Secretary of the Interior's Standards for the Treatment of Historic Properties* favor protecting historic properties with temporary materials while planning for repairs that meet the standards.



Figure 21: View of earth-lined section of canal from approximately M.P. 104.22; camera facing downstream from left bank, June 14, 2022.



Figure 22: View of embankment and concrete-lined section of canal; camera facing downstream from left bank, June 14, 2022.



Figure 23: View of embankment and maintenance road along earth-lined section; camera facing downstream from left bank, June 15, 2022.

C.W. Bill Jones Pumping Plant (Tracy Pumping Plant)

The Tracy Pumping Plant complex is made up of the Delta-Mendota Intake Canal (M.P. 0.0-2.52), the Tracy Pumping Plant facility (now called "C.W. Bill Jones Pumping Station") (M.P. 2.53), three (3) 15-foot (inside) diameter, 4,822-foot long concrete discharge pipes, a concrete-block siphon breaker house with a flat, overhanging roof at the end of the discharge lines (M.P. 3.49), and a concrete inlet structure that releases the water from the Plant into the concrete-lined section of the DMC, at M.P. 3.50. Each of these features is character defining of the Tracy Pumping Plant.

The Delta-Mendota Intake Canal contains fish collection facilities (M.P. 0.09) and a three-barrel siphon under Byron-Bethany Road and a single track for Union Pacific Railroad (formerly Southern Pacific Railroad) (M.P. 1.36/ M.P. 1.41). The character-defining features of the Intake Canal include: the fish collection facilities; the three-barrel siphon; and its loose-earth construction.

The Pumping Plant is a semi-outdoor facility. The building has a two-story rectangular plan, made of concrete, with a flat, parapet roof with inset handrails. The treatment of the concrete walls creates a rectangular pattern on the north, south, and east façades and the windows and doors of the north and south façades are symmetrically arranged and centered on their respective sides. The character-defining features of the Pumping Plant include: the aforementioned form and massing; concrete construction; the windows on the north façade; the accordion doors on the south façade; the inset handrails on the roof and north façade; the six circular, removable hatches on the roof; the six vertical-shaft pumping units symmetrically arranged in pairs within the three eastern sections of the building; and the inlet transition walls.



Figure 24: Tracy Pumping Plant; camera facing southwest, May 9, 2022.



Figure 25: Tracy Pumping Plant; camera facing east, May 9, 2022.

Siphons

The population of Delta-Mendota Canal siphons comprises 13 concrete structures (see **Appendix C** for a listing of all appurtenant DMC structures). Siphons are defined by their concrete construction, with sloped-to-vertical transitional wingwalls, concrete box inlets and outlets, and one-, two-, three, or four-barrel underground concrete channels that transport Delta-Mendota flows beneath waterways, railroads, highways, and an irrigation canal.

The Delta-Mendota Canal siphons retain historic integrity to their period of significance, 1946-1951, and therefore appear eligible for inclusion in the NRHP and CRHR as contributing features of Delta-Mendota Canal. In terms of integrity of design and setting, the Delta-Mendota Canal siphons all remain in their original locations—at the sites of waterways, roadways, railroad crossings, and an irrigation canal. These locations and settings appear largely unaltered. In terms of design, materials, and workmanship, research did not reveal that any substantial modifications have been made to any of the character-defining features of the siphons that would reduce their integrity. The siphons all retain their basic concrete construction, single- and multiple-barrel conveyance structure, and transitional wingwalls, and they all continue to transport Delta-Mendota Canal flows beneath major appurtenant crossings.



Figure 26: Three-barrel siphon inlet headwall at M.P. 13.67; camera facing downstream from left bank, May 10, 2022.



Figure 27: Four-barrel siphon outlet headwall at M.P. 16.34; camera facing upstream from left bank, May, 10, 2022.

Check Structures

The population of Delta-Mendota Canal check structures consists of 21 concrete structures composed of two types (see **Table 1** in DMC DPR 523 form in **Appendix B** for list of DMC check structures, and **Appendix C** for listing for all appurtenant DMC structures). Check structures are characterized by their predominately poured-in-place concrete construction, with sloped transitional wingwalls that contract and expand as Delta-Mendota Canal leads into and away from the check. All checks feature narrow equipment platforms with mechanical gate-hoisting equipment in metal encasements; the concrete platforms are framed with metal pipe railing and most have metal lampposts with umbrella shades. Concrete block check structure houses are later additions after the period of significance and are not character defining of the historic-era canal.

The character-defining features of the Delta-Mendota Canal check structure population retain historic integrity to their period of significance, 1946-1951, and therefore appear eligible for inclusion in the NRHP and CRHR as contributing features of Delta-Mendota Canal. In terms of integrity of design and setting, the Delta-Mendota Canal check structures all remain in their original locations in a setting characterized by adjacent San Joaquin Valley farmlands. Moreover, those check structures constructed near siphon inlets and wasteway turnouts retain their spatial relationships with other components of the canal. In terms of design, materials, and workmanship, research and field observations did not reveal that substantial modifications have been made to any of the character-defining features that would reduce the integrity of these structures. The later addition of the concrete block check houses does not constitute a loss of historic integrity because the structures are small and unobtrusive into the setting of the canal. Moreover, the historic-period population of Delta-Mendota Canal check structures continues to regulate Delta-Mendota Canal flows throughout the span of the canal.



Figure 28: Check No. 16 at M.P. 85.09; camera facing downstream from left bank, June 14, 2022.



Figure 29: Check No. 11 at M.P. 58.28; camera facing downstream from left bank, June 13, 2022.

Wasteways

Wasteways function as escape structures to protect the canal system by diverting water out of the canal and preventing it from overtopping the banks of the canal, minimize the damage resulting from a break in the canal, or by preventing additional damage from a washout or failure of the canal. This class of structures requires an accompanying waste channel from the canal to a point of discharge into a natural drainage channel. The wasteway channels are not in the APE for this project; however, the turnouts into the wasteways are integrated into Delta-Mendota Canal and are within the APE.

There are four primary wasteways and associated wasteway turnout structures along Delta-Mendota Canal and one overspill apron wasteway on the right bank of the canal (see **Appendix C** of report citied in *P11. for a listing of all appurtenant DMC structures). Wasteways turnouts are defined by poured-in-place concrete construction, two rectangular gate sections, two equally sized radial gates, and narrow equipment platforms with mechanical gate-hoisting equipment in metal encasements. The size of the gates is dictated by the capacity of the canal at the turnout. The concrete platforms are framed with metal pipe railing and feature metal lampposts with umbrella shades, though some umbrella shades are missing.

The four wasteway channels – Westley, Newman, Volta, and Firebaugh – are defined by their locations, size and shape of the excavation, concrete and earth lining, and outfalls into the San Joaquin River channel. Culverts and bridges along the wasteway are not directly related to the historical significance of Delta-Mendota Canal and are not character-defining features.

The Delta-Mendota Canal wasteway turnouts and turnout channels retain a good degree of historic integrity of design, materials, workmanship, setting, location, association, and feeling.

The character-defining features of the Delta-Mendota Canal wasteway turnouts and wasteway channels retain historic integrity to their period of significance, 1946-1951, and therefore are contributing features of Delta-Mendota Canal. In terms of integrity of design and setting, the Delta-Mendota Canal wasteways all remain in their original locations, the setting of which remains defined by adjacent San Joaquin Valley farmlands. Moreover, all wasteway turnouts retain their spatial relationships with other components of the canal, which include the canal lining, and the wasteway channels. In terms of design, materials, and workmanship, research and field observations did not reveal that any substantial modifications have been made to the character-defining features that would reduce the integrity of these structures. The population of Delta-Mendota Canal wasteways continues to function as it did historically to regulate Delta-Mendota Canal flows into natural waterways.



Figure 30: Radial gates at Firebaugh Wasteway's inlet structure; camera facing upstream from wasteway's right bank, June 14, 2022.



Figure 31: View of Newman Wasteway; camera facing upstream from right bank, June 13, 2022.

Turnouts

Turnouts function to deliver water into the local distribution systems of water users along the canal and those that have a high degree of integrity and, therefore, contribute to the significance of Delta-Mendota Canal are those that retain all or most of their character-defining features (**Figure 32**). Minor alterations to some of these turnouts such as conveyor-type debris screens across the channel openings, replacement gear mechanisms, and modern railing or fencing do not prevent the turnouts from conveying significance and they contribute to the canal's historical significance. Those turnouts added to the DMC after the initial period of construction that were designed in accordance with Reclamation's original design specifics and possess those character-defining features enumerated above may also be considered contributors to the DMC's significance. However, those turnouts that have been so heavily altered from their original design that they no longer have sufficient integrity to convey their significance are those that have had the original pedestal and geared hoist mechanism removed and replaced, or the concrete equipment decks raised or entirely replaced. These substantial alterations have diminished the integrity of design, materials, workmanship, and feeling to such a degree that these structures no longer convey the significance of the canal. Additionally, those turnouts that have been added that were designed divergently from Reclamation's original design specifications—such as steel-pipe turnouts and turnouts with automated electronic gate-hoisting equipment—are likewise not considered contributors to the DMC's significance (**Figure 33**).

The character-defining features of the turnouts are those materials, equipment, and design aspects that are part of the original construction of these structures, built according to the original design specifications. Specifically, this includes the concrete construction of the structure; shape and size of the water channels or barrels; metal grate debris screens over the openings; original gate hoisting mechanism; gates; concrete deck, railing, and steps; and the position of the turnout deck just above the canal lining.



Figure 32: Turnout at M.P. 45.35; camera facing downstream from left bank, May 12, 2022.



Figure 33: Two turnouts at M.P. 38.14; camera facing downstream from left bank, May 12, 2022.

Because the vast majority of the contributing elements of Delta-Mendota Canal retain historic integrity of the character-defining features, overall Delta-Mendota Canal retains integrity to its period of significance, 1946-1951, and is eligible for listing in the NRHP and CRHR under Criteria A / C and 1 / 3. The boundary of the historic property is from outside toe to outside toe from the inlet canal at M.P. 0.09 to the outlet at Mendota Pool at M.P. 116.61 because this encompasses all of the features of Delta-Mendota Canal that contribute to its significance.

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Lawton

***Date**: May 9-10, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-1

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 1 spans 11.25 miles between canal mileposts 0.09 and 11.34, from the Tracy Fish Collection Facility to a point just upstream of Check No. 1. This segment traverses the western edge of the San Joaquin Valley in Contra Costa, Alameda, and San Joaquin counties and the western edge of the city of Tracy. See **Sketch Map** and **Location Map** on Continuation Sheets.

UTM: Zone 10S, 626724.65mE / 4186399.55mN (north endpoint); 631965.67mE / 4174954mN (south endpoint)

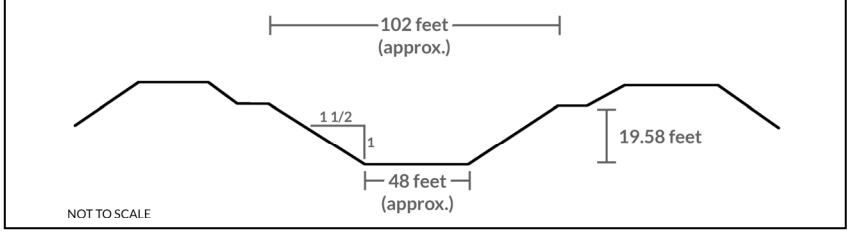
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 1 is a trapezoidal shaped canal with the first approximately 2.5-mile section between the Tracy Fish Collection Facility and the C.W. Bill Jones Pumping Station (known as the Delta-Mendota Intake Canal) being a loose earth channel, while the remainder is concrete lined (**Photograph 107** and **Photograph 131**) (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 102.24 feet (original)
b. **Bottom Width**: 100 feet - 48 feet
c. **Height or Depth**: 14.25 feet – 19.58 feet
d. **Length of Segment**: 11.25 miles

L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L4e. Sketch of Cross-Section (not to scale) **Facing:** Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This segment of the DMC passes through flat farmland, foothills, and an industrial area on the western edge of Tracy.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of a stilling well, pumphouse, and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 107: View of Segment 1 showing beginning of Intake Canal (left) along the right abutment wall of the fish collection facilities (center), with Tracy Fish Collection Facility (right); camera facing north, May 9, 2022 (A00165).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Abigail Lawton
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 1, the trapezoidal DMC is made of compacted-earth from M.P. 0.09 to 2.52, then lined with concrete from M.P. 3.50 to 11.34. The concrete lining was raised by 18 inches in 1965 (**Photograph 13**).[124] Flanking both sides of the canal are gravel maintenance roads approximately 20 feet wide. Another gravel maintenance road about 15 feet wide runs above the 4,822-foot long C.W. Bill Jones Pumping Station discharge pipes. For a detailed discussion of canal cross sections, see the typology discussion in Section P3a.

The major structures on this section of the DMC are the Tracy Fish Collection Facility, C.W. Bill Jones Pumping Station and discharge pipes, and the Mountain House Siphon.

The Bureau of Reclamation's Tracy Fish Collection Facility is located at 6525 Lindemann Road, adjacent to the right bank abutment of the DMC at M.P. 0.90 (**Photograph 107**). Fish collecting facilities were constructed at the head of the Delta-Mendota Intake Canal on Old River in 1947-51. Their purpose is to collect young fish in spring and summer and transport them further down the San Joaquin River. These facilities consist of a row of vertical louver vanes set one (1) inch apart and directed at right angles to the flow in a structure which extends about 340 feet diagonally across a concrete channel 83.5 feet wide and about 25 feet deep. As the fish approach the louvers they swim to one side to avoid the disturbing eddies and vibrations created by the louvers, and readily enter by-passes placed at intervals in the louvered barrier. The bypasses carry the fish to holding tanks. From the holding tanks the fish are transported by trucks 40 miles to the Suisun Bay area where they can swim safely to the ocean.[125]

Water from the Sacramento River flows through the Delta Cross Channel into Old River slough, where it is diverted through the Delta-Mendota Intake Canal, about 2.3 miles long, to C.W. Bill Jones Pumping Station (**Photograph 109**). The Pumping Station (originally known as the "Tracy Pumping Plant") was constructed in 1947-51 and is an original and integral feature of the DMC (ref Historic Photo – **Photograph 109**). It contains six vertical-shaft pumping units. The pumping plant is of the semioutdoor type. The architectural style is Brutalist with Streamline Moderne details (**Photograph 110 – Photograph 117**). The superstructure has a rectangular plan with a flat, parapet roof inset with handrails. The building measures about 360 feet long, 60 feet wide, and 50 feet high. Expansion joints divide the north and south façades into four sections. Horizontal grooves in the board-formed concrete intersect with vertical control and expansion joints to create a rectangular pattern on the façade. Two rows of small steel windows on the intake (north) side are evenly spaced and centered on the building (**Photograph 110**). On the discharge (south) side, instead of windows, there are evenly spaced large accordion doors, which provide gantry crane access to the pumps (**Photograph 116**). There is a 100-ton movable gantry crane affixed to the roof. The roof is also outfitted with large removable hatches that allow the crane access to handle pumping-plant equipment. The three eastern sections of the building house the six pumping units, spaced symmetrically in pairs. The fourth section, at the west end, houses the service bay. A small portion of the east section contains public facilities, stairs, and two offices. Each pumping unit has a rate capacity of 767 second-feet under a head of 197 feet. Each pump is driven by a 22,500-horsepower motor above the pump. The pumps lift a maximum of 4,600 second-feet of water up 197 feet and then through three 15-foot (inside) diameter, concrete discharge pipes for 4,822 feet to a concrete outlet structure that releases the water into the concrete-lined section of the DMC, at M.P. 3.50 (**Photograph 117**).[126]

Three irrigation canals cross the alignment of the discharge pipes. These laterals generally cross the DMC in an east-west orientation. The first, at M.P. 2.68, runs through a siphon under the DMC discharge pipes (**Photograph 120**). The second and third, at M.P. 2.92 and M.P. 3.33, cross over the discharge pipes and under the O&M road, which is carried over them by short concrete bridges with timber decks (**Photograph 121** and **Photograph 122**). Neither of these bridges possess handrails. They are not included within the general DMC bridge population and not part of the total count of extant bridges.

[124] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[125] USDI, Reclamation, *Tracy Pumping Plant and Intake Canal and Discharge Lines: Technical Record of Design and Construction*, May 1959: 14-17.
[126] USDI, Reclamation, *Tracy Pumping Plant and Intake Canal and Discharge Lines: Technical Record of Design and Construction*, May 1959: 1-4, 23, 28.

Near the siphon outlet, at M.P. 3.49, is a siphon breaker house and two 64-gallon water storage tanks. The breaker house is a square-plan, concrete block building with a flat, overhanging roof, single metal personnel door, and eight screen-covered, rectangular windows (**Photograph 123**). There is a metal ladder on the east side, giving access to the roof. The water storage tanks are large steel cylinders with slightly pitched roofs (**Photograph 124**). These tanks hold water for the SLDMWA, USBR, and WAPA compound.

The siphon at Mountain House Road is unique among the DMC siphon population. Located at M.P. 4.41/4.63, it extends a distance of 1,200 feet (**Photograph 126**). This single-barrel siphon is a monolithic concrete structure with an inside diameter of 24 feet 3 inches, and a shell thickness of 24 inches. Mountain House Road runs across the siphon at M.P. 4.46 and a blowoff box is located at M.P. 4.49 (**Photograph 127**). The one other siphon in Segment 1 is located at M.P. 1.36/1.41, along the intake canal section, conveying the DMC under Byron-Bethany Road and a single track for Southern Pacific Railroad. It is a three-barrel siphon of standard design, as described above in Section P3a.

At M.P. 7.20 there is a large, modern side-gable pumphouse with metal roof on the right bank constructed in 2011 which is not recorded in the *DMC Structures List* (2020). On the canal bank is an eight-barrel, concrete turnout structure covered by a metal debris screen (**Photograph 128**). On the opposite side of the building are four large pipes that appear to be metal. Adjacent to the pumphouse is a small electrical substation to power the pumps (**Photograph 129**). The pumphouse conveys water to the nearby California Aqueduct.

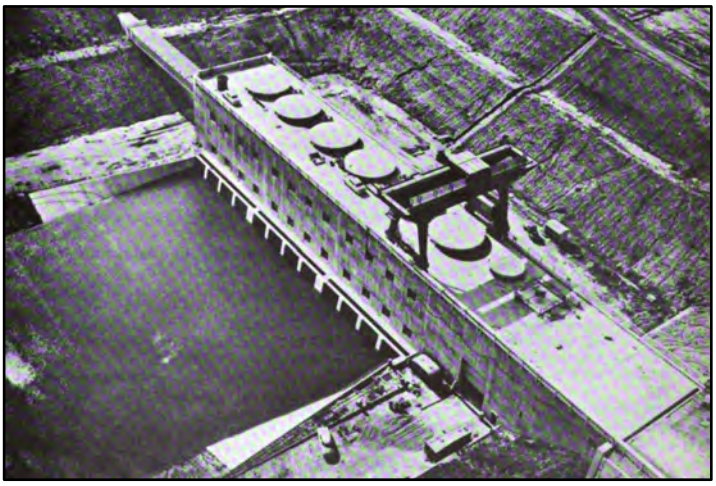
In addition to the major structures along DMC Segment 1 described above, this segment contains nine (9) bridges, 16 turnouts, one pump-in pipe (**Photograph 125**), one recorder house, two wash overchutes, 6 culverts, one stilling well, inlet and shoulder drains, safety ladders, cattle guards, and two Delta-Mendota Canal signs.

The Gage House salinity recorder is located at M.P. 3.65. This standing-seam metal building has a rectangular plan, measuring roughly 9 feet x 10 feet, with a metal door and low-pitched front-gable roof (**Photograph 130**). It is accessed by a set of concrete steps with a metal pipe handrail (**Photograph 131**).

The nine (9) bridges in this segment include: one County Highway Bridge, two State Highway Bridges, three non-original (post-1958) replacement bridges, and four Timber Farm Bridges. The County Highway Bridge at M.P. 0.33 along Lindemann Road is unique within the DMC bridge population. It has a concrete deck measuring 28 feet wide, supported by timber bents (**Photograph 64**). It is the only bridge along the DMC which retains a timber support structure. The three non-original bridges—at M.P. 9.29 along International Parkway / Mountain House Parkway, M.P. 10.28 along W. Schulte Road, and M.P. 10.62 along Hansen Road—are modern, concrete replacements of original County Highway Bridges. All other bridges in the segment are of standard design, although the farm bridge at M.P. 6.95 is barricaded on the right bank (**Photograph 132**) and the farm bridge at M.P. 9.87 has been damaged by fire and is barricaded on both banks (Error! Reference source not found.).

The 16 turnouts along this segment are all of standard design. One is a double-barrel (**Photograph 133**), while the remining 15 are single-barrel box or pipe types. Many of these have modern trash grates covering their inlets. All remaining features on this segment are of standard design. For a detailed discussion of standard repeating types, see the typology discussion in Section P3a.

Photographs (continued):



Photograph 108: Aerial view of Tracy Pumping Plant and inlet transition, April 1951.[127]



Photograph 109: View of water intake (north side) at C.W. Bill Jones Pumping Station; camera facing downstream from left bank, May 9, 2022. (A00106)



Photograph 110: North elevation of Pumping Station; camera facing south, May 9, 2022. (A00144)



Photograph 111: South elevation of Pumping Station; camera facing east, May 9, 2022. (A00095)

[127] [photograph], DM-1536-CV, in USDI, Reclamation, *Tracy Pumping Plant and Intake Canal and Discharge Lines: Technical Record of Design and Construction*, May 1959: 21.



Photograph 112: Suspended walkway on east side of Pumping Station; camera facing north, May 9, 2022. (A00099)



Photograph 113: East elevation of Pumping Station; camera facing west, May 9, 2022. (A00145)



Photograph 114: Roof access to Pumping Station from Road; camera facing northeast, May 9, 2022. (A00082)



Photograph 115: Detail view of removable hatches on roof of Pumping Station with gantry in background (left); camera facing east, May 9, 2022. (A00091)



Photograph 116: View of accordion doors on south façade; camera facing northeast, May 9, 2022. (A00098)



Photograph 117: View of windows on north façade of Pumping Station; camera facing west, May 9, 2022 (A00107).



Photograph 118: Detail view of east elevation and trusses on underside of suspended walkway; camera facing southwest, May 9, 2022. (A00102)



Photograph 119: Detail view of personnel door on east side of Pumping Station; camera facing west, May 9, 2022. (A00104)



Photograph 120: View of irrigation canal at M.P. 2.92; camera facing east, May 9, 2022. (A00176)



Photograph 121: View of bridge crossing over Irrigation Canal 120, around M.P. 3.12; camera facing east, May 9, 2022. (A00181)



Photograph 122: View of Irrigation Canal 155, around M.P. 3.33, with detail view of timber deck of bridge (bottom right); camera facing west, May 9, 2022. (A00188)



Photograph 123: View of concrete-block siphon breaker house at M.P. 3.49; camera facing south, May 9, 2022. (A00194)



Photograph 124: View of 64-gallon water storage tanks at M.P. 3.49; camera facing north, May 9, 2022. (A00192)



Photograph 125: View of BBID pump-in for Tracy Hills at M.P. 3.50, adjacent to discharge pipes inlet headwall (right); camera facing right bank from left bank, May 9, 2022. (A00199)



Photograph 126: View of Mountain House Road siphon inlet at M.P. 4.41; camera facing downstream from left bank, May 9, 2022. (A00216)



Photograph 127: View of blowoff box (M.P. 4.49, center foreground) on top of Mountain House Road siphon (M.P. 4.41/4.63); camera facing southwest, May 9, 2022. (A00219)



Photograph 128: View of pumphouse at M.P. 7.50 with eight-barrel concrete turnout structure covered by metal debris screen; camera facing right bank from left bank, May 9, 2022. (A00252)



Photograph 129: View of electrical substation adjacent to pumphouse at M.P. 7.50; camera facing downstream from left bank, May 9, 2022. (A00250)



Photograph 130: View of Gage House salinity recorder house at M.P. 3.65; camera facing upstream from left bank, May 9, 2022. (A00205)



Photograph 131: View of Gage House salinity recorder house and access stairs at M.P. 3.65 and concrete canal lining; camera facing downstream from left bank, May 9, 2022. (A00206)



Photograph 132: Detail view of barricade on right bank entrance to Farm Bridge at M.P. 6.95; camera facing downstream from left bank, May 9, 2022. (A00246)



Photograph 133: View of original double-barrel turnout at M.P. 3.54; camera facing right bank from left bank, May 9, 2022. (A00203)

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Lawton

***Date**: May 10, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-2

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 2 spans 4.83 miles between canal mileposts 11.35 and 16.18, from the Check No. 1 to a point just upstream of Check No. 2. This segment traverses the western edge of the San Joaquin Valley in San Joaquin County. See **Sketch Map** and **Location Map** on Continuation Sheets.

UTM: Zone 10S, 631988.99mE / 4174947.30mN (north endpoint); 637996.38mE / 4171388.27mN (south endpoint)

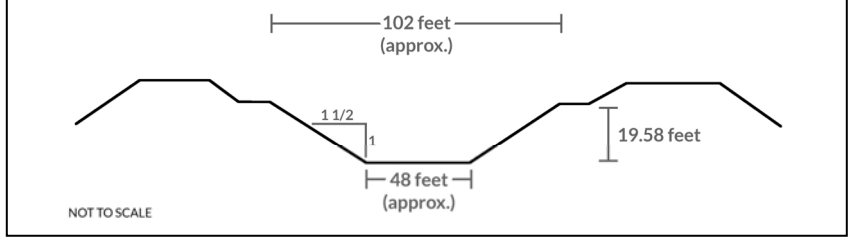
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
Beginning at Check No. 1 (**Photograph 134**), this segment of the DMC ends just upstream of Check No. 2 (**Photograph 146**) (see Continuation Sheet). This segment is concrete-lined with a trapezoidal cross section.

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 102 (original)
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 19.58 feet – 19.37 feet
d. **Length of Segment**: 4.83 miles

L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This segment of DMC traversed flat agricultural lands, orchards, hilly grasslands, and skirts an industrial area on the western edge of Tracy.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 134: Beginning of Segment 2, showing Check No. 1; camera facing upstream from left bank, May 10, 2022 (A00335).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Abigail Lawton
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 2, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[128] The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 135 - Photograph 136**).

The upstream end of DMC Segment 2 begins at Check No. 1, the site of which contains the check structure and check building (**Photograph 134**). Check No. 1, located at M.P. 11.35, is a concrete structure with a total length of 137 feet (**Photograph 137**), a width of approximately 102 feet at the upstream end, 123 feet at the check gates, and then narrowing again to about 102 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 138**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 11.35 on the left bank, is a concrete block structure, measuring approximately 9 feet by 7 feet. A stilling well is located just below Check No. 1, at M.P. 11.38, while a second stilling well is located just above Check No. 2 at M.P. 16.15. Both stilling wells are located on the left bank and are the typical cylindrical concrete type.[129]

In addition to the structures located at Check No. 1, DMC Segment 2 contains 15 turnouts, five (5) bridges, one wash overchute, two siphons, culverts, inlet drains, and cattle guards. The two siphons convey the DMC below single tracks for the Southern Pacific Railroad, at M.P. 11.49/11.51 (**Photograph 140** and **Photograph 141**), and Western Pacific Railroad, at M.P. 13.66/13.69 (**Photograph 142** and **Error! Reference source not found.**). Of the 15 Turnouts, 14 are concrete pipe types and one, at M.P. 15.95, is an overlining type for the City of Tracy and located adjacent to the Tracy Water Treatment Plant (**Photograph 144** and **Photograph 145**). This multi-component structure appears to have been modified (possibly enlarged) between 2005-2006.[130] All remaining turnouts are of standard design. Of the five (5) bridges, there are three Timber Farm Bridges, and two concrete County Highway Bridges, all of standard design, though the farm bridge at M.P. 15.10 is the only bridge with a timber deck measuring 12 feet wide and supported by four concrete piers, rather than the typical three piers (**Photograph 97**). All other features in this segment are of standard design. For a detailed discussion of standard repeating types, see the typology discussion in Section P3a.

[128] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[129] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*: 59, 62, 93, 97-99.
[130] USDI, Reclamation, *Milepost at Structure Sites: Delta-Mendota Canal*, December 1985: 17; USDI, Reclamation, *Delta-Mendota Canal Structures List*, May 2020: 8; Google Earth, historic views: 1985-2020

Photographs (continued):



Photograph 135: Downstream view from the top deck of Check No. 1 at M.P. 11.35; camera facing downstream from left bank; May 10, 2022 (A00337).



Photograph 136: Downstream view of deep excavation cuts at approximately M.P. 15.50; camera facing downstream from left bank, May 10, 2022 (A00431).



Photograph 137: Upstream view of Check No.1; camera facing upstream from left bank; May 10, 2022 (A00344).



Photograph 138: Top deck of Check No. 1; camera facing right bank, May 10, 2022 (A00342).



Photograph 139: *C*heck building on left bank at Check No. 1; camera facing northwest, May 10, 2022 (A00343).



Photograph 140: South Pacific Railroad Siphon inlet headwall at M.P. 11.49; camera facing downstream from left bank, May 10, 2022 (A00351).



Photograph 141: South Pacific Railroad Siphon outlet headwall at M.P. 11.51; camera facing upstream from left bank, May 10, 2022 (A00353).



Photograph 142: Western Pacific Railroad Siphon inlet headwall at M.P. 13.67; camera facing downstream from left bank, May 10, 2022 (A00392).



Photograph 143: Western Pacific Railroad Siphon outlet headwall at M.P. 13.69; camera facing upstream from left bank, May 10, 2022 (A00394).



Photograph 144: View of overlining type turnout at M.P. 15.95, for the City of Tracy; camera facing right bank from the left bank, May 10, 2022 (A00435).



Photograph 145: View of overlining type turnout at M.P. 15.95, for the City of Tracy, Tracy Water Treatment Plant visible in background (upper right corner); camera facing upstream from left bank, May 10, 2022 (A00436).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Lawton

***Date**: May 10, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-3

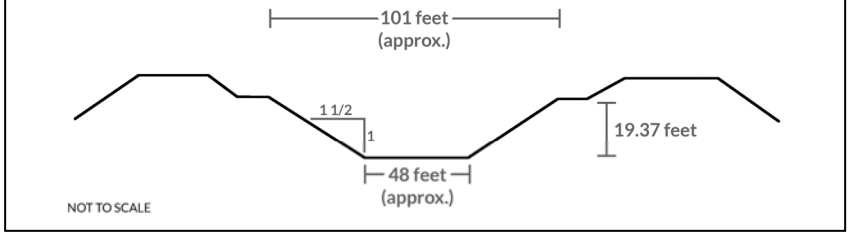
***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 3 spans 4.43 miles between mileposts 16.19 and 20.62 of the Delta-Mendota Canal, from Check No. 2 complex to just upstream of Check No. 3. This segment traverses the western edge of the San Joaquin Valley in San Joaquin County. See **Sketch Map** and **Location Map** on Continuation Sheets.
UTM: Zone 10S, 638014.15mE / 4171373.00mN (north endpoint); 643252.37mE / 4167485.02mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
Beginning at Check No. 2 (**Photograph 146**), this segment of the DMC traverses the grass-covered hillsides and flat agricultural lands of the western San Joaquin Valley to a downstream point located just upstream of Check No. 3. (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 101.6 feet (original)
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 19.37 feet
d. **Length of Segment**: 4.43 miles

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This segment of the DMC is located primarily in the flat agricultural lands of the San Joaquin Valley in southwestern San Joaquin County. Hillside vegetation to the east largely consists of tall grasses, while the surrounding agricultural lands are principally planted with orchards. Four public roadways cross this segment – S. Tracy Boulevard, Durham Ferry Road, McArthur Road, and Chrisman Road.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, patches to the canal lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 146: Beginning of Segment 3, showing Check No. 2; camera facing downstream from left bank, May 10, 2022 (A00446).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Abigail Lawton
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 3, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[131] Deterioration, cracking, and erosion are evident along some stretches of the canal lining (**Photograph 156**). Sandbags line the top of the canal wall in multiple locations (**Photograph 157 - Photograph 160**). The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 147** and **Photograph 148**). For a detailed discussion of DMC cross sections, see typology discussion in P3a. Description on Continuation Sheets.

The upstream end of DMC Segment 3 begins at Check No. 2, the site of which contains the check structure and check building; a siphon at M.P. 16.20/16.25 that carries the DMC under Tracy Blvd.; a short, narrow span of canal that runs from M.P. 16.25 to 16.31, approximately 310 feet long, with a non-transitioned siphon outlet and inlet; and a second siphon at M.P. 16.31/16.34 that conveys the DMC under a culvert that diverts Corral Hollow Creek across the canal (**Photograph 146, Photograph 150, - Photograph 153**). The outlet of this siphon, at M.P. 16.34, transitions back to the full-width canal (**Photograph 154**). Both siphons have four barrels and are of standard design, apart from their non-transitioned outlet/inlet, respectively.

Check No. 2 at M.P. 16.19 is a concrete structure with a total length of approximately 70 feet from its canal transition to the beginning of the siphon inlet (**Photograph 149**). It is approximately 101 feet wide at the widest upstream point where it meets the canal, then tapers as it transitions downstream to its narrowest point of approximately 62 feet wide. The walls of the check/inlet siphon structure transition from sloped, where it meets the canal, to vertical at the control gates. The canal narrows further between the check structure and the siphon inlet headwall, from approximately 62 feet to 50 feet (**Photograph 151**). The check structure is rectangular in cross section and divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. No provision was made for an overflow section. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 149**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. One metal lamp post with an umbrella-shaped shade is also present on the deck. The transitional concrete siphon outlet at M.P. 16.34 is approximately 70 feet long and 50 feet wide at the upstream end where it connects with the below-grade siphon (**Photograph 154**). The outlet walls are vertical at this point and flare out downstream as the outlet transitions to the canal, at which point the structure is 101 feet wide where it meets the canal. A stilling well is located just below this transition, at M.P. 16.39, while a second stilling well is located just above Check No. 3 at M.P. 20.60. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[132]

In addition to the canal features described above, DMC Segment 3 contains other major appurtenant structures in its span, including one wash overchute, four bridges, and 17 turnouts. The wash overchute at M.P. 18.59 is the typical reinforced concrete box type and carries the Corral Hollow Creek across the DMC. The four bridge crossings in this span, consist of: one Timber Operating Bridge and three Concrete County Highway Bridges, all of standard design. There are three types of turnouts in this segment: one overlining, one concrete box, and the rest are the typical concrete pipe type.

DMC Segment 3 also contains numerous minor appurtenant structures, including ladders, well discharges, and inlet and shoulder drains, virtually all constructed of metal and PVC pipes. The drain inlets consist of three types: concrete box, metal or PVC pipes, and pipes with a flap gate cover. For a detailed discussion of repeating major and minor appurtenant structures along the DMC, including siphon, overchute, bridge, turnout, culvert, inlet drain, stilling well, and check building types, see typology discussion in P3a. Description on Continuation Sheets.

[131] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[132] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*: 59-61, 93, 98-99; *2020 Structures List*: 8.

Photographs (continued):



Photograph 147: Downstream view from approximately M.P. 16.39; camera facing downstream from left bank; May 10, 2022 (B00003).



Photograph 148: Downstream view from approximately M.P. 20.37, with Check No. 3 in the distance; camera facing downstream from left bank, May 10, 2022 (B00076).



Photograph 149: View of Check No. 2, showing its transition into the Tracy Boulevard Siphon; camera facing downstream from left bank; May 10, 2022 (A00448).



Photograph 150: Check building at Check No. 2; camera facing northeast, May 10, 2022 (A00451).



Photograph 151: Transition between Check No. 2 and Tracy Boulevard Siphon, showing the siphon's inlet headwall; camera facing right bank from left bank, May 10, 2022 (A00452).



Photograph 152: Tracy Boulevard Siphon outlet headwall at M.P. 16.25; camera facing upstream from left bank, May 10, 2022 (A00454).



Photograph 153: Corral Hollow Creek Siphon inlet headwall at M.P. 16.31; camera facing right bank from left bank, May 10, 2022 (A00455).



Photograph 154: Corral Hollow Creek Siphon outlet headwall at M.P. 16.34; camera facing upstream from left bank, May 10, 2022 (B0002).



Photograph 155: Upstream view of Corral Hollow Creek where it crosses over the Corral Hollow Creek Siphon; camera facing southwest, May 10, 2022 (B00001).



Photograph 156: New cracking at a repair to the canal lining at M.P.; camera facing right bank from left bank, May 10, 2022. (B00029)



Photograph 157: View of sandbags lining the top of the canal wall at a turnout at M.P. 19.59; camera facing right bank from left bank, May 10, 2022. (B00069)



Photograph 158: View of sandbags lining the top of the canal wall at turnout site at M.P. 19.85; camera facing right bank from left bank, May 10, 2022. (B00070)



Photograph 159: View of sandbags lining the top of the canal wall at a turnout on the left bank at M.P. 20.42; camera facing right bank from left bank, May 10, 2022. (B00079)



Photograph 160: View of sandbags lining the top of the canal wall at a turnout on the left bank at M.P. 20.59; camera facing right bank from left bank, May 10, 2022. (B00085)

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Lawton

***Date**: May 10-11, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-4

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 4 spans 3.79 miles between mileposts 20.63 and 24.42 of the Delta-Mendota Canal, from just above the Check No. 3 to just above Check No. 4 in San Joaquin County along the western edge of the San Joaquin Valley. See **Sketch Map** and **Location Map** on Continuation Sheets.

UTM: Zone 10S, 643262.92mE / 4167471.29mN (north endpoint); 647820.49mE / 4164770.17mN (south endpoint)

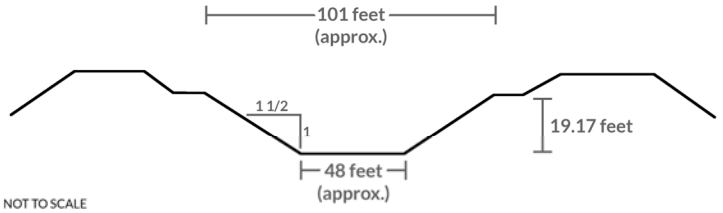
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)

Beginning immediately upstream of the Check No. 3 (**Photograph 161**), this segment of the DMC traverses the flat agricultural lands of the western San Joaquin Valley to a downstream point located just north of Check No. 4 (**Photograph 174**) (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 101 feet (original)
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 19.17 feet
d. **Length of Segment**: 3.79 miles

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)

This segment of the DMC is located primarily in the flat agricultural lands of the San Joaquin Valley in southwestern San Joaquin County. Surrounding agricultural lands are principally planted with orchards. Four public roadways cross the segment – S. Bird Road, Highway 132, Interstate 5, and Blewett Road.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, patches to the canal lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 161: Beginning of Segment 4, showing Check No. 3 and check building with a turnout and stilling well in the foreground; camera facing downstream from left bank, May 10, 2022 (B00084).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Abigail Lawton
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 4, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[133] Repairs and new cracking are evident along some stretches in this segment (**Photograph 171** and **Photograph 172**). Sandbags have been placed along the top of the canal lining in some areas (**Photograph 173**). The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 162** and **Photograph 163**). For a detailed discussion of DMC cross sections, see P3a. Description on Continuation Sheets.

The upstream end of DMC Segment 4 begins at Check No. 3, which includes the check structure and check building (**Photograph 161**). Check No. 3, at M.P. 20.63, is a concrete structure with a total length of 137 feet. It is approximately 101 feet wide at the upstream end, widens to about 123 feet at the check gates, and then narrows again to 101 feet where it rejoins the canal walls on the downstream side (**Photograph 164** and **Photograph 165**). The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 166**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. One metal lamp post with an umbrella-shaped shade is also present on the deck. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 20.63 on the left bank, is a rusticated concrete block structure, measuring approximately 9 feet by 7 feet. A stilling well is located just below Check No. 3, at M.P. 20.69, while a second stilling well is located just above Check No. 4 at M.P. 24.40 (**Photograph 167**). Both stilling wells are located on the left bank and are standard design.[134]

In addition to the canal features located at Check No. 3, DMC Segment 4 contains other major appurtenant structures in its span, including nine (9) bridges, twelve turnouts, one wash overchute, one CVP sign, and one siphon. The nine bridge crossings in this span consist of five non-original (post-1958) State Highway bridges, two timber Farm Bridges, and one concrete County Highway bridge, and one County Road crossing a siphon. Blewett Road crosses over the DMC siphon at M.P. 23.95/24.01 and is included in the bridge population of this inventory because it is categorized as a Bridge in the *DMC Structures List* (**Photograph 168** and **Photograph 169**). This siphon is a three-barrel type, of standard design. Of the segment's twelve turnouts, one is a steel pipe turnout (**Photograph 170**), while the rest are the typical concrete pipe type all with modern trash racks. The wash overchute at M.P. 21.91 is a reinforced concrete box type, carrying Lone Tree Creek north across the DMC.

DMC Segment 4 contains numerous minor appurtenant structures, including pipe crossings, inlet and shoulder drains, and ladders.

For a detailed discussion of DMC siphon, bridge, turnout, culvert, pipe crossings, inlet drain, CVP signs, stilling well, and check building types, see typology description in P3a. Description on Continuation Sheets.

[133] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[134] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*: 59, 62, 93, 97-99.

Photographs (continued):



Photograph 162: Upstream view from approximately M.P. 21.65; camera facing camera facing upstream from left bank, with a turnout in the foreground; May 10, 2022 (B00124).



Photograph 163: Downstream view from approximately M.P. 23.41; camera facing camera facing downstream from left bank, May 10, 2022 (A00459).



Photograph 164: Check No. 3; camera facing camera facing downstream from left bank, May 10, 2022 (B00092).



Photograph 165: Check No. 3; camera facing upstream from left bank, May 10, 2022 (B00091).



Photograph 166: Deck of Check No. 3; camera facing right bank from left bank, May 10, 2022 (B00090).



Photograph 167: View of stilling well, M.P. 20.69, and Check No. 3 outlet transition; camera facing upstream from left bank, May 10, 2020 (B00096.)



Photograph 168: Blewett Road Siphon inlet headwall; camera facing downstream from left bank; May 11, 2022 (A00471).



Photograph 169: Blewett Road Siphon outlet headwall; camera facing upstream from left bank; May 11, 2022 (A00475).



Photograph 170: The one steel pipe turnout in this segment at M.P. 20.97; camera facing right bank from left bank, May 10, 2022 (B00104).



Photograph 171: Cracking in canal lining at right abutment of BRIDGE at M.P.; camera facing downstream from left bank, May 10, 2022 (B00116).



Photograph 172: View of repair to concrete lining around M.P 22.90., with sandbags on top of wall downstream; camera facing right bank from left bank, May 10, 2022 (B00180).



Photograph 173: Sandbags lining the concrete wall above the turnout at M.P.; camera facing right bank from left bank, May 10, 2022 (B00097

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Lawton

***Date**: May 11, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-5

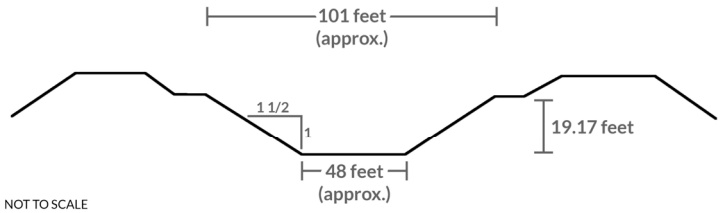
***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) FKC Segment 5 spans 5.38 miles between mileposts 24.43 and 29.81 of the Delta-Mendota Canal, from just above Check No. 4 in San Joaquin County to just above Check No. 5 in Stanislaus County along the western edge of the San Joaquin Valley. See **Sketch Map** and **Location Map** on Continuation Sheets.
UTM: Zone 10S, 647821.03mE / 4164752.13mN (north endpoint); 652704.37mE / 4158413.08mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
Beginning immediately upstream of Check No. 4 (**Photograph 174**), this segment of the DMC traverses the grass-covered hillsides and flat agricultural lands of the western San Joaquin Valley to a downstream point located just upstream of Check No. 5 (**Photograph 181**) (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 101 feet (original)
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 19.17 feet
d. **Length of Segment**: 5.83 miles

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This segment of the DMC is located primarily in the flat agricultural lands of the San Joaquin Valley in southwestern San Joaquin County and northwestern Stanislaus County. The surrounding agricultural lands are principally planted with orchards. The canal is traversed by four public roadways – Koster Road, Gaffery Road, Welty Road, and Hamilton Road.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, patches to the canal lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 174: Beginning of Segment 5, showing Check No. 4 and recorder house; camera facing downstream from left bank, May 11, 2022 (A00484).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Abigail Lawton
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: July 2022

L3. Description (continued):

In Segment 5, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[135] Cracking is evident along some stretches in this segment (**Photograph 180**). The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 175** and **Photograph 176**). For a detailed discussion of DMC cross sections, see P3a. Description on Continuation Sheets.

The upstream end of DMC Segment 5 begins immediately above Check No. 4, the site of which contains the check structure and building (**Photograph 174**). Check No. 4, at M.P. 24.42, is a concrete structure with a total length of 137 feet (**Photograph 177**). It is approximately 101 feet wide at the upstream end, widens to about 123 feet at the check gates, and then narrows again to 101 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 178**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. One metal lamp post with an umbrella-shaped shade is also present on the deck. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 24.42 on the left bank, is a rusticated concrete block structure, measuring approximately 9 feet by 7 feet. A stilling well is located just below Check No. 4, at M.P. 24.48, while a second stilling well is located just above Check No. 5 at M.P. 29.79. Both stilling wells are located on the left bank and are of standard design.[136]

In addition to the canal features located at the Check No. 4 site, DMC Segment 5 contains other major appurtenant structures in its span, including 19 turnouts, five (5) bridges, and two wash overchutes. There are 18 active turnouts, of which 16 are the typical concrete pipe type, and 2 are steel pipes. There is an additional concrete pipe turnout listed in the Structures List at M.P. 25.61, but this appears to have been deactivated and its pump removed (**Photograph 179**). There are five bridge crossings, consisting of four concrete County Highway bridges and one Timber Farm bridge, all of standard type. Both overchutes are the reinforced concrete box type. The overchute at M.P. 25.20 carries Hospital Creek across the DMC and the overchute at M.P. 25.62 conveys Little Hospital Creek.

DMC Segment 5 contains numerous minor appurtenant structures, including ladders, and inlet and shoulder drains, virtually all of which are made of metal or PVC.

For a detailed discussion of DMC bridge, turnout, siphon undercrossing, inlet drain, and recorder house types, see typology discussion in P3a. Description on Continuation Sheets.

[135] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[136] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*: 59, 62, 93, 97-99.

Photographs (continued):



Photograph 175: Downstream view from approximately M.P. 24.89; camera facing downstream from left bank, May 11, 2022 (A00498).



Photograph 176: Downstream view from approximately M.P. 27.22; camera facing downstream from left bank, May 11, 2022 (A00548).



Photograph 177: Check No. 4; camera facing downstream from left bank, May 11, 2022 (A00485).



Photograph 178: Check No. 4; camera facing right bank from left bank, May 11, 2022 (A00489).



Photograph 179: Site where a concrete pipe turnout listed at M.P. 25.61, appears to have been deactivated and its pump removed; camera facing downstream from left bank, May 11, 2022 (A00515).



Photograph 180: Cracking on concrete lining around turnout at M.P. 26.69; camera facing right bank from left bank, May 11, 2022 (A00535).

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Lawton

***Date**: May 11, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-6

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 6 spans 4.59 miles between canal mileposts 29.82 and 34.41, from Check No. 5 to just above Check No. 6 along the western edge of the San Joaquin Valley in Stanislaus County. See **Sketch Map** and **Location Map** on Continuation Sheets.

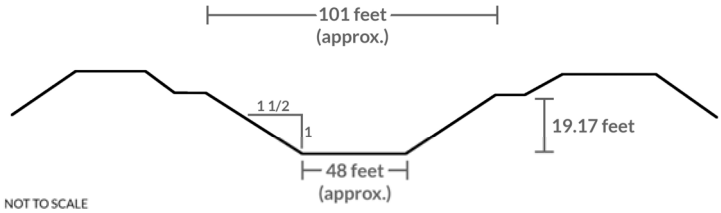
UTM: Zone 10S, 652727.27mE / 4158408.47mN (north endpoint); 657414.47mE / 4154272.19mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
Beginning at Check No. 5 (**Photograph 181)**, this segment of the DMC is 4.59 miles long and ends just upstream of Check No. 6 (**Photograph 182**). This segment of the DMC is concrete-lined and has the same trapezoidal cross section as elsewhere on the canal. Along both sides of the conduit are gravel maintenance roads approximately 12 to 20 feet wide (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 101 feet (original)
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 19.17 feet
d. **Length of Segment**: 4.59 miles

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This segment of DMC passes through flat agricultural lands planted principally with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 181: Beginning of Segment 6, showing the Check No. 5 and recorder house with a stilling well in the foreground; camera facing downstream from left bank, May 11, 2022 (A00602).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Abigail Lawton
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 6, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[137] Deterioration, cracking, and erosion are evident along some stretches in this segment and sandbags line the top of the canal wall in some locations (**Photograph 198 - Photograph 203**). The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 182 - Photograph 184**). For a detailed discussion of DMC cross sections, see P3a. Description on Continuation Sheets.

The upstream end of DMC Segment 6 begins immediately above Check No. 5, the site of which contains the check structure and building (**Photograph 181**). Check No. 5 at M.P. 29.81 is a concrete structure with a total length of 137 feet. It is approximately 101 feet wide at the upstream end, widens to about 123 feet at the check gates, and then narrows again to 101 feet where it rejoins the canal walls on the downstream side (**Photograph 185** and **Photograph 186**). The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 185**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. One metal lamp post with an umbrella-shaped shade is also present on the deck. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 29.81 on the left bank, is a rusticated concrete block structure, measuring approximately 9 feet by 7 feet. A stilling well is located just below Check No. 5, at M.P. 29.88, while a second stilling well is located just above Check No. 6 at M.P. 34.39. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[138]

Downstream of Check No. 5 is the Westley Wasteway on the east side of the canal at M.P. 34.32 (**Photograph 187**). The wasteway allows water to flow from the canal northeast about 3.9 miles to the San Joaquin River. The wasteway begins with a concrete inlet structure on the left bank of the canal consisting of two waterways, each with a steel radial gate—measuring 20 feet wide and 17 feet tall—controlling the water flow (**Photograph 188** and **Photograph 189**). Both radial gates each have two gate arms, each measuring 19 feet, 9.5 inches long, with the pivot points bolted to a concrete headwall. The gates' arms all have truss designs, and the arched gate faces are all reinforced by a grid pattern of steel beams. The gates are raised and lowered by a row of electric motors, hoists, pulleys, and a manual handle mounted on a concrete platform on top of the structure. This top deck includes a service walkway with pipe railing along the edge, and it also features a metal electrical box.[139]

Water passing through the wasteway control structure flows into a concrete chute on the east side of the canal levee (**Photograph 190** and **Photograph 191**). About 3.8 miles of the wasteway are concrete-lined and of trapezoidal chute section with vertical top walls, and 0.1 mile is unlined earth (**Photograph 192 - Photograph 195**). The concrete sidewalls quickly narrow from about 47 feet wide where the water emerges from the control structure to about 23 feet wide where the water is siphoned into the main chute of the wasteway, which quickly expands to a width of about 42 feet. After the concrete transitions to earth the wasteway continues for approximately 0.1 miles until it terminates at an inlet to the San Joaquin River

[137] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[138] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*: 59, 62, 93, 97-99.
[139] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*, "Table 1.—Design data for gates and hoists installed at structures on Delta-Mendota Canal," 99; USDI, Reclamation, Central Valley Project – California (CVP), "Delta Mendota Canal-Sta.625+00-Check, Radial Gate and Hoist Installation" dwg. no. 214-D-13893, ca. 1947.

(**Photograph 196**). The only Railroad Bridge associated with the DMC crosses over the Westley Wasteway at M.P. 2.06 (station 108+85.20). It is a single-span bridge originally provided for the Southern Pacific Railroad. It has a concrete deck supported on steel stringer, with metal pipe railings (**Photograph 193**). It was designed for a single track, but abutments were designed to accommodate two tracks. It was designed for an E-72 loading in accordance with "Specifications for Steel Railway Bridges" of the American Railway Engineering Association, 1946 edition.[140]

In addition to the canal features located at or near the Check No. 5 site and Westley Wasteway, DMC Segment 6 contains other major appurtenant structures in its span, including 16 turnouts and eight (8) bridges. The 16 turnouts consist of 15 of the concrete pipe type, and one concrete box type (**Photograph 197**). The eight bridge crossings include: two Timber Farm bridges, one concrete County Highway bridge, one County Highway Wasteway Crossing bridge, one Timber Operating bridge, and three non-original bridges built post-1958. The three non-original bridges consist of two concrete county road bridges that were rebuilt in 1965, at M.P. 29.93 along McCracken Road and at M.P. 34.39 along Needham Road, and one timber operating bridge at M.P. 33.29 that was replaced in 1998. All other bridges are of standard design. There are also three siphon undercrossings that convey irrigation laterals under the DMC at M.P. 31.65, 33.72, and 34.1

DMC Segment 6 contains numerous minor appurtenant structures, including ladders, and inlet and shoulder drains, virtually all of which are made of metal or PVC. These all follow the standard design type.

For a detailed discussion of DMC bridge, turnout, siphon undercrossing, inlet drain, stilling well and check building types, see typology discussion in P3a. Description on Continuation Sheets.

[140] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*: 13, 88.

Photographs (continued):



Photograph 182: Upstream view from approximately M.P. 30.33; camera facing upstream from left bank, May 11, 2022 (A00615).



Photograph 183: Downstream view from approximately M.P. 30.33; camera facing downstream from left bank, May 11, 2022 (A00614).



Photograph 184: Downstream view from approximately M.P. 32.38; camera facing downstream from left bank, May 11, 2022 (A00666).



Photograph 185: Detail view of Check No. 5 deck, camera facing right bank from left bank, May 11, 2022 (A00606).



Photograph 186: Upstream view of Check No. 5; camera facing upstream from left bank, May 11, 2022 (A00607).



Photograph 187: Downstream view of inlet to Westley Wasteway at M.P. 34.32, including wasteway bridge; camera facing downstream from left bank from left bank, May 11, 2022 (A00709).



Photograph 188: Detail view of Westley Wasteway's inlet structure's top deck and gate-hoisting equipment; camera facing upstream from left bank, May 11, 2022 (A00713).



Photograph 189: Detail view of the radial gates in Westley Wasteway's inlet structure; camera facing west, May 11, 2022 (A00712).



Photograph 190: View of beginning of concrete-lined chute of Westley Wasteway from inlet at M.P. 34.32; camera facing east from left bank, May 11, 2022 (A00710).



Photograph 191: View of Westley Wasteway inlet from approximately M.P. 34.32; camera facing upstream from left bank of the Westley Wasteway, May 11, 2022 (A00728).



Photograph 192: View of wasteway concrete chute and missing bridge around M.P. 0.35 on the Westley Wasteway; camera facing downstream from right bank, May 11, 2022 (A00730).



Photograph 193: View of Railroad Bridge at M.P. 2.06 on the Westley Wasteway; camera facing upstream from right bank, May 11, 2022 (A00756).



Photograph 194: "Drop" structure at the end of concrete lined section of Westley Wasteway at wasteway M.P. 3.84; camera facing upstream from wasteway's right bank, May 11, 2022 (A00775).



Photograph 195: Upstream view of earth section of Westley Wasteway around wasteway M.P. 3.85; camera facing upstream from wasteway's right bank, May 11, 2022 (A00778).



Photograph 196: End of earth section of Westley Wasteway where it natural water feature connected to the San Joaquin River at wasteway M.P. 4.01; camera facing downstream from wasteway's right bank, May 11, 2022 (A00785).



Photograph 197: Concrete box turnout at M.P. 31.31; camera facing downstream from left bank, May 11, 2022 (A00645).



Photograph 198: View of a new crack on a repair to the canal wall near M.P. 30.63; camera facing right bank from left bank, May 11, 2022 (A00634).



Photograph 199: View of sandbags lining the top of the concrete wall around turnout at M.P. 33.53; camera facing right bank from left bank, May 11, 2022 (A00690).



Photograph 200: View of large patch on right embankment above concrete lining at approximately M.P. 33.71; camera facing downstream from left bank, May 11, 2022 (A00693).



Photograph 201: View of sandbags lining the top of the concrete wall around features at M.P. 33.71; camera facing downstream from left bank, May 11, 2022 (A00694)



Photograph 202: View of patch to canal wall transitioning to bags laid on top of the concrete lining at approximately M.P. 33.71; camera facing right bank from left bank, May 11, 2022 (A00697).



Photograph 203: View of sandbags lining the top of the concrete wall around features on both side of the canal at M.P. 33.90; camera facing upstream from left bank, May 11, 2022 (A00703).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby, A. Lawton & A. Young

***Date**: May 11-12, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-7

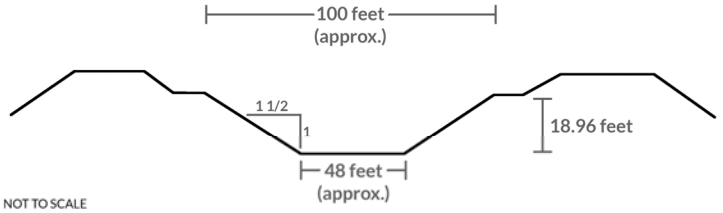
***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 7 spans 4.25 miles between canal mileposts 34.42 and 38.67, from just above Check No. 6 to just above Check No. 7. See **Sketch Map** and **Location Map** on Continuation Sheets.
UTM: Zone 10S, 657420.14mE / 4154251.96mN (north endpoint); 660474.74mE / 419242.05mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
This segment begins at a point just upstream of Check No. 6 and continues to a point just upstream of Check No. 7 (**Photograph 204**) (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100.38 feet (original)
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 18.96 feet
d. **Length of Segment**: 4.25 miles

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
The setting of Segment 7 is the flat agricultural lands of the western San Joaquin Valley surrounded largely by orchards. This segment terminates at the northwest corner of the City of Patterson.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 204: Beginning of Segment 7, showing the Check No. 6 and check building; camera facing downstream from left bank, May 11, 2022 (A00720).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Abigail Lawton
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 7, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[141] The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 206 and Photograph 207**).

The upstream end of DMC Segment 7 begins at Check No. 6, the site of which contains the check structure and building (**Photograph 204**). Check No. 6, at M.P. 34.42, is a concrete structure with a total length of 137 feet (**Photograph 208** and **Photograph 209**). It is approximately 100 feet wide at the upstream end, widens to about 123 feet at the check gates, and then narrows again to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 208**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. One metal lamp post with an umbrella-shaped shade is also present on the deck. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 34.42 on the left bank, is a rusticated concrete block structure, measuring approximately 9 feet by 7 feet. A stilling well is located just below Check No. 6, at M.P. 34.47, while a second stilling well is located just above Check No. 7 at M.P. 38.64. Both stilling wells are located on the left bank and are of standard design.

In addition to the canal features located at Check No. 6 and described above, DMC Segment 7 contains other major appurtenant structures in its span, including 13 turnouts, five (5) bridges, two siphon undercrossing, one siphon, one pump-in structure, and one "underdrain." Of the 13 turnouts, 12 are the typical concrete pipe type, and one is a fiberglass pipe. The five bridges in this segment include: two timber Operating Bridges, two Timber Farm Bridges, and one concrete Operating Bridge (**Photograph 205**). Most of these bridges are of the standard type, except for the concrete Operating Bridge at M.P. 37.28, adjacent to the Del Puerto Creek siphon. This is the only operating bridge with a concrete deck on concrete bents (**Photograph 210** and **Photograph 211**). Its deck measures 16 feet wide and has modern steel guard-rails. The date of construction of this bridge is unknown. Original design drawings show that, initially, all DMC operating bridges were of timber construction, therefore it is likely that this concrete bridge replaced an original timber bridge at or near this location, at a date unknown. The siphon under Del Puerto Creek, at M.P. 37.24/37.31, is a three-barrel siphon of standard design (**Photograph 213** and **Photograph 214**). The two siphon undercrossings carry irrigation lines under the DMC at M.P. 34.64 and 35.05. The Modesto Irrigation District pump-in is included in the DMC Structures List at M.P. 37.33, however it was observed as being slightly further downstream (**Photograph 215** and **Photograph 216**).

DMC Segment 7 contains numerous minor appurtenant structures, including ladders, and inlet and shoulder drains, virtually all comprised of metal and PVC pipes. This segment also contains one stairway for fishing at M.P. 38.11. This structure is a four-step concrete stairway on the canal bank with a metal pipe railing and a short metal pipe railing at the canal edge to stand along (**Photograph 212**).

For a detailed discussion of repeating major and minor appurtenant structures along the DMC, including bridge, turnout, culvert, inlet drain, stilling well, and check building types, see typology discussion in P3a. Description on Continuation Sheets.

[141] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.

Photographs (continued):



Photograph 205: Upstream view of Segment 7, showing farm bridge at M.P. 35. 39 with a tractor crossing it; camera facing upstream from left bank, May 12, 2022 (A00834).



Photograph 206: Downstream view of Segment 7 from approximately M.P. 35.10, showing a well discharge (left bank) and inlet drain (right bank); camera facing downstream from left bank, May 12, 2022 (A00815).



Photograph 207: View from the deck of a farm bridge a M.P. 38.14; camera facing upstream, May 12, 2022.



Photograph 208: View of Check No. 6; camera facing downstream from left bank, May 11, 2022 (A00722).



Photograph 209: Upstream view of Check No. 6; camera facing upstream from left bank, May 11, 2022 (A00723).



Photograph 210: View of concrete deck on Operating Bridge at M.P. 37.28; camera facing right bank from left bank, May 12, 2022 (B00255).



Photograph 211: Detail view of concrete bents on Operating Bridge at M.P. 37.28; camera facing northwest, May 12, 2022 (B00256).



Photograph 212: Fishing stairs at M.P. 38.11; camera facing downstream from left bank, May 12, 2022 (B00266).



Photograph 213: Downstream view of siphon inlet headwall at M.P. 37.31; camera facing downstream from left bank, May 12, 2022 (B00234).



Photograph 214: Upstream view of siphon outlet headwall at M.P. 37.31; camera facing upstream from right bank, May 12, 2022 (B00252).



Photograph 215: Modesto Irrigation District pump-in near M.P. 37.33, camera facing upstream from right bank, May 12, 2022 (B00245).



Photograph 216: Modesto Irrigation District pump-in, reportedly at M.P. 37.33, but here shown upstream of an inlet drain marked at M.P. 37.34, camera facing upstream from right bank, May 12, 2022 (B00245).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Lawton

***Date**: May 12, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-8

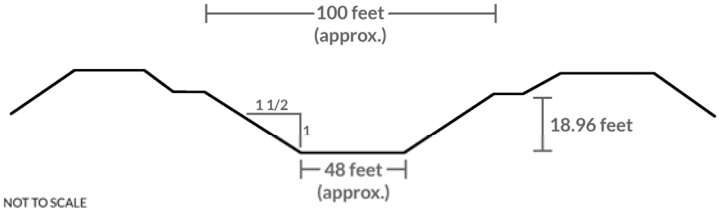
***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) FKC Segment 8 spans 5.57 miles between canal mileposts 38.68 and 44.25, from just above Check No. 7 to just above Check No. 8 along the western edge of the San Joaquin Valley in Stanislaus County. See **Sketch Map** and **Location Map** on Continuation Sheets.
UTM: Zone 10S, 660487.43mE / 4149239.14mN (north endpoint); 665394.03mE / 4143148.06mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
Beginning at Check No. 7 (**Photograph 217**), this segment of the DMC ends just upstream of Check No. 8 (**Photograph 240**) (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100.38 feet (original)
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 18.96 feet
d. **Length of Segment**: 5.57 miles

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This segment of DMC is located in the flat agricultural lands of the San Joaquin Valley principally planted with orchards. The canal skirts the commercial zones at the western edge of the City of Patterson.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, patches to the canal lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 217: Beginning of Segment 8, showing Check No. 7, check building, and stilling well; camera facing downstream from left bank, May 12, 2022 (B00297).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Abigail Lawton
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 8, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[142] Heavy deterioration, cracking, erosion, and subsidence are evident along some stretches in this segment (**Photograph 233 - Photograph 239**). The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 218 - Photograph 220**).

The upstream end of DMC Segment 8 begins at Check No. 7, the site of which contains the check structure and building (**Photograph 217**). Check No. 7, at M.P. 38.68, is a concrete structure with a total length of 137 feet (**Photograph 221 - Photograph 223**). It is approximately 100 feet wide at the upstream end, widens to about 123 feet at the check gates, and then narrows again to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 222**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. One metal lamp post with an umbrella-shaped shade is also present on the deck. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 36.68 on the left bank, is a rusticated concrete block structure, measuring approximately 9 feet by 7 feet. A stilling well is located just below Check No. 7, at M.P. 38.74, while a second stilling well is located just above Check No. 8 at M.P. 44.24. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[143]

In addition to the canal features located at Check No. 7, DMC Segment 8 contains other major appurtenant structures in its span, including one wasteway, one culvert, one overchute, one overflow inlet structure, one set of fishing stairs, seven (7) bridges, and 18 turnouts. This segment also includes the Patterson O&M storage yard on the east side of the O&M road, at M.P. 40.00, which consists of a fenced in yard containing two single-story standing-seam metal buildings of rectangular plan, with low-pitched gable roofs. (**Photograph 224** and **Photograph 225**). The prefabricated metal construction of these buildings was common and ubiquitous throughout the CVP. They are no longer in use and have suffered heavy deterioration, such as missing roofing and siding panels and many missing doors and windows. Remaining metal siding and roofing has been subject to heaving rusting.

The wasteway is a concrete overspill apron, the only one of its type on DMC, located at M.P. 39.32/39.42 on the right bank (**Photograph 226** and **Photograph 227**). Just downstream of this, at M.P. 39.46, is the culvert crossing that carries Black Gulch under the DMC. The overchute, at M.P. 41.93, is the typical reinforced concrete box type and carries Salado Creek across the DMC. Just downstream of the overchute is the City of Patterson's overflow inlet structure for Salado Creek. This structure consists of three 60-inch concrete pipes at M.P. 41.94 (**Photograph 228** and **Photograph 229**). Fishing stairs were observed around M.P. 38.75, although they are not included in the DMC Structures List (2020) (**Photograph 230**). They consist of a set of four concrete steps, with a metal pipe handrail, leading from the road to the canal with another short span of metal pipe railing along the top of the canal wall. The seven bridge crossings in this segment include: three concrete County Highway bridges, two Timber Farm bridges, one Timber Operating bridge, and one non-original (post-1958) county highway bridge. The non-original county highway bridge at M.P. 39.81 carries Sperry Road/Hwy 130 across the DMC. It is a concrete bridge, deck measuring 30 feet wide, that stretches between two large abutments with no support piers (**Photograph 231** and **Photograph 232**). The footings of the original bridge are still evident underneath the current bridge. All other bridges in this

[142] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[143] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*, 59, 62, 93, 97-99.

segment are of standard designs. Of the 18 turnouts in this span, 15 are the typical concrete pipe type, two are the concrete box type, and one is a steel pipe.

DMC Segment 8 contains numerous minor appurtenant structures, including ladders, well discharges, and inlet and shoulder drains, virtually all constructed of metal and PVC pipes.

For a detailed discussion of repeating major and minor appurtenant structures along the DMC, including bridge, turnout, overchute, culvert, inlet drain, stilling well, and check building types, see typology discussion in P3a. Description on Continuation Sheets.

Photographs (continued):



Photograph 218: Downstream view from the deck of Check No. 7; camera facing downstream, May 12, 2022 (B00318).



Photograph 219: Downstream view from approximately M.P. 38.74; camera facing downstream from left bank, May 12, 2022 (B00321).



Photograph 220: Downstream view from approximately M.P. 43.73; camera facing downstream from left bank, May 12, 2022 (B00449).



Photograph 221: Downstream view of Check No. 7; camera facing downstream from left bank, May 12, 2022 (B00298).



Photograph 222: Detail view of Check No. 7's deck and gate-hoisting equipment; camera facing right bank from left bank, May 12, 2022 (B00300).



Photograph 223: View of downstream side of Check No. 7; camera facing upstream from left bank, May 12, 2022 (B00320).



Photograph 224: Patterson O&M storage yard on the east side of the O&M road, at M.P. 40.00 containing two deteriorated and unused buildings; camera facing southeast, May 12, 2022 (B00364).



Photograph 225: Patterson O&M storage yard at M.P. 40.00 where buildings are no longer in use and have suffered heavy deterioration; camera facing southwest, May 12, 2022 (B00368).



Photograph 226: Concrete overspill apron wasteway at M.P. 39.32/39.42 on the right bank is the only one of its type on the DMC; camera facing downstream from left bank; May 12, 2022 (B00338).



Photograph 227: Concrete overspill apron wasteway at M.P. 39.32/39.42 on the right bank, the only one of its type on the DMC; camera facing upstream from left bank; May 12, 2022 (B00342).



Photograph 228: City of Patterson's overflow inlet structure for Salado Creek at M.P. 41.94, just below overchute; camera facing upstream from left bank, May 12, 2022 (B00412).



Photograph 229: City of Patterson's overflow inlet structure for Salado Creek at M.P. 41.94, consists of three 60-inch concrete pipes; camera facing right bank from left bank, May 12, 2022 (B00413).



Photograph 230: Fishing stairs around M.P. 38.75; camera facing southwest from left bank, May 12, 2022 (B00323).



Photograph 231: Non-original replacement county highway bridge at M.P. 39.81 along Sperry Road/Hwy 130, concrete deck measuring 30 feet wide, that stretches between two large abutments with no support piers; camera facing downstream from left bank, May 12, 2022 (B00343).



Photograph 232: Non-original replacement county highway bridge at M.P. 39.81 along Sperry Road/Hwy 130, with footings of the original bridge still evident underneath the current bridge; camera facing upstream from left bank, May 12, 2022 (B00350).



Photograph 233: Subsidence on right bank around M.P. 42.30; camera facing right bank from left bank, May 12, 2022 (B00417).



Photograph 234: Repair to the right bank canal lining around M.P. 42.3; camera facing right bank from left bank, May 12, 2022 (B00417).



Photograph 235: Repairs to the right bank canal lining around M.P. 42.53; camera facing right bank from left bank, May 12, 2022 (B00426).



Photograph 236: Patches to right bank canal lining with fresh cracks visible around turnout at M.P. 43.08; camera facing right bank from left bank, May 12, 2022 (B00434).



Photograph 237: Patches to right bank canal wall and subsidence just above Marshall Road bridge at M.P. 43.24; camera facing right bank from left bank, May 12, 2022 (B00442).



Photograph 238: Large repair to right bank canal wall between Marshall Road bridge and inlet drain at M.P. 43.24; camera facing right bank from left bank, May 12, 2022 (B00447).



Photograph 239: Cracking in right bank canal lining between a large repair to canal wall just below Marshall Road bridge at M.P. 43.24 and drain inlet with flap gate on right bank at M.P. 43.26; camera facing right bank from left bank, May 12, 2022 (B00448).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Lawton

***Date**: May 12-13, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-9

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 9 spans 4.35 miles between canal mileposts 44.26 and 48.61, from just above Check No. 8 to just above Check No. 9 along the western edge of the San Joaquin Valley in Stanislaus County. See **Sketch Map** and **Location Map** on Continuation Sheets.
UTM: Zone 10S, 665395.16mE / 4143126.94mN (north endpoint); 667851.60mE / 4137214.23mN (south endpoint)

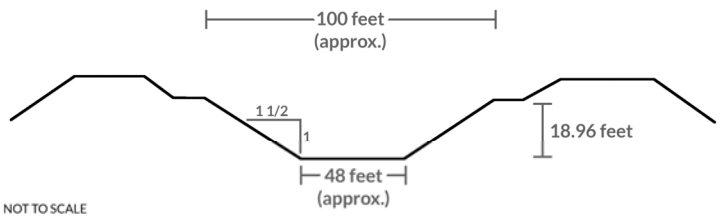
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
This segment begins at a point just upstream of Check No. 8 and continues to a point just upstream of Check No. 9 (**Photograph 240**). The canal has a trapezoidal cross-section and is lined with concrete (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100.38 feet (original)
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 18.96 feet
d. **Length of Segment**: 4.35 miles

L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This segment of DMC passes through the flat agricultural lands of the western San Joaquin Valley. Surrounding agricultural lands are principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 240: Beginning of Segment 9, showing Check No. 8 and check building; camera facing downstream from left bank, May 12, 2022 (B00456)

L9. Remarks:

L10. Form prepared by:
H. Norby & A. Lawton
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 9, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[144] Subsidence and cracking are evident along some stretches of this segment and sandbags line the top of the canal wall in some locations (**Photograph 243** and **Photograph 244**). The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 241**). For a detailed discussion of DMC cross sections, see typology discussion in P3a. Description on Continuation Sheets.

DMC Segment 9 begins at Check No. 8 at M.P. 44.26, the site of which contains the check structure and building (**Photograph 240**). The check is a concrete structure with a total length of 137 feet (**Photograph 242**). It is approximately 100 feet wide at the upstream end, widens to 123 feet at the check gates, and then narrows again to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge. On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. One metal lamp post with an umbrella-shaped shade is also present on the deck. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 44.26 on the left bank, and is of standard design. A stilling well is located just below Check No. 8, at M.P. 44.32, while a second stilling well is located just above Check No. 9 at M.P. 48.59. Both stilling wells are located on the left bank and are of standard design.[145]

In addition to the structures located at Check No. 8, DMC Segment 9 contains one overchute, one culvert, one pipe crossing, six (6) bridges, and 14 turnouts. The Crow Creek overchute at M.P. 48.43 and the Little Salado Creek culvert crossing at M.P. 45.75 are of standard design. The six bridge crossings in this span include: three concrete County Highway bridges and three timber Farm Bridges, all of standard design. Additionally, the concrete abutments from a no longer extant farm bridge are still evident at M.P. 46.36 (**Photograph 244**).

DMC Segment 9 also contains numerous minor appurtenant structures, including ladders, well discharges, and inlet and shoulder drains, virtually all constructed of metal and PVC pipes.

For a detailed discussion of repeating major and minor appurtenant structures along the DMC, including bridge, turnout, overchute, culvert, inlet drain, stilling well, and check building types, see typology discussion in P3a. Description on Continuation Sheets.

[144] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[145] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*, 59, 62, 93, 97-99.

Photographs (continued):



Photograph 241: Downstream view from the deck of the farm bridge at M.P. 47.38; camera facing downstream, May 13, 2022 (A00862).



Photograph 242: Upstream view of Check No. 8; camera facing upstream from left bank, May 13, 2022 (B00457).



Photograph 243: Downstream view of DMC from approximately M.P. 46.02 showing sandbags lining the top of the canal wall; camera facing downstream from left bank, May 13, 2022 (A00838).



Photograph 244: Right abutment from a no longer extant farm bridge at M.P. 46.36, with cracking visible along the canal lining; camera facing right bank from left bank, May 13, 2022 (A00848).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

*Resource Name or # (Assigned by recorder): Delta-Mendota Canal

*Recorded by: H. Norby, A. Lawton, & A. Young

*Date: May 13 & June 13, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation:** DMC-10

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 10 spans 5.78 miles between canal mileposts 48.62 and 54.40, from Check No. 9 to just above Check No. 10 along the western edge of the San Joaquin Valley in Stanislaus County. See **Sketch Map** and **Location Map** on Continuation Sheets.

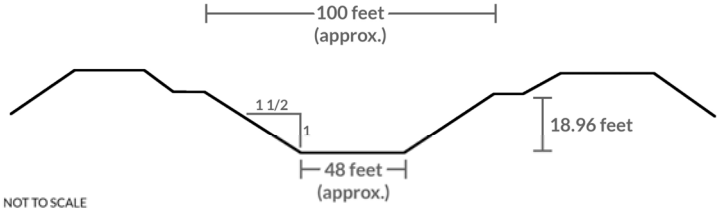
UTM: Zone 10S, 667851.77mE / 4137192.11mN (north endpoint); 669484.97mE / 4128831.84mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
Segment 10 begins at a point just upstream of Check No. 9 and continues to a point just upstream of Check No. 10 (**Photograph 245)**. (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width:** 100.38 feet (original)
b. **Bottom Width:** 48 feet
c. **Height or Depth:** 18.96 feet
d. **Length of Segment:** 5.78 miles

L4e. Sketch of Cross-Section (not to scale) **Facing:** Northeast



L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This segment of DMC is located primarily in the flat agricultural lands of the San Joaquin Valley in southwestern Stanislaus County. Surrounding agricultural lands are principally planted with orchards. This segment is crossed by four public roadways – Bell Road, Stuhr Road, Orestimba Road, and Shiells Road.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 245: Downstream view of Segment 10's northern end, showing Check No. 9 and check building with a stilling well in the foreground; camera facing downstream from left bank, May 13, 2022 (A00885).

L9. Remarks:

L10. Form prepared by:
Heather Norby, Abigail Lawton, & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 10, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[146] The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 246 - Photograph 248**). For a detailed discussion of DMC cross sections, see typology discussion in P3a. Description on Continuation Sheets.

The upstream end of DMC Segment 10 begins at Check No. 9, the site of which contains the check structure and building (**Photograph 245**). Check No. 9, at M.P. 48.62, is a concrete structure with a total length of 137 feet (**Photograph 249 - Photograph 251**). It is approximately 100 feet wide at the upstream end, widens to about 123 feet at the check gates, and then narrows again to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 250**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. One metal lamp post with an umbrella-shaped shade is also present on the deck. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 48.62 on the left bank and is of standard design. A stilling well is located just below Check No. 9, at M.P. 48.69, while a second stilling well is located just above Check No. 10 at M.P. 54.39. Both stilling wells are located on the left bank and are of standard design.[147]

In addition to the canal features located at Check No. 9, DMC Segment 10 contains other major appurtenant structures in its span, including the Newman Wasteway, one siphon, two culverts, six (6) bridges, and 13 turnouts.

The Orestimba Creek siphon at M.P. 51.18/51.27 is a four-barrel siphon conveying the DMC 330 feet under Bell Road, at M.P. 51.21, and the Orestimba Creek culvert, at M.P. 51.31, which provides an outlet for the Orestimba Water District (**Photograph 252 - Photograph 255**). A retaining wall on the east side of the Orestimba Creek siphon was repaired in 1995 after experiencing severe storm damage. Damaged steel sheet piles were removed or cut off and new Government supplied AZ 18 sheet piles were installed (**Photograph 254**).[148]

The second culvert in this segment crosses below the DMC at M.P. 50.49 to facilitate drainage. The six bridge crossings in this span include: three concrete County Highway bridges, one County Highway Wasteway Crossing bridge, and two timber Farm bridges, all of standard design. All 13 turnouts are the concrete pipe type and are of standard design.

The Newman Wasteway is on the left bank (east side) of the canal at M.P. 54.38 (**Photograph 256 - Photograph 263**). The wasteway extends generally northeast about 8.2 miles to the San Joaquin River. The wasteway begins with a concrete inlet structure on the left bank of the canal consisting of two waterways, each with a steel radial gate—measuring 20 feet wide and 17 feet tall—controlling the water flow. Both radial gates each have two gate arms, each measuring 19 feet, 9.5 inches long, with the pivot points bolted to a concrete headwall (**Photograph 258**). The gates' arms all have truss designs, and the arched gate faces are all reinforced by a grid pattern of steel beams. The gates are raised and lowered by a row of electric motors, hoists, pulleys, and a manual handle mounted on a concrete platform on top of the structure. This top deck includes a service

[146] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[147] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*, 59, 62, 93, 97-99.
[148] Welsh, Richard A., USDI, Reclamation, *Technical Report of Construction: Orestimba Creek Siphon Repairs*, September 28, 2001: 1-8, Appendix B, Central Valley Project – California (CVP), "Delta-Mendota Canal, Orestimba Creek Siphon Repair, Sheet Pile Drop and Impact Basin Plan", dwg. no. 214-D-22675, 1995.

walkway with pipe railing along the edge, and it also features a metal electrical box. Water passing through the wasteway control structure is channeled into a concrete-line trapezoidal chute with vertical top walls (**Photograph 259** and **Photograph 260**). This concrete-lined section of the wasteway extends about 1.5 miles and the remaining 6.7 miles are earth-line (**Photograph 261** and **Photograph 262**).[149]

DMC Segment 10 also contains numerous minor appurtenant structures, including ladders, well discharges, cattle guards, and inlet and shoulder drains, virtually all constructed of metal and PVC pipes. In this segment, some inlet drains were observed at locations not included in the *2020 DMC Structures List*, while other inlet drains included in that document were not observed at the specified locations. There were also three large pipes observed at approximately M.P. 54.39 on the right bank, however they did not appear to be connected/operable (**Photograph 264**). A review of archival photographs on Google Earth showed the pipes present at this location beginning in 2015. No photographs appear to show them operational.

For a detailed discussion of repeating major and minor appurtenant structures along the DMC, including bridge, turnout, culvert, inlet drain, stilling well, cattle guards, and check building types, see typology discussion in P3a. Description on Continuation Sheets.

[149] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*, 53.

Photographs (continued):



Photograph 246: Downstream view from the deck of a farm bridge at M.P. 49.55; camera facing downstream, May 13, 2022 (A00909).



Photograph 247: View of deep excavations on the right bank of the DMC from approximately M.P. 50.00; camera facing downstream from left bank, May 13, 2022 (C20400).



Photograph 248: Downstream view of DMC from approximately M.P. 53.15, Shiells Road bridge visible in distance (left background); camera facing downstream from left bank, May 13, 2022 (A00973).



Photograph 249: Detail view of Check No. 9 from the deck of Diehl Road Bridge; camera facing downstream from left bank, May 13, 2022 (A00883).



Photograph 250: Detail view of Check No. 9, showing its top deck and a pipe crossing mounted atop its support piers; camera facing right bank from left bank, May 13, 2022 (A00889).



Photograph 251: View of downstream side of Check No. 9; camera facing upstream from left bank, May 13, 2022 (A00893).



Photograph 252: Inlet headwall for Orestimba Creek siphon at M.P. 51.18; camera facing downstream from left bank, May 13, 2022 (A00940).



Photograph 253: Bell Road crossing over the 330-foot long Orestimba Creek siphon at M.P. 51.21; camera facing southeast, May 13, 2022 (A00941).



Photograph 254: Retaining wall around siphon and culvert that was repaired in 1995 after sheet piles were damaged in severe storm, fence around siphon outlet visible on elevated embankment in background (top center); camera facing south, May 13, 2022 (A00946).



Photograph 255: Outlet headwall of Orestimba Creek siphon, at M.P. 51.27, repaired retaining wall visible in background (far right); camera facing upstream from left bank, May 13, 2022 (A00948).



Photograph 256: View of Newman Wasteway inlet structure, looking upstream; camera facing downstream from left bank, May 13, 2022 (A00994).



Photograph 257: Newman Wasteway inlet structure, showing automatic-siphon spillways; camera facing downstream from left bank, May 13, 2022 (A00990).



Photograph 258: Detail view of Newman Wasteway inlet structure, showing the top deck, gate-hoisting equipment, and a radial gate's backside; camera facing right bank from left bank, May 13, 2022 (A00992).



Photograph 259: Downstream view of Newman Wasteway showing the start of the concrete-lined section at M.P. 54.38; camera facing east from left bank, May 13, 2022 (A00993).



Photograph 260: Upstream view of Newman Wasteway, showing concrete-lined section; camera facing upstream from wasteway's right bank, June 13, 2022 (C10778).



Photograph 261: Upstream view of Newman Wasteway, showing earth-lined section; camera facing upstream from wasteway's right bank, June 13, 2022 (C10778).



Photograph 262: Upstream view of Newman Wasteway from approximately M.P. 8.15, showing earth-lined section; camera facing upstream from wasteway's right bank, June 13, 2022 (C0025).



Photograph 263: Downstream view of Newman Wasteway's terminus where it joins the San Joaquin River; camera facing dowstream from wasteway's right bank, June 13, 2022 (C0026).



Photograph 264: Three (uninstalled) large pipes just above Check No. 10 at M.P. 54.41 on the right bank; camera facing downstream from left bank, May 13, 2022 (A00989).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Lawton

***Date**: May 13, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-11

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) Segment 11 spans 3.86 miles between canal mileposts 54.41 and 58.27, from Check No. 10 in southwestern Stanislaus County to the just above Check No. 11 in northwestern Merced County. See **Sketch Map** and **Location Map** on Continuation Sheets.

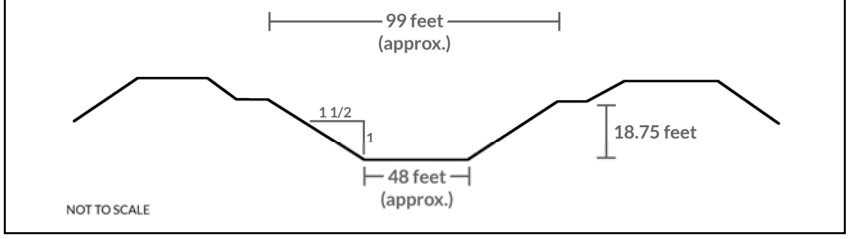
UTM: Zone 10S, 669490.56mE / 412888.06mN (north endpoint); 670531.47mE / 4123389.25mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
This segment begins at a point just upstream of Check No. 10 and continues to a point just upstream of Check No. 11 (**Photograph 265**). (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 99.75 feet (original)
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 18.75 feet
d. **Length of Segment**: 3.86 miles

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L5. Associated Resources: Delta Cross Channel, Mendota Canal, and O'Neill Forebay

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 11 skirts along the junction of the low-hilled grasslands and flat agricultural lands of the western San Joaquin Valley. The agricultural lands are principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has been altered in this segment by raising the concrete lining, modifications to appurtenant bridges, turnouts, and inlets, and the addition of stilling wells and multiple pipe crossings.

L8b. Description of Photo, Map, or Drawing:
Photograph 265: Beginning of Segment 11, showing Check No. 10 (center right), check building (left), and a stilling well (bottom right); camera facing downstream from left bank, May 13, 2022. (A00995)

L9. Remarks:

L10. Form prepared by:
Heather Norby, Abigail Lawton, & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

In Segment 11, the trapezoidal DMC is lined with concrete, which was raised by 18 inches in 1965 (**Photograph 13**).[150] The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank. The width of the roads seems to vary based on topography (**Photograph 266** and **Photograph 267**). For a detailed discussion of DMC cross sections, see typology discussion in P3a. Description on Continuation Sheets.

DMC Segment 11 begins at Check No. 10, the site of which contains the check structure and building (**Photograph 265**). Check No. 10, located at M.P. 54.4is a concrete structure with a total length of 137 feet. Its width is approximately 100 feet wide at the upstream end, widens to about 123 feet at the check gates, and then narrows back to 100 feet where it rejoins the canal walls on the downstream side (**Photograph 268** and **Photograph 269**). The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 268**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 54.41 on the left bank, is of standard design. A stilling well is located just below Check No. 10, at M.P. 54.49, while a second stilling well is located just above Check No. 11 at M.P. 58.25. Both stilling wells are located on the left bank and are of standard design.[151]

In addition to the structures located at Check No. 10 and described above, DMC Segment 11 contains three culverts, three (3) bridges, and 13 turnouts. The three bridge crossings in this segment include: two concrete County Highway bridges and one timber Operating Bridge, however this operating bridge, at M.P. 56.02, is currently barricaded at both ends and shows evidence of fire damage (**Photograph 270**). The two concrete County Highway bridges are of standard design, though the bridge at M.P. 56.60 along Pete Miller Road has parapet concrete walls, rather than the typical steel guard-rails (**Photograph 271**). Of the 13 turnouts, eleven are the typical concrete pipe type while two are the concrete box type. All of these are of standard design. The three drainage culverts are all of standard design.

DMC Segment 11 also contains numerous minor appurtenant structures, including ladders and inlet and shoulder drains, virtually all constructed of metal and PVC pipes.

For a detailed discussion of repeating major and minor appurtenant structures along the DMC, including bridge, turnout, culvert, inlet drain, stilling well, cattle guards, and check building types, see typology discussion in P3a. Description on Continuation Sheets.

[150] USDI, Reclamation, *Designers' Operating Criteria Delta-Mendota Canal and Delta Cross Channel*, Sept. 1971: 2, Appendix I-3.
[151] USDI, Reclamation, *Delta-Mendota: Technical Record of Design and Construction*, 59, 62, 93, 97-99.

Photographs (continued):



Photograph 266: Downstream view of DMC from approximately M.P. 55.07, with spoil piles flanking both banks; camera facing downstream from left bank, May 13, 2022 (A01010).



Photograph 267: Upstream view of DMC from approximately M.P. 56.18; camera facing upstream from left bank, May 13, 2022 (A01012).



Photograph 268: Check No. 10; camera facing downstream from left bank, May 13, 2022 (A00997).



Photograph 269: Check No. 10; camera facing right bank from left bank, May 13, 2022 (A00998).



Photograph 270: Detail view of fire damaged deck of Operating Bridge at M.P. 56.02; right bank from left bank, May 13, 2022 (A01020)



Photograph 271: View of concrete County Highway bridge at M.P. 56.60 along Pete Miller Road with parapet concrete walls, rather than the typical steel guard-rails; downstream from left bank, May 13, 2022 (A01027).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 13, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-12

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) Segment 12 of the canal spans 5.70 miles between canal mileposts 58.28 and 63.98, from Check No. 11 to a point just above Check No. 12 in northwestern Merced County. See **Sketch Map** and **Location Map** on Continuation Sheets.

UTM: Zone 10S, 670530.32mE / 4123386.32mN (north endpoint); 673476.73mE / 4115507.16mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 12 begins at Check No. 11 (**Photograph 272**) and ends at a point just upstream of Check No. 12 (

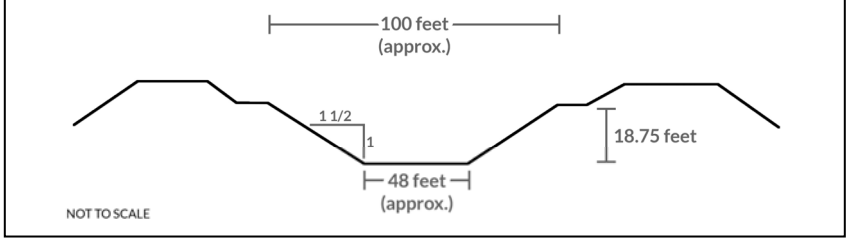
Photograph 273). It has the same concrete lining and trapezoidal cross section as elsewhere along the canal, and it is flanked with unpaved maintenance roads on both banks that are approximately 12 to 20 feet wide. (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100 feet
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 18.75 feet
d. **Length of Segment**: 5.70 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 12 skirts along the junction of the low-hilled grasslands and flat agricultural lands of the western San Joaquin Valley. The agricultural lands are principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by raising the concrete lining, alterations to bridges and turnouts, and the addition of stilling wells, well discharges, and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 272: Beginning of Segment 12 showing Check No. 11 and check building (left) with a turnout and stilling well (foreground); camera facing downstream from the left bank, June 13, 2022 (C0080).

L9. Remarks:

L10. Form prepared by:
Heather Norby and Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

Segment 12 of the canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 273** - **Photograph 275**). The width of the roads seems to vary based on topography.

Segment 12 begins at Check No. 11, located at M.P. 58.28. The check is a concrete structure with a total length of approximately 100 feet. Its width approximately is 100 feet at the upstream end, narrows to 60 feet at the check gates, and then narrows again to 40 feet where it transitions into the inlet of Garzas Creek Siphon (**Photograph 276**). The check structure is rectangular in cross section and divided into three bays of equal size, each with a radial gate for regulation and closure. The banks of the canal transition from sloped to vertical at the control structure. Spanning the top of the structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 277**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The check building, at M.P. 58.28 on the left bank, is of concrete block construction, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 11 at M.P. 58.25 while a second stilling well is located just below the siphon's outlet at M.P.58.40. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[152]

The Garzas Creek Siphon begins immediately downstream from Check No. 11 (**Photograph 278**). The concrete structure consists of inlet and outlet headwalls that are connected by four 12-by-16-feet barrels. The inlet headwall at M.P. 58.29 is 51 feet wide and approximately 23.75 feet tall. The outlet headwall at M.P. 58.35 is 48 feet wide and approximately 22.5 feet tall (**Photograph 279**). The barrels are 225 feet long and buried beneath Garzas Creek (**Photograph 280**). A concrete weir (**Photograph 281**) sits in the Garzas Creek streambed approximately in line with the canal's left bank.[153]

The four bridge spans in this segment include: three concrete county highway bridges and one timber-deck county highway bridge, at M.P. 62.09. All these bridges are of standard design.

In addition to the structures discussed above, DMC Segment 12 contains one pipe crossing, twelve turnouts, and inlet drains. All the other structures are of standard design or have standard alterations as discussed in the above typology discussion in Section P3a.

[152] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 62, 93, 97-99.

[153] "Garzas Creek Check and Siphon: Profile and Siphon Details," on file at the Bureau of Reclamation Design Construction Library; "Garzas Creek Check and Siphon: Details of Check and Siphon Inlet," on file at the Bureau of Reclamation Design Construction Library; Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 64-65.

Photographs (continued)



Photograph 273: View of Segment 12 from approximately M.P. 63.64, with a spoils pile flanking the right bank; camera facing downstream from left bank, June 13, 2022 (C0137).



Photograph 274: View of Segment 12 from approximately M.P. 63.34; camera facing upstream from left bank, June 13, 2022 (C0135).



Photograph 275: View of Segment 12 from the deck of Gravel Pit Road at M.P. 58.46; camera facing downstream, June 13, 2022 (C0094).



Photograph 276: Transition between Check No. 11 and Garzas Creek Siphon; camera facing right upstream from left bank, June 13, 2022 (C0087).



Photograph 277: Detail view of Check No. 11's gate hoisting equipment; camera facing upstream from left bank, June 13, 2022 (C0088).



Photograph 278: Garzas Creek Siphon's inlet headwall; camera facing downstream from left bank, June 13, 2022 (C0085).



Photograph 279: Garzas Creek Siphon's outlet headwall from the deck of Gravel Pit Road bridge at M.P. 58.46; camera facing upstream, June 13, 2022 (C0080).



Photograph 280: View across the Garzas Creek Siphon, with its outlet in the background; camera facing downstream, June 13, 2022 (C0086).



Photograph 281: Upstream view of Garzas Creek, showing the weir that sits approximately adjacent to the DMC centerline; camera facing west, June 13, 2022 (C0090).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 13, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-13

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 13 of the canal spans 6.01 miles between canal mileposts 63.99 and 70.00, from Check No. 12 to a point just upstream from Check No. 13.
UTM: Zone 10S, 673489.44mE / 4115478.07mN (north endpoint); 674434.29mE / 4106749.78mN (south endpoint)

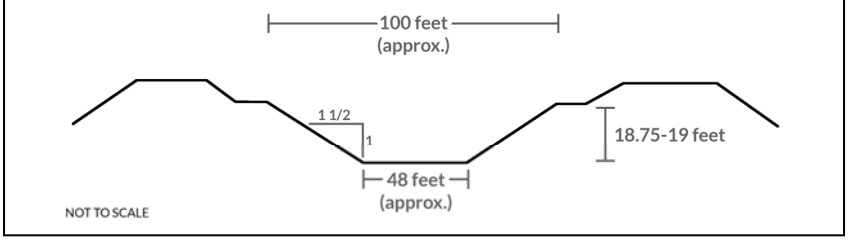
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 13 begins at Check No. 12 (**Photograph 282**) and ends at a point just upstream of Check No. 13. It has the same concrete lining and trapezoidal cross section as elsewhere along the canal, and it is flanked with unpaved maintenance roads on both banks that are approximately 12 to 20 feet wide.

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100 feet
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 18.75 feet – 19.00 feet
d. **Length of Segment**: 6.01 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 13 skirts along the junction of the low-hilled grasslands and flat agricultural lands of the western San Joaquin Valley. The agricultural lands are principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by raising the concrete lining, alterations to bridges, turnouts and inlet drains, and the addition of stilling wells, pipe crossings, and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 282: Beginning of Segment 13 showing Check No. 12 and check building (left), with a turnout and stilling well (foreground); camera facing south, June 13, 2022 (C0140)

L9. Remarks:

L10. Form prepared by:
Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

(west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 283** - **Photograph 284**). The width of the roads seems to vary based on topography.

Segment 13 begins at Check No. 12 located at M.P. 63.99 (**Photograph 285** - **Photograph 286**). The check is a concrete structure with a total length of 180 feet. Its width approximately is 100 feet wide at the upstream end, widens to 135 feet at the check gates, and then narrows back to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of the structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge. On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 63.99 on the left bank, is a concrete block structure, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 12 at M.P. 63.95 while a second stilling well is located just below it at M.P. 64.06. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[154]

The O'Neill Forebay intake channel extends from the canal's right bank at M.P. 69.30 (**Photograph 287**). It is approximately 125 feet wide and extends approximately one-half mile from the canal to the forebay intake.

The Volta Wasteway extends from the canal's left bank at M.P. 69.98 (**Photograph 288**). It is approximately six miles in total length, ending where it transitions into the San Luis Wasteway. It begins with a concrete inlet structure consisting of two 15-foot-wide channels, each with a steel radial gate to control the flow of water. The arced gate faces are 16.5 feet tall and 15 feet wide and reinforced on the back by a grid of steel members. Each has two steel arms of a truss design that pivot from pins fixed into the central support pier and channel sidewalls. Supported by the pier and sidewalls is a concrete top deck on which electric gate-hoisting equipment and a concrete bridge are mounted. A replacement automatic-siphon spillway passes beneath the south radial gate (**Photograph 289**). Water passing through the inlet structure flows down a chute, into a stilling pool, and then into the wasteway lined with compacted earth (**Photograph 290** - **Photograph 291**). The O'Neill Forebay Wasteway, which passes beneath the DMC through a culvert at M.P. 69.85 (**Photograph 292**), joins the Volta Wasteway approximately 850 feet downstream from the inlet structure (**Photograph 293**).[155]

A Bureau of Reclamation O&M yard is sited on the east side of the canal at approximately M.P. 69.90 and flanked by the Volta and O'Neill wasteways on its northeast and southeast sides (**Photograph 294**). It consists of two Quonset huts sited parallel to each other. The approximately 4,000-square-feet buildings have rectangular footprints, semi-cylindrical forms, and they are clad in metal. Access to each is provided through double garage doors at both ends. Fenestration on the west building includes sliding aluminum windows flanking the garage doors while the east building includes no fenestration.

The five extant bridge crossings in this segment include two concrete county highway bridges, one county highway wasteway crossing bridge, one non-original (post-1958) state highway bridge, and the O'Neill intake channel operating bridge. All county highway bridges are of standard design, although the bridge at M.P. 68.03, along McCabe Road, has concrete parapet walls, instead of the typical steel guard-rails, and is supported by three concrete piers, rather than the typical two piers (**Photograph 295**). The non-original bridge at M.P. 65.89 consists of two spans that carry Interstate 5 north and south. This

[154] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 62, 97-99.
[155] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 65, 70-74.

bridge, constructed in 1965, has paved concrete decks, each measuring 39 feet, 8 inches wide, and supported by steel stringers. The abutments on the right bank sit directly next to the canal and support the stringers, while on the left bank, the stringers terminate monolithic concrete piers, while the decks extend over the O&M road adjacent to the canal and terminate at abutments further up the embankment.[156] The O'Neill intake channel operating bridge has a paved concrete deck supported by a single support pier. Additionally, the abutments of a non-extant farm bridge remain at M.P. 67.15.

In addition to the structures discussed above, DMC Segment 13 contains two overchutes, two culverts, three pipe crossings, 18 turnouts, and inlet drains. All these structures are of standard design or have standard alterations as discussed in the above typology discussion in Section P3a.

[156] USDI, Reclamation, *Designer's Operating Criteria*, 1971: 26.

Photographs (continued):



Photograph 283: View of Segment 13 from approximately M.P. 64.44, with spoils piles along the right bank; camera facing downstream from left bank, June 13, 2022 (C0158).



Photograph 284: View of Segment 13, showing the canal's left bank and a turnout at M.P. 65.89; camera facing downstream from left bank, June 13, 2022 (C0165).



Photograph 285: Check No. 12, with a turnout at M.P. 63.96 visible in the foreground; camera facing downstream from left bank, June 13, 2022 (C0142).



Photograph 286: Check No. 12; camera facing upstream from left bank, June 13, 2022 (C0147).



Photograph 287: The O'Neill Forebay Intake Channel; camera facing right bank from left bank, June 13, 2022 (C0189).



Photograph 288: Volta Wasteway's inlet structure at M.P. 69.98, with Check No. 13 in the background; camera facing downstream from left bank, June 13, 2022 (C0194).



Photograph 289: Automatic-siphon spillway; camera facing northeast from left bank, June 13, 2022 (C0198).



Photograph 290: Upstream view of the Volta Wasteway, with its inlet structure in the background; camera facing upstream from wasteway's left bank, June 13, 2022 (C0219).



Photograph 291: View of Volta Wasteway with a pipe crossing at approximately M.P. 1.5; camera facing upstream from wasteway's left bank, June 13, 2022 (C0225).



Photograph 292: Culvert channeling the O'Neill Forebay Wasteway beneath the DMC at M.P. 69.62; camera facing upstream from wasteway's right bank, June 13, 2022 (C0214).



Photograph 293: View of the O'Neill Forebay Wasteway, showing its junction with the Volta Wasteway in the distance; camera facing downstream from wasteway's right bank, June 13, 2022 (C0215).



Photograph 294: Quonset huts in O&M yard approximately at M.P. 69.90; camera facing northeast, June 13, 2022 (C0223).



Photograph 295: Bridge at M.P. 68.03; camera facing downstream from left bank, June 13, 2022 (C0178).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 13-14, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-14

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 14 of the canal spans 4.38 miles between canal mileposts 70.01 and 74.39, from Check No. 13 to a point just above Check No. 14 in Merced C3ounty.

UTM: Zone 10S, 674462.32mE / 4106744.51mN (north endpoint); 680767.62mE / 4104237.10mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)

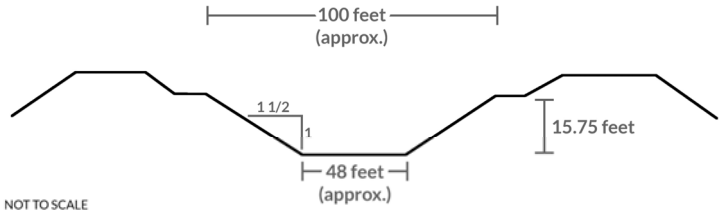
DMC Segment 14 begins at Check No. 13 (**Photograph 296**) and ends at a point just upstream of Check No. 14. It has the same concrete lining and trapezoidal cross section as elsewhere along the canal, and it is flanked with unpaved maintenance roads on both banks that are approximately 12 to 20 feet wide. (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100 feet
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 15.75 feet
d. **Length of Segment**: 4.38 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)

Segment 14 skirts along the junction of the low-hilled grasslands and flat agricultural lands of the western San Joaquin Valley. The agricultural lands are principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by raising the concrete lining, alterations to bridges, turnouts, and inlet drains, and the addition of stilling wells, pipe crossings, and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 296: Beginning of Segment 14 showing Check No. 13 with the Volta Wasteway in the foreground; camera facing downstream from left bank, June 13, 2022 (C0192).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

Segment 14 of the canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 297** - **Photograph 298**). The width of the roads seems to vary based on topography.

Segment 14 begins at Check No. 13 (**Photograph 299**), located at M.P. 70.00. The check is a concrete structure with a total length of 180 feet. Its width approximately is 100 feet at the upstream end, widens to 135 feet at the check gates, and then narrows back to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same sloped angle as the canal. Spanning the top of the structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge. On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 70.00 on the left bank, is of concrete block construction, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 13 at M.P. 69.99 while a second stilling well is located just below it at M.P. 70.04. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[157]

The salinity station building on the right bank at M.P. 70.01 has a 7-by-7-feet, square footprint (**Photograph 300**). Its roof and walls are covered in corrugated metal. A metal door provides access on its northwest side.

The three bridge crossings in this segment include one state highway bridge, one timber county highway bridge, and one non-original (post-1958) state highway bridge. The state highway bridge at M.P. 71.31 along Jenson Road/State Route 207 and the timber county highway bridge at M.P. 72.33 along Hilldale Avenue are of standard design. The non-original bridge at M.P. 72.80 consists of two spans that carry Interstate 5's north and south bound lanes. This bridge, constructed in 1965, has paved concrete decks, each measuring 39 feet, 8 inches wide, and supported by steel stringers. The abutments of this bridge sit right next to the canal lining and the stringers are strung directly between the abutments (**Photograph 301**).[158]

In addition to the canal structures discussed above, Segment 14 contains two siphon undercrossings, two culverts, five pipe crossings, two siphon undercrossings, ten turnouts, and inlet drains. Of the eight turnouts, all are concrete pipe types. All these structures are of standard design or have standard alterations as discussed in the above typology discussion in Section P3a.

[157] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 62, 93, 97-99.
[158] USDI, Reclamation, *Designer's Operating Criteria*, 1971: 26.

Photographs (continued)



Photograph 297: View of Segment 14 from approximately M.P. 74.20, with Check No. 14 visible in the distance; camera facing downstream from left bank, June 14, 2022 (D2214).



Photograph 298: View of Segment 14 from approximately M.P. 73.87; camera facing upstream from left bank, June 14, 2022 (D2211).



Photograph 299: Check No. 13; camera facing upstream from left bank, June 13, 2022 (D0203).



Photograph 300: Salinity station building along the right bank at M.P. 70.01; camera facing right bank from left bank, June 13, 2022 (D0201).



Photograph 301: Bridge at M.P. 72.80; camera facing upstream from left bank, June 14, 2022 (D0206).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 14, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-15

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 15 spans 5.23 miles between canal mileposts 74.40 and 79.63, from Check No. 14 to a point just above Check No. 15.
UTM: Zone 10S, 680778.56mE / 4104215.13mN (north endpoint); 686746.73mE / 4099027.25mN (south endpoint)

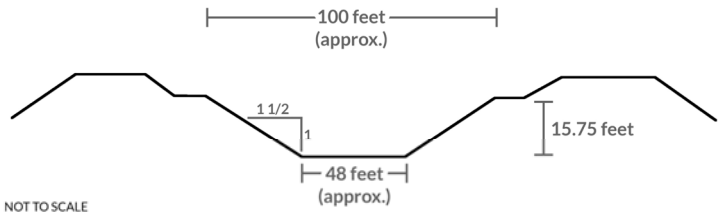
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 15 begins at Check No. 14 (**Photograph 302**) and ends at a point just upstream of Check No. 15. It has the same concrete lining and trapezoidal cross section as elsewhere along the canal, and it is flanked with unpaved maintenance roads on both banks that are approximately 12 to 20 feet wide. (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100 feet
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 15.75 feet
d. **Length of Segment**: 5.23 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 15 skirts the junction of the low-hilled grasslands and flat agricultural lands of the western San Joaquin Valley. The agricultural lands are principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by raising the concrete lining, alterations to bridges, turnouts, and inlet drains, and the addition of stilling wells, pipe crossings, and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 302: Beginning of Segment 15's northern end showing Check No. 14, check building (left), and a stilling well (foreground); camera facing downstream from left bank, June 14, 2022 (D2215).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

Segment 15 of the canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 303 - Photograph 304**). The width of the roads seems to vary based on topography.

Segment 15 begins at Check No. 14 (**Photograph 305**), located at M.P. 74.44. The check is a concrete structure with a total length of approximately 135 feet. Its width approximately is 100 feet wide at the upstream end, widens to 135 feet at the check gates, and then narrows back to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of the structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 306**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below (**Photograph 307**). The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms 19 feet, 9.5 inches that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 74.40 on the left bank, is of concrete block construction, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 14 at M.P. 74.36 while a second stilling well is located just below it at M.P. 74.45. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[159]

The Wolfsen Bypass extends from the canal's left bank at M.P. 76.04 (**Photograph 308**). It begins at a concrete inlet structure that consists of two four-by-five-feet turnouts that are the box barrel type (**Photograph 309**), and it extends approximately 900 feet until it transitions into another canal that runs alongside and generally parallel to DMC Segment 15 (**Photograph 310**).

The Los Banos Creek inlet, located along the right bank at M.P. 79.63, consists of a 10-by-6-foot concrete double-box-barrel with lift gates (**Photograph 311**). Manual gate hoisting equipment raises and lowers the gates.

The five bridge crossings in this segment include three concrete county highway bridges, one timber county highway bridge, and one state highway bridge. Most of these bridges are of standard design, however the deck of the county highway bridge at M.P. 77.20 appears different from the typical concrete decks (**Photograph 312**). It does not possess any curbs and an examination report from 1971 notes: "Many timber bridges have been replaced or repaired. Most of the replacements have used a treated-timber superstructure; however, the bridge at Mile 77.20 was replaced using prestressed precast slabs. This bridge looks very good."[160]

In addition to the canal structures discussed above, Segment 15 contains two overchutes, five pipe crossings, twelve turnouts, and inlet drains. All these structures are of standard design or have standard alterations as discussed in the above typology discussion in Section P3a.

[159] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 62, 93, 97-99.
[160] USDI, Reclamation, *Condition of Major Irrigation Structures and Facilities, Region 2*, 1970: 6.

Photographs (continued)



Photograph 303: View of Segment 15 approximately from M.P. 76.64; camera facing upstream from left bank, June 14, 2022 (C0254).



Photograph 304: View of Segment 15, showing a well discharge and remnants of a deleted pipe crossing at M.P. 78.31; camera facing downstream from left bank, June 14, 2022 (C0267).



Photograph 305: Check No. 14; camera facing downstream from left bank, June 14, 2022 (D2216).



Photograph 306: Check No. 14, with a pipe crossing mounted on its piers; camera facing upstream from left bank, June 14, 2022 (D2218).



Photograph 307: Detail view of Check No. 14's top deck; camera facing right bank from left bank, June 14, 2022 (D2217).



Photograph 308: Wolfsen Bypass inlet structure along left bank at M.P. 76.04; camera facing downstream from left bank, June 14, 2022 (C0250).



Photograph 309: Detail view of Wolfsen Bypass inlet structure along left bank at M.P. 76.04, showing the gates for each box-barrel-type turnout; camera facing east, June 14, 2022 (C0251).



Photograph 310: Downstream view of Wolfsen Bypass at M.P. 76.04; camera facing northwest from left bank of DMC, June 14, 2022 (C0252).



Photograph 311: Los Banos Creek inlet at M.P. 79.63; camera facing right bank from left bank, June 14, 2022 (C0282).



Photograph 312: Bridge at M.P. 77.20; camera facing downstream from left bank, June 14, 2022 (C0259).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 14, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-16

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 16 of the canal spans 5.44 miles between canal mileposts 79.64 and 85.08, from Check No. 15 to a point just above Check No. 16 in Merced County.
UTM: Zone 10S, 686757.91mE / 4099011.75mN (norther endpoint); 693000.31mE / 4093641.06mN (south endpoint)

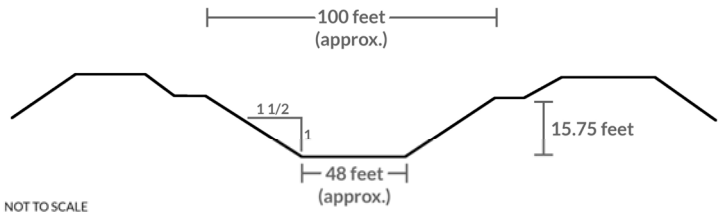
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 16 begins at Check No. 15 (**Photograph 313**) and ends at a point just upstream of Check No. 16. It has the same concrete lining and trapezoidal cross section as elsewhere along the canal, and it is flanked with unpaved maintenance roads on both banks that are approximately 12 to 20 feet wide. (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100 feet
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 15.75 feet
d. **Length of Segment**: 5.44 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 16 traverses through the flat agricultural lands of the western San Joaquin Valley principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by raising the concrete lining, alterations to bridges, turnouts, and inlet drains, and the addition of stilling wells, pipe crossings, and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 313: Beginning of Segment 16 showing Check No. 15, check building (left), turnout (right), and well discharge (foreground); camera facing downstream from left bank, June 14, 2022 (C0279).

L9. Remarks:

L10. Form prepared by:

Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

Segment 16 of the canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 314 - Photograph 316**). The width of the roads seems to vary based on topography.

Segment 16 begins at Check No. 15 (**Photograph 317**), located at M.P. 79.64. The check is a concrete structure with a total length of approximately 100 feet. Its width approximately is 100 feet wide at the upstream end, narrows to 60 feet at the check gates, and then narrows again to 40 feet where it transitions into the Los Banos Creek Siphon. The banks of the canal transition from sloped to vertical at the control structure. Spanning the top of the structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 318**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is rectangular in cross section and divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The check building, at M.P. 79.64 on the left bank, is of concrete block construction, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 15 at M.P. 79.63 while a second stilling well is located just below the Los Banos Siphon's outlet at M.P. 80.01. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[161]

The Los Banos Creek Siphon begins immediately downstream of Check No. 15. The concrete structure consists of inlet and outlet headwalls that are connected by three 12-feet by 16-feet barrels. The barrels are 250 feet long and buried beneath Los Banos Creek. The inlet headwall at M.P. 79.64 is 41 feet wide and approximately 25 feet tall. The outlet headwall at M.P. 79.72 is 41.5 feet wide and approximately 23 feet tall (**Photograph 319**). The barrels are 250 feet long and buried beneath Los Banos Creek. A bridge extends across Los Banos Creek along the DMC centerline, and a modern check+ structure sits in Los Banos Creek directly upstream from the bridge (**Photograph 320 - Photograph 321**).[162]

The San Luis and Delta-Mendota Water Authority Field Office is sited on the west side of the canal at M.P. 80.00 (**Photograph 322**). It consists of a generally triangular-shaped lot containing a modern office building, two original garages, one modern garage, and several outbuildings. As originally developed, the two original garages likely functioned as Bureau of Reclamation O&M buildings. The approximately 2,700-square-feet, modern office building is sited toward the lot's southeast corner (**Photograph 323**). It has a rectangular footprint, side gable roof of crimped metal, and walls clad in metal. The main entrance is located on its north side and consists of double metal doors sheltered beneath a metal canopy. An additional entrance is comprised of a metal door on the east side. Fenestration includes sliding windows. Two approximately 2,500-square-feet, five-bay garages are sited in the lot's southwest corner next to each other facing north (**Photograph 324**). Both have rectangular footprints and side-gable metal roofs. The west garage is original and of a prefabricated metal construction that was common and ubiquitous throughout the CVP. Of its five bays, four are open while the bay at its west end has been enclosed by the addition of a metal roll-up garage door. The east garage is modern but of a similar prefabricated metal construction. Of its five bays, the two at its east end are open while the rest are enclosed and accessed by metal roll-up garage doors, and the bay at its west sits above grade, atop a concrete foundation. An additional entryway to the above-grade bay is provided by a metal door accessed by a metal staircase on the garage's east side. The second original garage is sited in the middle of the lot's west edge. It is approximately 4,700-square-feet, has a rectangular footprint, and walls clad in metal. An addition was constructed onto the original section's east side. Primary and secondary side-gable metal roofs cover both sections, with the secondary roof over the addition sitting slightly higher than the primary. Both sections are accessed by metal roll-up garage doors.[163]

The nine bridge crossings in this segment include six concrete county highway bridges, two timber farm bridges, and one operating bridge, which consists of a road with steel guard-rails along the Los Banos Creek siphon. This structure replaced the

[161] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59-61, 93, 97-99.
[162] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59-61, 64-65.
[163] Cartwright and Co., Flight ABF-1957, Frame 11T-90, 1:20,000 (April 9, 1957) flown for USDA; USGS, Flight NAPP, Frame 462-23, 1:40,000 (June 17, 1987) flown for USGS.

original timber operating bridge at this location and is included in the bridge inventory because it possesses a Caltrans bridge number. All other bridges in this segment are of standard design.

In addition to the canal structures discussed above, Segment 16 contains two overchutes, 14 pipe crossings, 13 turnouts, and inlet drains. All these structures are of standard design or have standard alterations as discussed in the above typology discussion in Section P3a.

Photographs (continued)



Photograph 314: View of Segment 16 from approximately M.P. 82.17; camera facing upstream from left bank, June 14, 2022 (C0312).



Photograph 315: View of Segment 16 from approximately M.P. 82.17; camera facing downstream from left bank, June 14, 2022 (C0313).



Photograph 316: View of Segment 16 from at M.P. 84.65, showing a pipe crossing; camera facing right bank from left bank, June 14, 2022 (C0330).



Photograph 317: Check No. 15, showing where it transitions into the Los Banos Creek Siphon inlet; camera facing downstream from left bank, June 14, 2022 (C0280).



Photograph 318: Detail view of Check No. 15's top deck; camera facing right bank from left bank, June 14, 2022 (C0284).



Photograph 319: Los Banos Creek Siphon outlet at M.P. 79.69; camera facing upstream from right bank, June 14, 2022 (C0293).



Photograph 320: Check structure in Los Banos Creek from the deck of the operating bridge at M.P. 79.69; camera facing west, June 14, 2022 (C0288).



Photograph 321: Check structure in Los Banos Creek at the Los Banos Creek Siphon; camera facing southwest, June 14, 2022 (C0287).



Photograph 322: San Luis and Delta-Mendota Water Authority Field Office; camera facing right bank from left bank, June 14, 2022 (C0294).



Photograph 323: Office building at San Luis and Delta-Mendota Water Authority Field Office; camera facing right bank from left bank, June 14, 2022 (C0295).



Photograph 324: Both two 5-bay garages at San Luis and Delta-Mendota Water Authority Field Office; camera facing right bank from left bank, June 14, 2022 (C0296).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 14, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-17

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 17 spans 5.44 miles between canal mileposts 85.09 and 90.53, from Check No. 16 to a point just above Check No. 17 in Merced County.
UTM: Zone 10S, 693007.86mE / 4093625.13mN (north endpoint); 698602.59mE / 4088374.85mN (south endpoint)

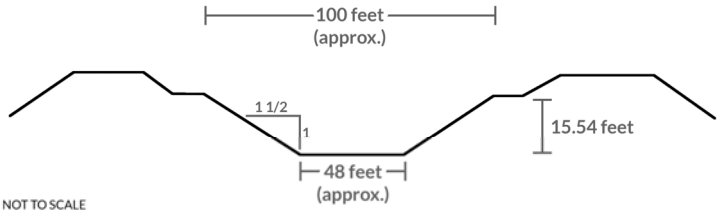
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 17 begins at Check No. 16 (**Photograph 325**) and ends at a point just upstream of Check No. 17.
It has the same concrete lining and trapezoidal cross section as elsewhere along the canal, and it is flanked with unpaved maintenance roads on both banks that are approximately 12 to 20 feet wide. (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100 feet
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 15.54 feet
d. **Length of Segment**: 5.44 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 17 traverses through the flat agricultural lands of the western San Joaquin Valley principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by raising the concrete lining, alterations to bridges, turnouts, and inlet drains, and the addition of stilling wells and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 325: Beginning of Segment 17 showing Check No. 16 and check building (left); camera facing downstream from left bank, June 14, 2022 (C0333).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

Segment 17 of the canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 326 - Photograph 327**). The width of the roads seems to vary based on topography.

Segment 17 begins at Check No. 16 (**Photograph 328 - Photograph 329**), located at M.P. 85.09. The check is a concrete structure with a total length of approximately 145 feet. Its width approximately is 100 feet at the upstream end, widens to 130 feet at the check gates, and then narrows back to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of the structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge. On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 85.07 on the left bank, is of concrete block construction, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 16 at M.P. 85.09 while a second stilling well is located just below the Los Banos Siphon's outlet at M.P. 85.14. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[164]

The four bridge crossings in this segment include two timber farm bridges and two concrete county highway bridges. All are standard design.

In addition to the canal structures located at Check No. 16, Segment 17 contains eight pipe crossings, 15 turnouts, and inlet drains. All these structures are of standard design or have standard alterations as discussed in the above typology discussion in Section P3a.

[164] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 62, 93, 97-99.

Photographs (continued)



Photograph 326: View of Segment 17 approximately from M.P. 90.16, showing two well discharges and an inlet drain; camera facing downstream from left bank, June 14, 2022 (C0363).



Photograph 327: View of Segment 17 approximately from M.P. 86.51; camera facing downstream from left bank, June 14, 2022 (C0344).



Photograph 328: Check No. 16 at M.P. 85.09; camera facing downstream from left bank, June 14, 2022 (C0333).



Photograph 329: Check No. 16 at M.P. 85.09; camera facing downstream from left bank, June 14, 2022 (C0336).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 14, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-18

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 18 of the canal spans 6.26 miles between canal mileposts 90.54 and 96.80, from Check No. 17 in Merced County to a point just above Check No. 18 in Fresno County.
UTM: Zone 10S, 698618.86mE / 4088361.11mN (north endpoint); 707625.65mE / 4085198.89mN (south endpoint)

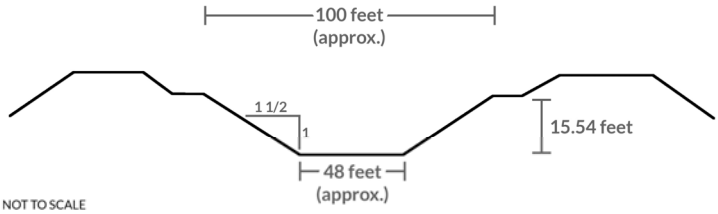
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 18 begins at Check No. 17 (**Photograph 330**) and ends at a point just upstream of Check No. 18 (**Photograph** 297). It has the same concrete lining and trapezoidal cross section as elsewhere along the canal, and it is flanked with unpaved maintenance roads on both banks that are approximately 12 to 20 feet wide. (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 100 feet
b. **Bottom Width**: 48 feet
c. **Height or Depth**: 15.54 feet
d. **Length of Segment**: 6.26 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 18 traverses through the flat agricultural lands of the western San Joaquin Valley principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by raising the concrete lining, alterations to bridges, turnouts, and inlet drains, and the addition of stilling wells, well discharges, and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 330: Beginning of Segment 18 showing Check No. 17 and check building (left); camera facing downstream from left bank, June 14, 2022 (E0366).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

Segment 18 of the canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 331 - Photograph 334**). The width of the roads seems to vary based on topography.

Segment 18 begins at Check No. 17 (**Photograph 335**), located at M.P. 90.54. The check is a concrete structure with a total length of approximately 145 feet. Its width approximately is 100 feet at the upstream end, widens to 120 feet at the check gates, and then narrows back to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of the structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge. On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 90.54 on the left bank, is of concrete block construction, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 17 at M.P. 90.53 while a second stilling well is located just it at M.P. 90.61. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[165]

The seven bridge crossings in this segment include five timber farm bridges, one concrete county highway bridge, and one timber operating bridge. All of these bridges are of standard design.

In addition to the canal structures discussed above, Segment 18 contains 7 pipe crossings, one siphon undercrossing, 14 turnouts, well discharges, and inlet drains. All the bridges are of standard design. All these structures are of standard design or have standard alterations as discussed in the above typology discussion in Section P3a.

[165] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 62, 93, 97-99.

Photographs (continued)



Photograph 331: View of Segment 18 from approximately M.P. 91.36, with Check No. 17 in the distance; camera facing upstream from left bank, June 14, 2022 (C0376).



Photograph 332: View of Segment 18 approximately from M.P. 91.77; camera facing upstream from left bank, June 14, 2022 (C0381).



Photograph 333: View of Segment 18 from the deck of a farm bridge at M.P. 95.45; camera facing downstream, June 14, 2022 (C0398).



Photograph 334: View from approximately from M.P. 91.77; camera facing right bank from left bank, June 14, 2022 (C0404).



Photograph 335: Check No. 17, with an operating bridge in the background; camera facing downstream from left bank, June 14, 2022 (C0368).



Photograph 336: View from approximately M.P. 90.57, showing a pipe crossing, operating bridge, and Check No. 17 in the background; camera facing upstream from left bank, June 14, 2022 (C0371).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 14, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-19

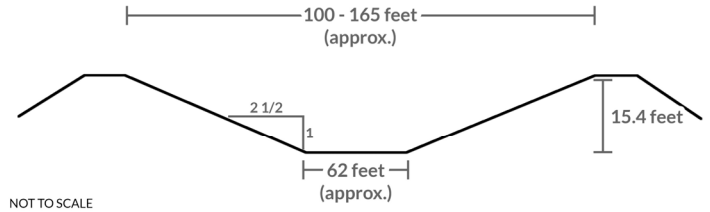
***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 19 of the canal spans 8.24 miles between canal mileposts 96.81 and 105.05, from Check No. 19 to a point just above Check No. 19 in Fresno County.
UTM: Zone 10S, 707647.78mE / 4085198.79mN (north endpoint); 720476.64mE / 4083384.47mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 19 begins at Check No. 18 (**Photograph 337**) and ends at a point just upstream of Check No. 19. It the same trapezoidal cross section as elsewhere along the canal. The northern approximately one-quarter of this segment is concrete-lined while the remainder is lined with compacted earth. On both sides of the canal are unpaved maintenance roads approximately 12 to 20 feet wide. (See Continuation Sheet.)

L4. Dimensions: (in feet for historic features and meters for prehistoric features)
- **a. Top Width**: 100 - approximately 165 feet
- **b. Bottom Width**: 48-84 feet
- **c. Height or Depth**: 15.54 feet – 15.40 feet
- **d. Length of Segment**: 8.24 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 19 traverses through the flat agricultural lands of the western San Joaquin Valley principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by alterations to bridges, turnouts, and inlet drains and the addition of stilling wells, well discharges, and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 337: Beginning of Segment 19's northern end showing Check No. 18 and check building (right); camera facing downstream from left bank, June 14, 2022 (C0409).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

Segment 19 of the canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (Error! Reference source not found. - Error! Reference source not found.). The width of the roads seems to vary based on topography. The canal is lined with concrete from its beginning to M.P. 98.62, after which it is lined with compacted earth **(**Error! Reference source not found. - Error! Reference source not found.).

Segment 19 begins at Check No. 18 (Error! Reference source not found.), located at M.P. 96.81. The check is a concrete structure with a total length of approximately 135 feet. Its width approximately is 100 feet at the upstream end, widens to 130 feet at the check gates, and then narrows back to 100 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of the structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge. On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 96.81 on the left bank, is of concrete block construction, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 18 at M.P. 96.71 while a second stilling well is located just below it at M.P. 96.88. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[166]

The six bridge crossings in this segment include three concrete county highway bridges, two timber farm bridges, and one non-original (post-1958) replacement farm bridge. The farm bridge at M.P. 102.03 was reconstructed in 2014 with a concrete deck, measuring 22 feet wide, supported by five concrete bents, with steel guard-rails (**Photograph 345**). All other bridges are of standard design.

In addition to the canal structures discussed above, Segment 19 contains nine pipe crossings, one siphon undercrossing, ten turnouts, well discharges, and inlet drains. All these structures are of standard design or have standard alterations as discussed in the above typology discussion in Section P3a.

[166] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 62, 93, 97-99.

Photographs (continued)



Photograph 338: View of Segment 19's concrete-lined section from approximately M.P. 98.62; camera facing upstream from left bank, June 14, 2022 (C0419).



Photograph 339: Deteriorated concrete lining along right bank at approximately M.P. 96.82; camera facing right bank from left bank, June 14, 2022 (C0411).



Photograph 340: View of Segment 19 from approximately M.P. 98.62, showing where it transitions from concrete-lined to earth-lined; camera facing downstream from left bank, June 14, 2022 (C0418).



Photograph 341: View of Segment 19's transition from concrete-lined to earth-lined at M.P. 98.74; camera facing upstream, June 14, 2022 (C0423).



Photograph 342: View of Segment 19's earth-lined section from approximately M.P. 104.22; camera facing downstream from left bank, June 14, 2022 (C0449).



Photograph 343: Check No. 18; camera facing right bank from left bank, June 14, 2022 (C0413).



Photograph 344: Check No. 18; camera facing upstream from left bank, June 14, 2022 (C0412).



Photograph 345: Bridge at M.P. 102.03; camera facing downstream from left bank, June 14, 2022 (C0440).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 14, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-20

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 20 of the canal spans 6.19 miles between canal mileposts 105.06 and 111.25, from Check No. 19 to a point just above Check No. 20 in Fresno County.
UTM: Zone 10S, 720497.39mE / 4083377.60mN (north endpoint); 728358.55mE / 4079053.51mN (south endpoint)

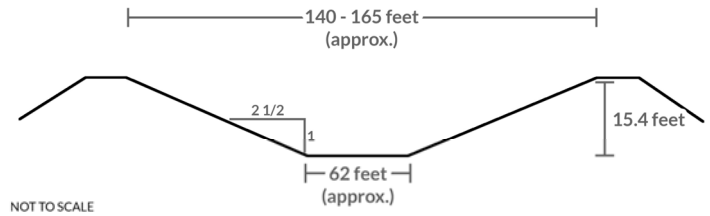
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 20 begins at Check No. 19 (**Photograph 346**) and ends at a point just upstream of Check No. 20. It has the same trapezoidal cross section as elsewhere on the canal and is lined with compacted earth. It is flanked with unpaved maintenance roads on both banks that are approximately 12 to 20 feet wide. (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: Approximately 140-165 feet
b. **Bottom Width**: 60-84 feet
c. **Height or Depth**: 15.40 feet
d. **Length of Segment**: 6.19 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 20 traverses through the flat agricultural lands of the western San Joaquin Valley principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by alterations to bridges and inlet drains and the addition of stilling wells, pipe crossings, well discharges, and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 346: Beginning of Segment 20 showing Check No. 19 and check building (right); camera facing downstream from left bank, June 14, 2022 (C0453).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

Segment 20 of the canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 347 - Photograph 349**). The width of the roads seems to vary based on topography.

Segment 20 begins at Check No. 19 (**Photograph 350**), located at M.P. 105.06. The check is a concrete structure with a total length of approximately 125 feet and a width that approximately is 145 feet at the upstream end, narrows to 125 feet at the check gates, and then widens again to 145 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of the structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge. On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 96.81 on the left bank, is of concrete block construction, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 19 at M.P. 105.05 while a second stilling well is located just below it at M.P. 105.09. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[167]

The Southern Pacific Railroad and State Highway 33 Siphon (**Photograph 351** - **Photograph 352**) begins approximately one quarter mile upstream from Check No. 20. The concrete structure consists of inlet and outlet headwalls that are connected by three 16-by-16-feet barrels. The inlet headwall at M.P. 110.96 is approximately 39 feet wide while the outlet headwall at M.P. 111.02 is approximately 38 feet wide. The barrels are 305 feet long and buried beneath the Southern Pacific Railroad and State Highway 33.[168]

The Firebaugh Wasteway extends from the canal's left bank at M.P. 111.22 (**Photograph 353**). It is approximately 1.1 miles in total length, ending where it flows into the San Joaquin River. It begins with a concrete inlet structure consisting of two 15-foot-wide channels, each with a steel radial gate to control the flow of water. The arced gate faces are 15 feet tall and 13 feet wide and reinforced on the back by a grid of steel members (**Photograph 354**). Each has two steel arms of a truss design that pivot from pins fixed into the central support pier and channel sidewalls. Supported by the pier and sidewalls is a concrete top deck on which electric gate-hoisting equipment is mounted and a concrete bridge. Double automatic-siphon spillways flank the gates (**Photograph 355**). Water passing through the inlet structure flows down a chute, into a stilling pool, and then into the wasteway lined with compacted earth.[169]

A siphon undercrossing at M.P. 111.24 consists of two one-foot pipes that convey the Master Drain beneath the DMC.

The six bridge crossings in this segment include two concrete county highway bridges, one county highway wasteway crossing bridge, one timber farm bridge, one non-original (post-1958) replacement farm bridge, and one crossing over a siphon. The farm bridge at M.P. 106.58 was replaced in 2004 and now has a concrete deck, measuring 20 feet wide, supported by five concrete bents, with steel guard-rails (**Photograph 356**). The crossing at M.P. 110.99 carries State Highway 33 and a single track for the Southern Pacific Railroad across the siphon at M.P. 110.96/111.02 (**Photograph 357**). It is included in the bridge population because it is categorized as a bridge in the DMC Structures List (2020). All other bridges are of standard design.

[167] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 62, 93, 97-99.
[168] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 64-65.
[169] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 53, 65, 72-73.

In addition to the structures discussed above, Segment 20 contains nine pipe crossings, four siphon undercrossings, well discharges, turnouts, and inlet drains. Of the three turnouts, two are overlining types, and one is a concrete pipe type. All these structures are of standard design or have standard alterations as discussed in the above typology discussion in Section P3a.

Photographs (continued)



Photograph 347: View of Segment 20 from the deck of the bridge at M.P. 106.58 Check No. 19; camera facing downstream, June 14, 2022 (C0462).



Photograph 348: View of Segment 20 from approximately M.P. 107.43; camera facing upstream from left bank, June 14, 2022 (C0464).



Photograph 349: View of Segment 20 from approximately M.P. 107.65; camera facing downstream from left bank, June 14, 2022 (C0466).



Photograph 350: Check No. 19; camera facing upstream from left bank, June 14, 2022 (C0456).



Photograph 351: Siphon inlet headwall at M.P. 110.96; camera facing downstream from left bank, June 14, 2022 (C0477).



Photograph 352: Siphon outlet headwall at M.P. 111.02; camera facing upstream from left bank, June 14, 2022 (C0479).



Photograph 353: Firebaugh Wasteway inlet structure at M.P. 111.22, with Check No. 20 visible in the background; camera facing downstream from left bank, June 14, 2022 (C0480).



Photograph 354: Firebaugh Wasteway inlet structure at M.P. 106.58, showing the radial gates (center) and an outlet to one of the automatic-siphon spillways (bottom, right); camera facing upstream from the wasteway's right bank, June 14, 2022 (C0485).



Photograph 355: Detail view of the Firebaugh Wasteway inlet structure at M.P. 111.22; camera facing downstream from left bank, June 14, 2022 (C0482).



Photograph 356: Bridge at M.P. 106.58; camera facing upstream from the wasteway's right bank, June 14, 2022 (C0460).



Photograph 357: Bridge at M.P. 1106.96; camera facing upstream from the left bank, June 14, 2022 (C0479).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 14-15, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-21

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 21 spans 5.22 miles between canal mileposts 111.26 and 116.48, from the Check No. 20 complex to a point just above Check No. 21 in Fresno County, near the city of Mendota.
UTM: Zone 10S, 728376.12mE / 4079046.33mN (north endpoint); 734438.24mE / 4073782.25mN (south endpoint)

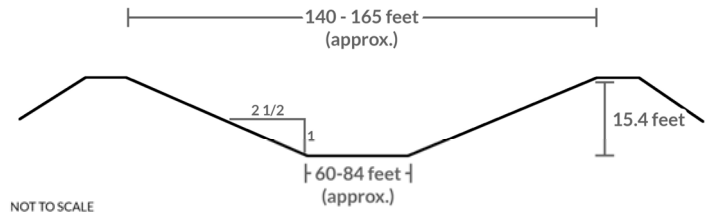
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 21 begins at Check No. 20 (**Photograph 358**) and ends at a point just upstream of Check No. 21. It has the same trapezoidal cross section as elsewhere on the canal and is lined with compacted earth. The canal is flanked by gravel access roads on both banks that are approximately 12 to 20 feet wide. (See Continuation Sheet.)

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: Approximately 140-165 feet
b. **Bottom Width**: 60-84 feet
c. **Height or Depth**: 15.40 feet
d. **Length of Segment**: 5.22 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 21 traverses through the flat agricultural lands of the western San Joaquin Valley principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: This segment has been altered by alterations to bridges and inlet drains and the addition of stilling wells, well discharges, and modern turnouts.

L8b. Description of Photo, Map, or Drawing:
Photograph 358: Beginning of Segment 21 showing Check No. 20, the Firebaugh Wasteway inlet structure (foreground), and check building (distance left), camera facing downstream from left bank, June 14, 2022 (C0480).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

Segment 21 of the canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 359** - **Photograph 362**). The width of the roads seems to vary based on topography.

Segment 21 begins at Check No. 20 (**Photograph 363**), located at M.P. 111.26. The check is a concrete structure with a total length of approximately 105 feet and a width that approximately is 145 feet wide at the upstream end, narrows to 125 feet at the check gates, and then widens again to 145 feet where it rejoins the canal walls on the downstream side. The banks of the check structure maintain the same slope angle as the canal. Spanning the top of structure is an 8-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge (**Photograph 364**). On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates below. The check structure is trapezoidal in cross section. A central, rectangular section is divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 20 feet tall by 17 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. The triangular section on each side is divided into a series of short bays. The lower or triangular part of each of these bays is closed with a concrete curtain wall. The top of the curtain wall in the outside bay on each side is set one inch above the designed maximum water surface elevation. Stop plank grooves are provided for all interior bays to permit closure from the top of the curtain wall to the designed water surface elevation. The check building, at M.P. 111.26 on the left bank, is of concrete block construction, measuring approximately 9 feet by 7 feet. A stilling well is located just above Check No. 20 at M.P. 111.24 while a second stilling well is located just below it at M.P. 111.28. Both stilling wells are located on the left bank and are the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail.[170]

The Miller & Lux Outside Canal Siphon (**Photograph 365**) begins approximately one mile upstream from Check No. 20. The concrete structure consists of inlet and outlet headwalls that are connected by three 16-by-16-feet barrels. The inlet headwall at M.P. 115.57 is approximately 36 feet wide while the outlet headwall at M.P. 115.59 is approximately 38 feet wide. The barrels are 156 feet long and buried beneath the Miller & Lux Outside Canal.[171]

The single extant bridge crossing in this segment is a concrete county highway bridge at M.P. 111.51, along Sierra Avenue, and is of standard design. The bents and abutments of a non-extant operating bridge are still evident at M.P. 115.58 (**Photograph 366**).

In addition to structures discussed above, Segment 21 contains two pipe crossings, one siphon undercrossing, well discharges, and inlet drains. All these structures are of standard design as discussed above in Section P3a.

[170] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 62, 93, 97-99.
[171] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 64-65.

Photographs (continued)



Photograph 359: View of Segment 21 from M.P. 113.72, with a well discharge in the foreground; camera facing upstream from left bank, June 14, 2022 (C0509).



Photograph 360: View of Segment 21 from approximately M.P. 111.55, with the Miller & Lux Outside Canal (left) running parallel to the Delta-Mendota Canal; camera facing downstream from left bank, June 14, 2022 (C0508).



Photograph 361: View of Segment 21 from atop the outlet of the siphon at M.P. 115.59, with two well discharges visible in the background; camera facing downstream, June 15, 2022 (C0566).



Photograph 362: View of Segment 21 from approximately M.P. 116.45 showing the canal bank functioning as a levee; camera facing upstream from left bank, June 15, 2022 (C0558).



Photograph 363: Check No. 20; camera facing downstream from left bank, June 14, 2022 (C0487).



Photograph 364: View of Check No. 20; camera facing upstream from left bank, June 14, 2022 (C0487).



Photograph 365: Miller & Lux Outside Canal Siphon outlet headwall at M.P. 115.59; camera facing upstream from left bank, June 15, 2022 (C0562).



Photograph 366: Remnants of no-longer extant operating bridge that previously spanned the Miller & Lux Outside Canal where it crosses over the DMC at M.P. 115.58; camera facing upstream, June 15, 2022 (C0565).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____
Trinomial _____

***Resource Name or #** (Assigned by recorder): Delta-Mendota Canal

***Recorded by**: H. Norby & A. Young

***Date**: June 15, 2022

L1. Historic and/or Common Name: Delta-Mendota Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation**: DMC-22

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) DMC Segment 22 spans 0.13 miles between canal mileposts 116.48 and 116.61, from the Check No. 21 complex to the canal's terminus at the San Joaquin River in Fresno County, near the city of Mendota.
UTM: Zone 10S, 734475.93mE / 4073788.85mN (north endpoint); 734675.53mE / 4073828.97mN (south endpoint)

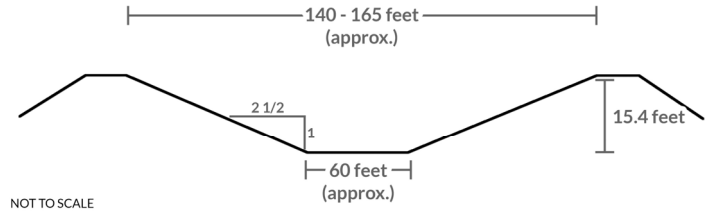
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
DMC Segment 22 begins at Check No. 21 (**Photograph 367**) and ends at canal's terminus at the San Joaquin River in Fresno County, near the city of Mendota. It has the same trapezoidal cross section as elsewhere on the canal and is lined with compacted earth. The canal is flanked by gravel access roads on both banks that are approximately 12 to 20 feet wide. (See Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: Approximately 140-165 feet
b. **Bottom Width**: 60-84 feet
c. **Height or Depth**: 15.40 feet
d. **Length of Segment**: 5.22 miles

L5. Associated Resources: Delta Cross Channel and Mendota Dam

L4e. Sketch of Cross-Section (not to scale) **Facing**: Northeast



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
Segment 22 traverses through the flat agricultural lands of the western San Joaquin Valley principally planted with orchards.

L8a. Photograph, Map, or Drawing.



L7. Integrity Considerations: The canal has not been altered in this segment.

L8b. Description of Photo, Map, or Drawing:
Photograph 367: Beginning of Segment 22 showing Check No. 21 and check building (background, center), with a pipe crossing (foreground); camera facing southeast, June 15, 2022 (C0550).

L9. Remarks:

L10. Form prepared by:
Heather Norby & Andrew Young
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

L11. Date: August 2022

L3. Description (continued):

The canal is flanked by gravel access roads on both banks, which are approximately 15-20 feet wide on the right (west) bank and approximately 12-18 feet wide on the left (east) bank (**Photograph 368** - **Photograph 369**). The width of the roads seems to vary based on topography.

Segment 22 begins at Check No. 21 (**Photograph 370**), located at M.P. 116.48. The check is a concrete structure with a total length of approximately 300 feet and a width that is approximately 150 feet wide at the upstream end, narrows to 60 feet at the check gates, and then widens again to approximately 160 feet where it rejoins the canal walls on the downstream side. The banks of the canal transition from sloped to vertical at the control structure. The check structure is rectangular in cross section and divided into three bays of equal size, each with a radial gate for regulation and closure. The arced gate faces are 18 feet tall by 18 feet wide, and each has two steel arms that rotate on pin bearings supported by brackets attached to the structure sidewalls. The gate arms have a truss design, and the gate faces are all reinforced by a grid pattern of steel beams on the back side. Spanning the top of the structure is a 10-foot-wide concrete gate hoist equipment deck and walkway with a pipe railing along the edge. On the platform is electric gate-hoisting equipment in waterproof steel enclosures used to raise and lower the three steel radial gates that face downstream. The check building, at M.P. 116.48 on the right bank, is of concrete block construction, measuring approximately 12 feet by 11 feet. A stilling well is located just above Check No. 21 at M.P. 116.45. It is located on the right bank and is the typical cylindrical concrete type, accessed by a set of concrete steps with a metal handrail. [172]

The single bridge crossing in this segment is a concrete County Highway Bridge at M.P. 116.48, along Bass Avenue and is of standard design (**Photograph 371**).

The Bureau of Reclamation maintenance yard is located at M.P. 116.50, along the right bank (**Photograph 372**). It consists of a generally rectangular lot containing a garage, a storage building, and an intermodal shipping container. The approximately 1,850-square-feet, three-bay garage is sited in the lot's northwest corner and faces east (**Photograph 373** - **Photograph 374**). It has a rectangular footprint, a side-gable roof of crimped metal, and walls clad in metal. The bay at its north end is fully enclosed. It is accessed by a doorway piercing its east side, and its fenestration consists of original divided-light awning windows and a replacement aluminum sliding window. The other two bays are fully open along the garage's east side. The approximately 1,050-square-feet storage building is sited toward the lot's southeast corner (**Photograph 375**). It has a rectangular footprint, a side-gable roof of crimped metal, and walls clad in metal. It is accessed by a metal door its south side, and fenestration consists of a sliding window concealed behind a screen. The intermodal shipping container is sited parallel to the storage building's east side, approximately 40 feet away. Metal chain-link fencing fully encloses the lot's southern half while its northern half is enclosed by metal chain-link fencing that extends onto and along the canal's right bank to enclose the check building at Check No. 21 as well.

[172] Bureau of Reclamation, *Technical Record of Design and Construction: Delta-Mendota Canal*, 59, 86-87, 93, 97-99.

Photographs (continued)



Photograph 368: View of Segment 22 from approximately M.P. 116.55, showing the canal's terminus, where it flows into the San Joaquin River; camera facing downstream from right bank, June 15, 2022 (C0537).



Photograph 369: View of Segment 22 from approximately M.P. 116.55, with Check No. 21 in the background; camera facing upstream from right bank, June 15, 2022 (C0538).



Photograph 370: Check No. 21, showing the radial gates fully open; camera facing upstream from left bank, June 15, 2022 (C0555).



Photograph 371: Check No. 21 and Bass Avenue Bridge, showing radial gates' backside; camera facing downstream from left bank, June 15, 2022 (C0551).



Photograph 372: View of maintenance yard at M.P. 116.50 (left), with Check No. 21 visible in the distance (right); camera facing west, June 15, 2022 (C0540).



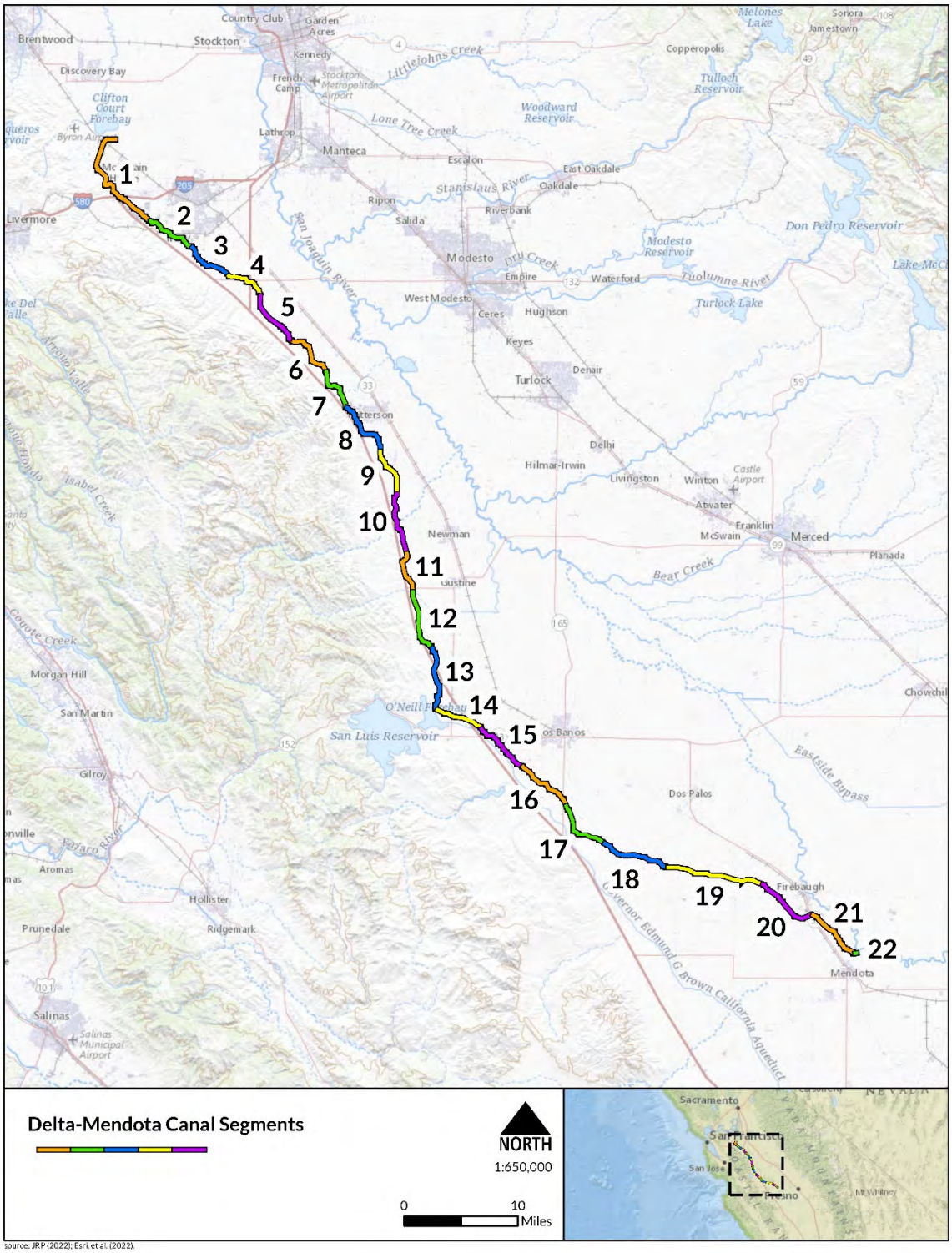
Photograph 373: Front (east) side of three-bay garage; camera facing west, June 15, 2022 (C0542).



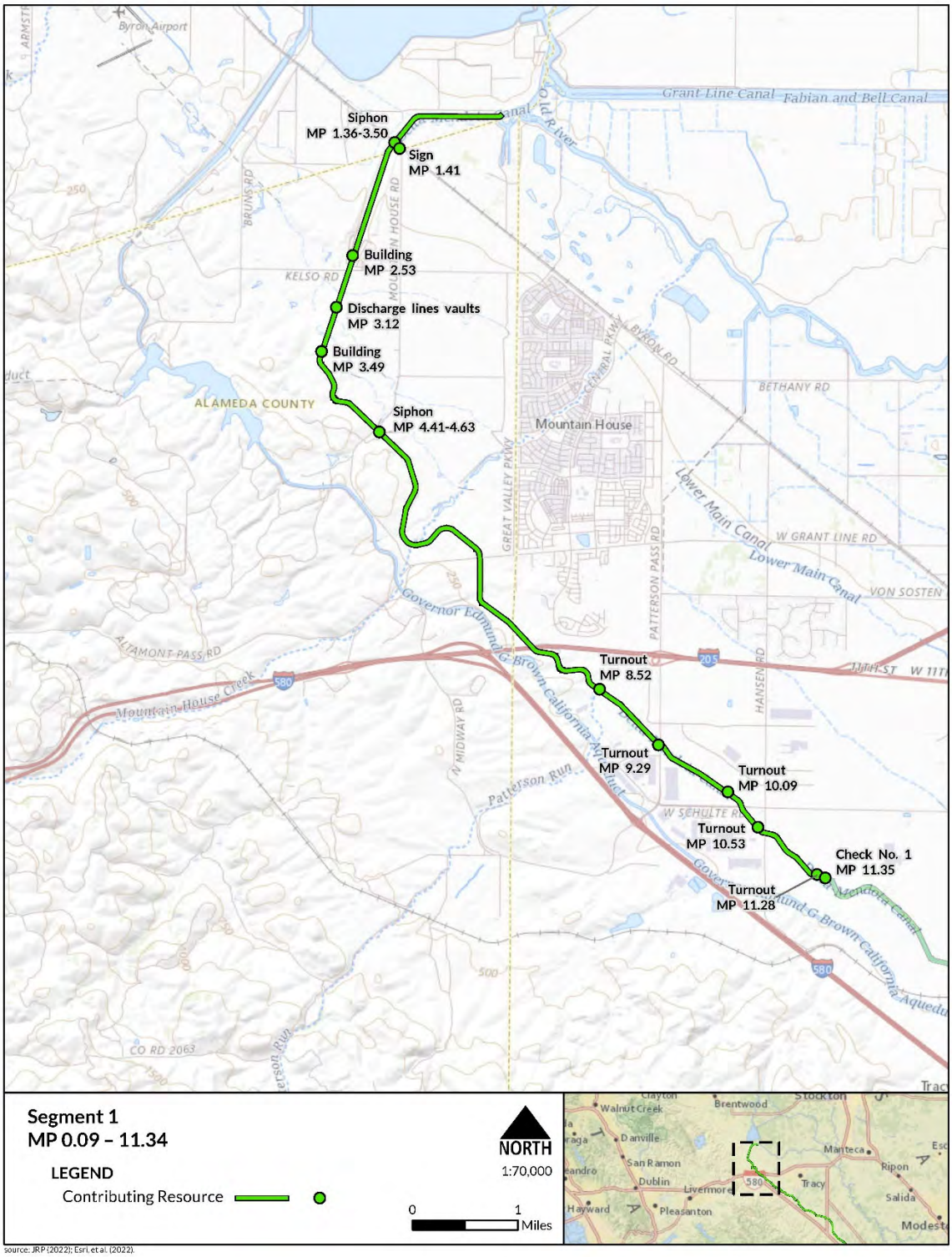
Photograph 374: West and south sides of three-bay garage; camera facing northeast, June 15, 2022 (C0548).



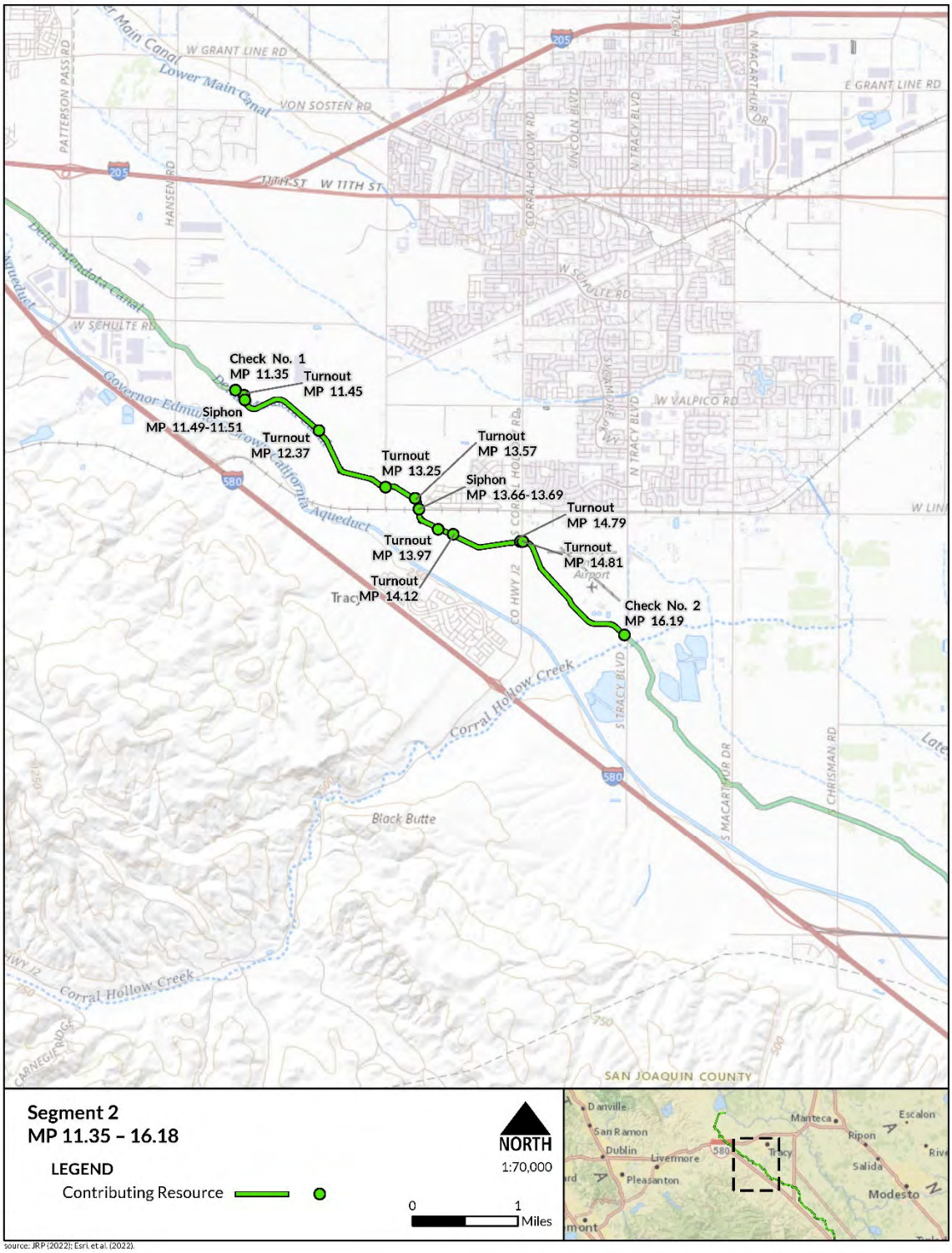
Photograph 375: South and east sides of storage building; camera facing northwest, June 15, 2022 (C0545).

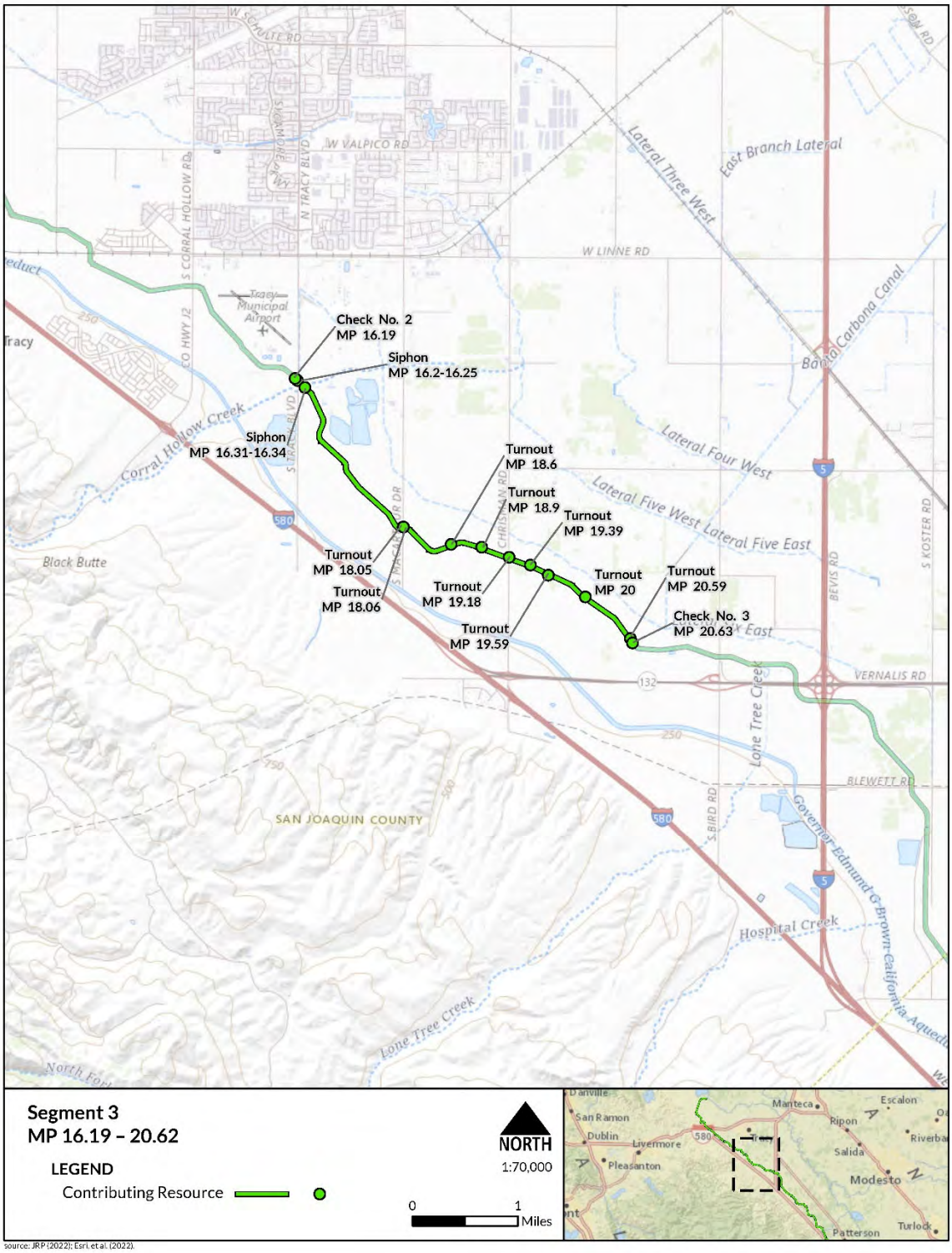


source: JRP (2022); Esri, et al. (2022).

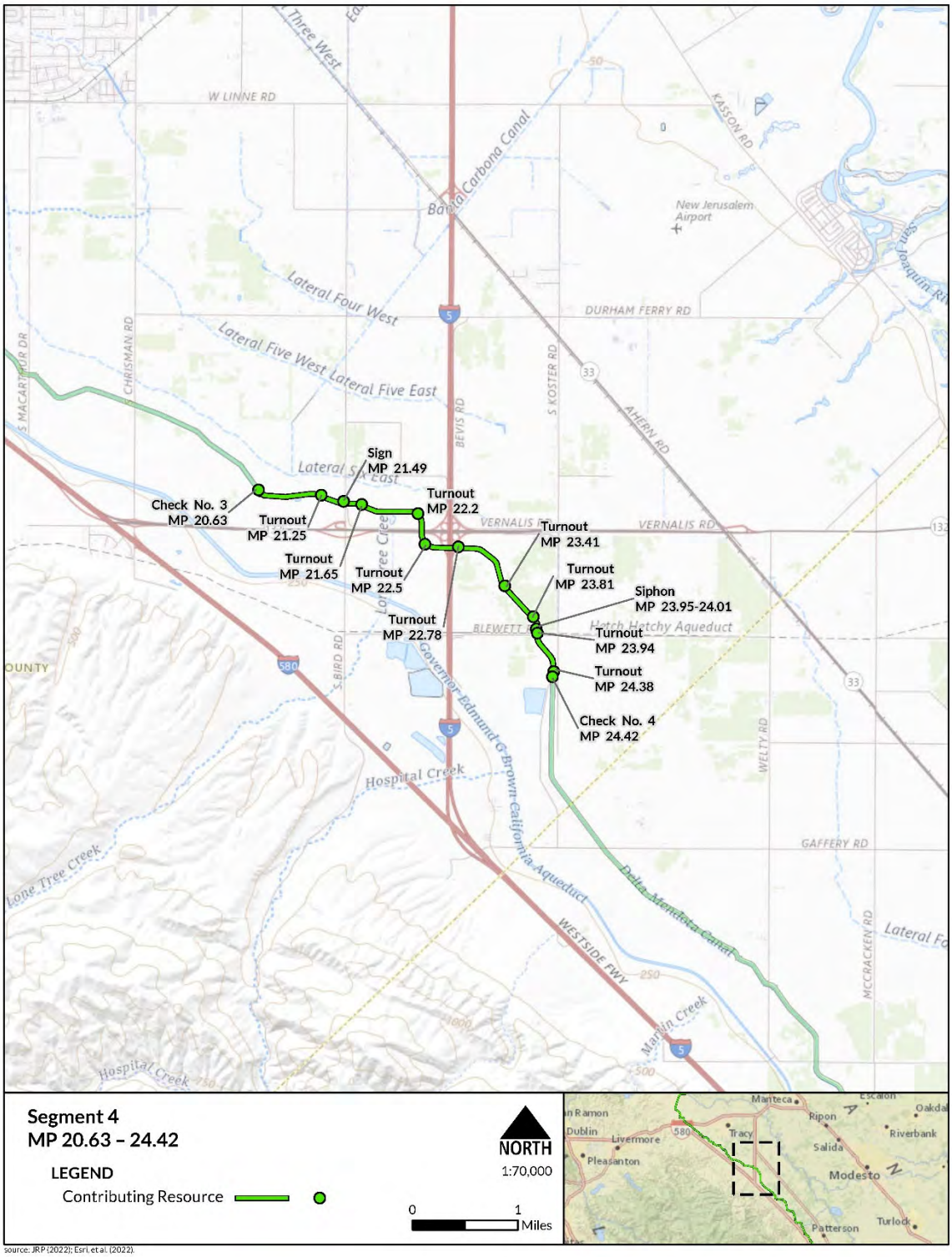


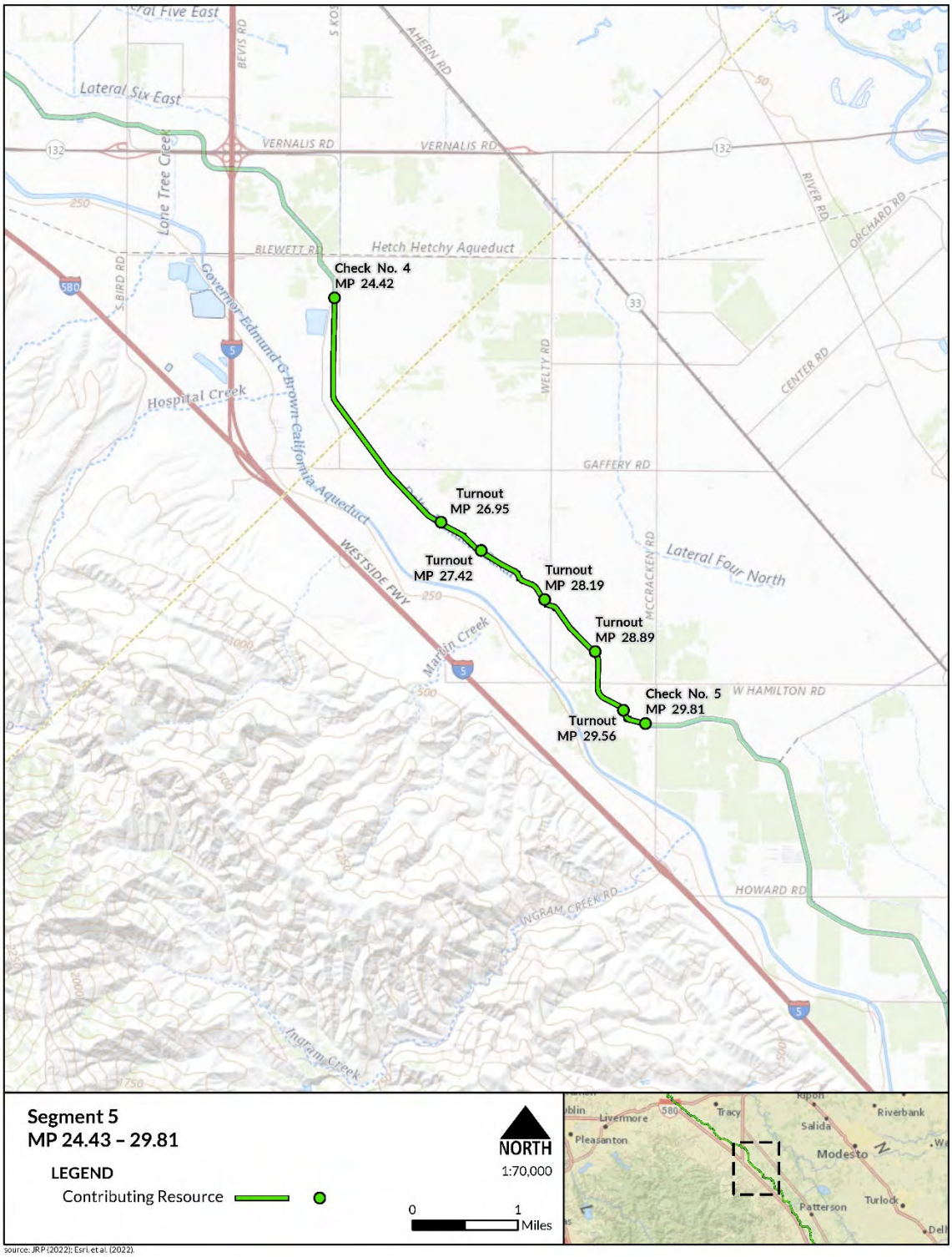
source: JRP (2022); Esri, et al. (2022).

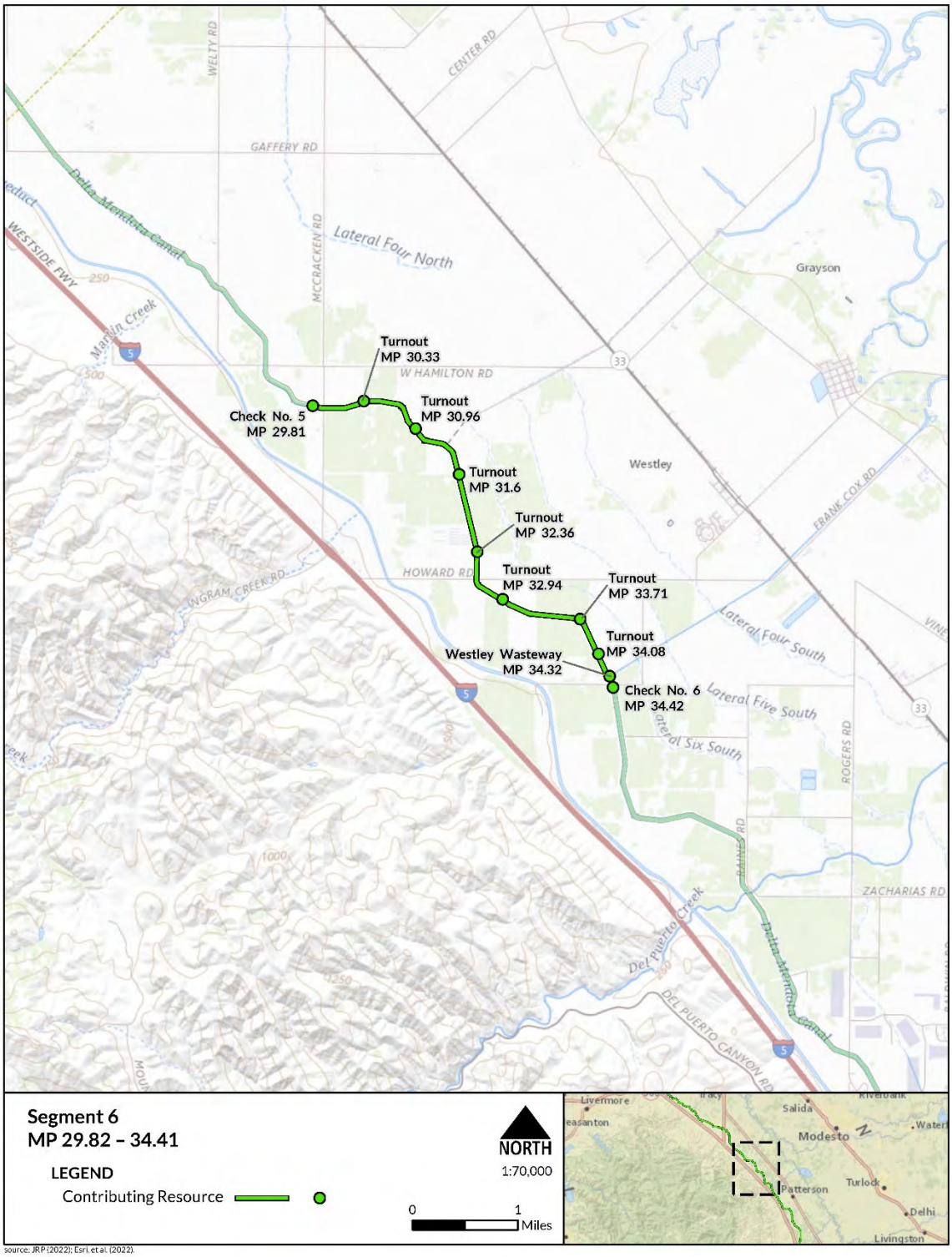

Check No. 1
MP 11.35
Turnout
MP 11.45
Siphon
MP 11.49-11.51
Turnout
MP 12.37
Turnout
MP 13.25
Turnout
MP 13.57
Siphon
MP 13.66-13.69
Turnout
MP 14.79
Turnout
MP 13.97
Turnout
MP 14.81
Turnout
MP 14.12
Check No. 2
MP 16.19
Delta-Mendota Canal
Governor Edmund G. Brown California Aqueduct
Corral Hollow Creek
Black Butte
SAN JOAQUIN COUNTY
Segment 2
MP 11.35 – 16.18
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
source: JRP (2022); Esri, et al. (2022).

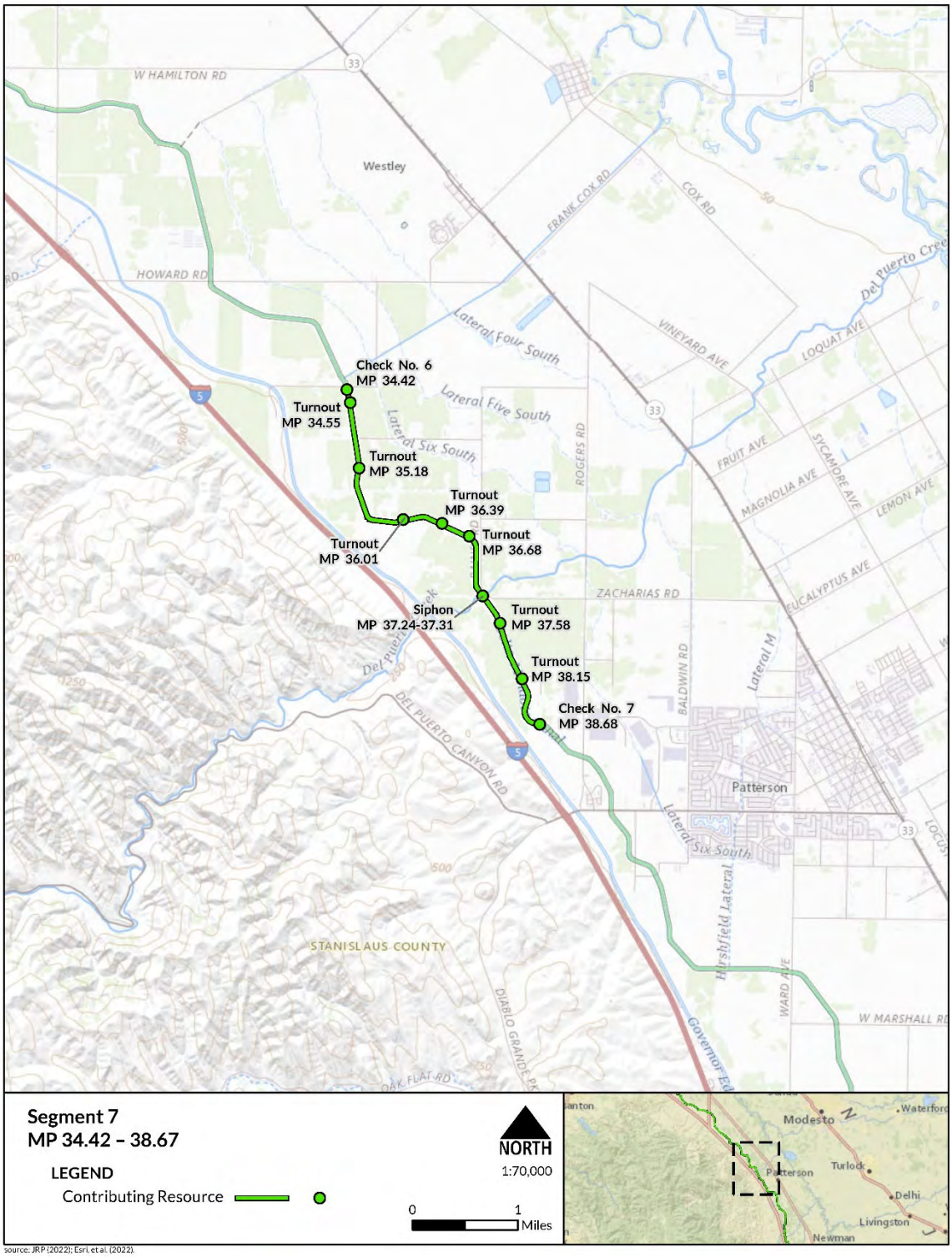


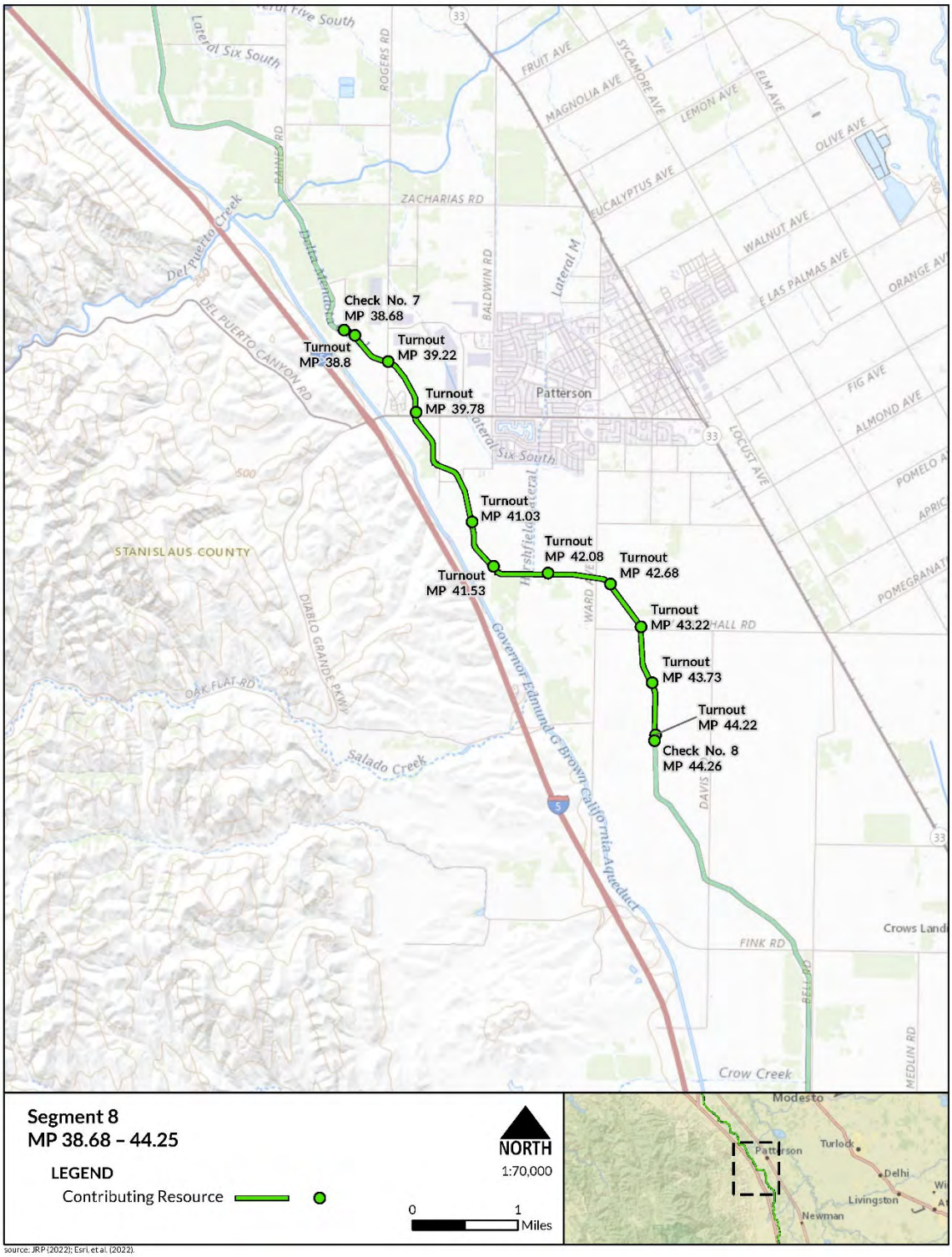
source: JRP (2022); Esri, et al. (2022).

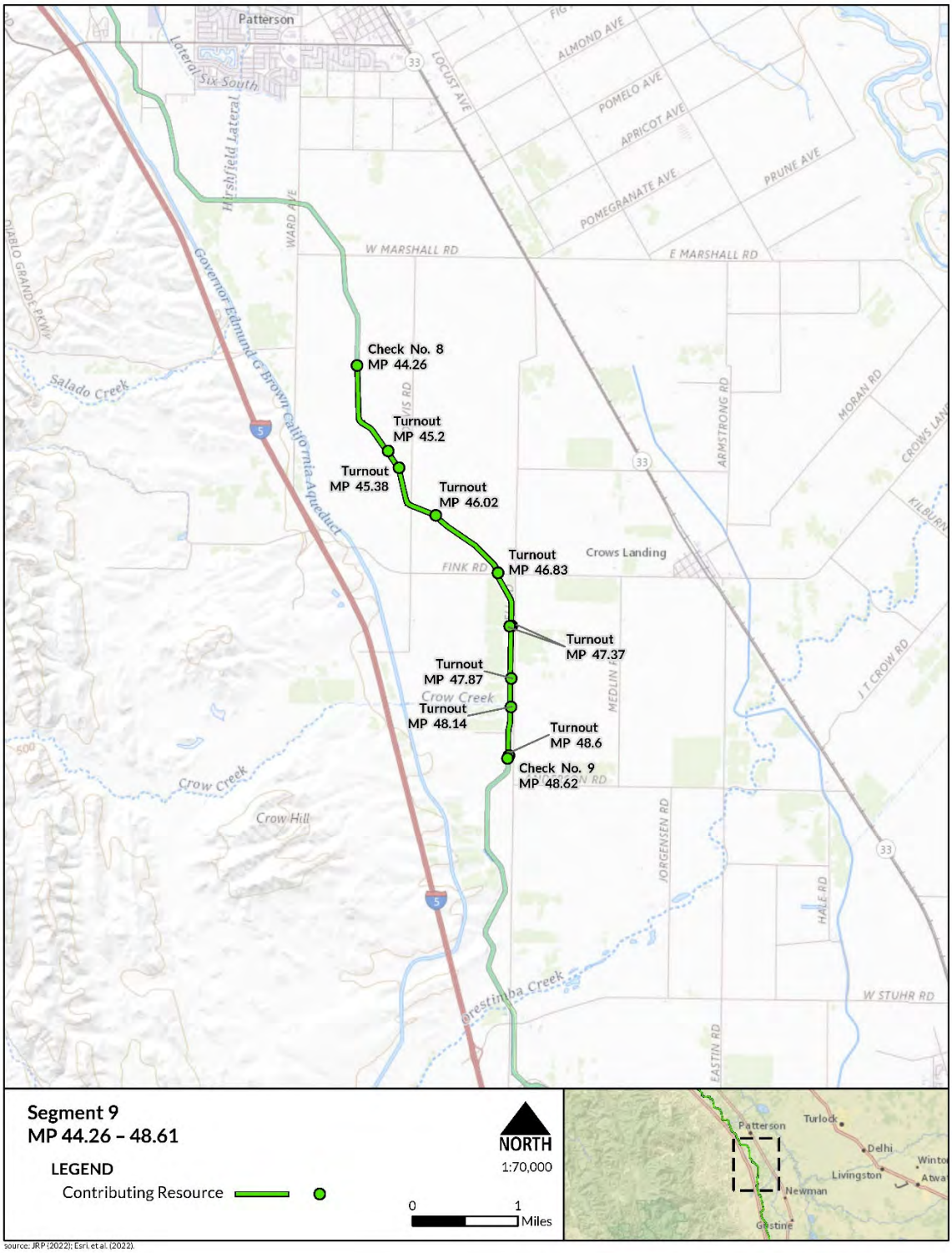

Sign
MP 21.49
Check No. 3
MP 20.63
Turnout
MP 21.25
Turnout
MP 22.2
Turnout
MP 21.65
Turnout
MP 22.5
Turnout
MP 22.78
Turnout
MP 23.41
Turnout
MP 23.81
Siphon
MP 23.95-24.01
Turnout
MP 23.94
Turnout
MP 24.38
Check No. 4
MP 24.42
Segment 4
MP 20.63 – 24.42
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
source: JRP (2022); Esri, et al. (2022).
W LINNE RD
Three West
Lateral Four West
Lateral Five West Lateral Five East
DURHAM FERRY RD
VERNALIS RD
BEVIS RD
S KOSTER RD
AHERN RD
CHRISMAN RD
S MACARTHUR DR
S BIRD RD
KASSON RD
New Jerusalem Airport
Hospital Creek
Lone Tree Creek
Governor Edmund G Brown California Aqueduct
Delta-Mendota Canal
WESTSIDE FWY
GAFFERY RD
WELTY RD
MCCRACKEN RD
Martin Creek
Hetch Hetchy Aqueduct
Manteca
Ripon
Tracy
Salida
Modesto
Riverbank
Patterson
Turlock
Livermore
Dublin
Pleasanton

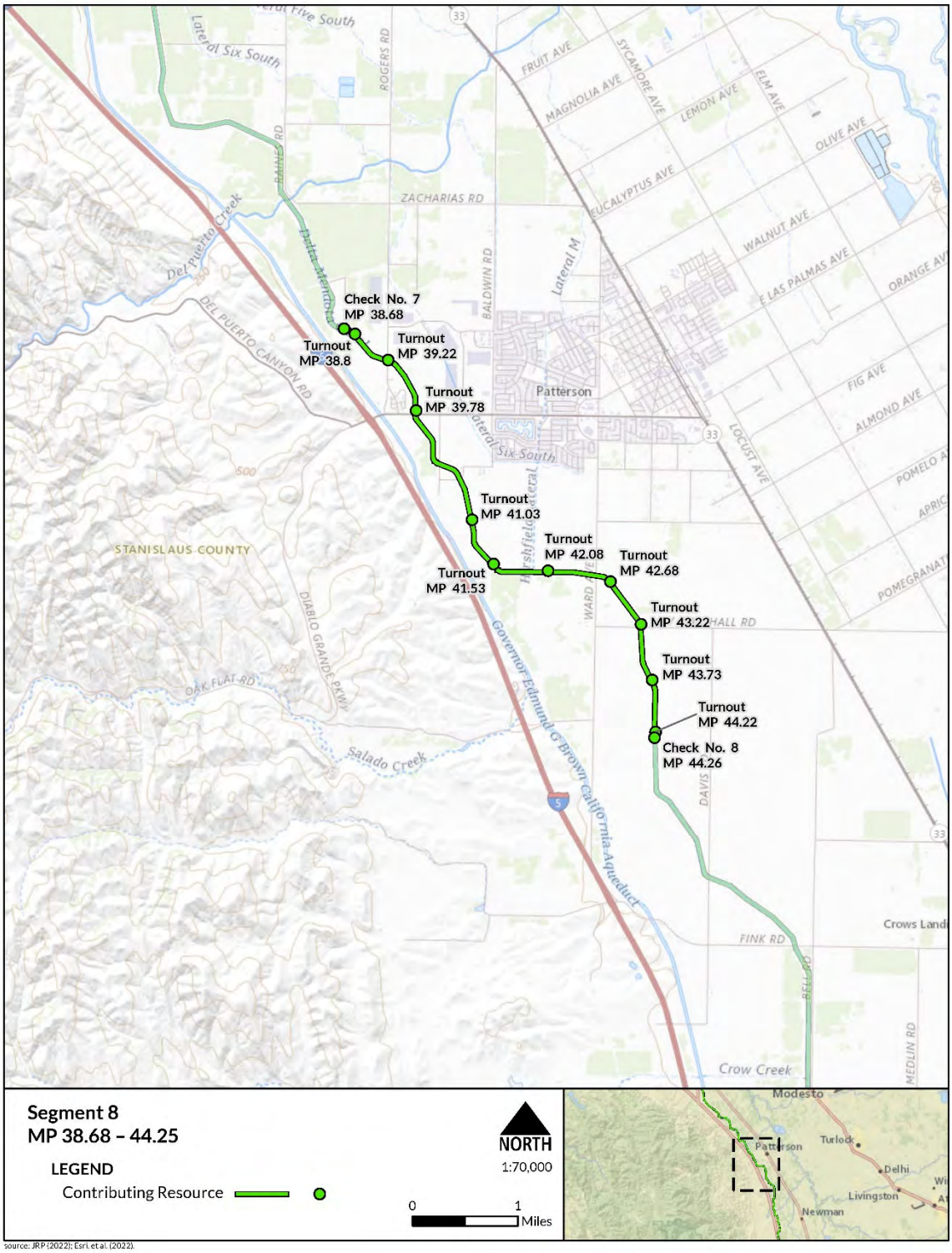

Lateral Five East
Lateral Six East
BEVIS RD
AHERN RD
VERNALIS RD
Lone Tree Creek
BLEWETT RD
Hetch Hetchy Aqueduct
S BIRD RD
Governor Edmund G Brown California Aqueduct
Hospital Creek
WELTY RD
RIVER RD
ORCHARD RD
CENTER RD
GAFFERY RD
MCCRACKEN RD
Lateral Four North
WESTSIDE FWY
Marblin Creek
W HAMILTON RD
INGRAM CREEK RD
HOWARD RD
Ingram Creek
Check No. 4
MP 24.42
Turnout
MP 26.95
Turnout
MP 27.42
Turnout
MP 28.19
Turnout
MP 28.89
Check No. 5
MP 29.81
Turnout
MP 29.56
Segment 5
MP 24.43 – 29.81
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Livermore
Pleasanton
Tracy
Salida
Riverbank
Modesto
Patterson
Turlock
source: JRP (2022); Esri, et al. (2022).

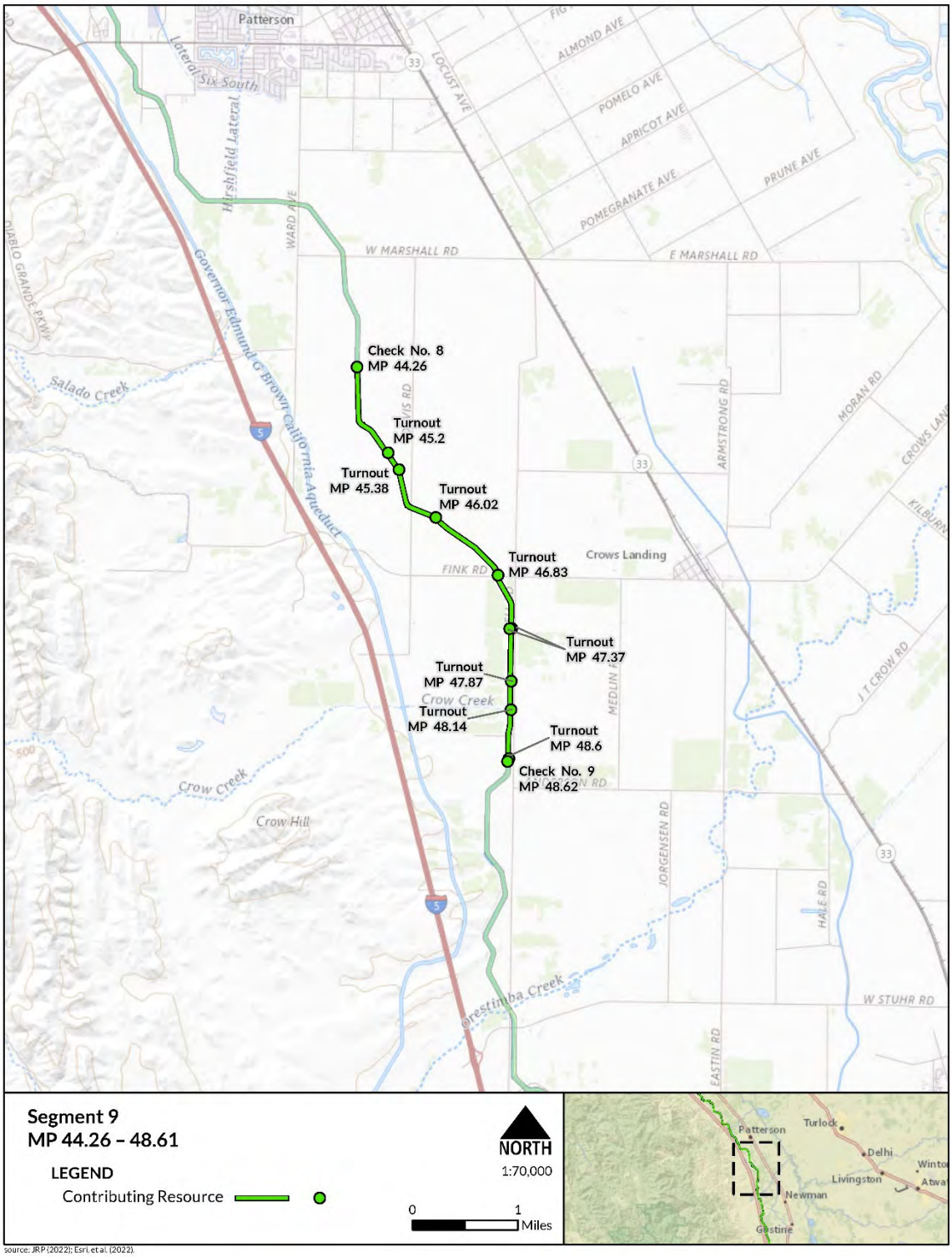

Turnout
MP 30.33
Turnout
MP 30.96
Check No. 5
MP 29.81
Turnout
MP 31.6
Turnout
MP 32.36
Turnout
MP 32.94
Turnout
MP 33.71
Turnout
MP 34.08
Westley Wasteway
MP 34.32
Check No. 6
MP 34.42
Lateral Four North
Lateral Four South
Lateral Five South
Lateral Six South
Delta-Mendota Canal
Del Puerto Creek
Marsh Creek
Ingram Creek
Grayson
Westley
W HAMILTON RD
HOWARD RD
GAFFERY RD
CENTER RD
WELTY RD
MCCRACKEN RD
FRANK COX RD
ROGERS RD
ZACHARIAS RD
DEL PUERTO CANYON RD
WESTSIDE FWY
Segment 6
MP 29.82 – 34.41
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Livermore
Salida
Modesto
Patterson
Turlock
Delhi
Livingston
source: JRP (2022); Esri, et al. (2022).

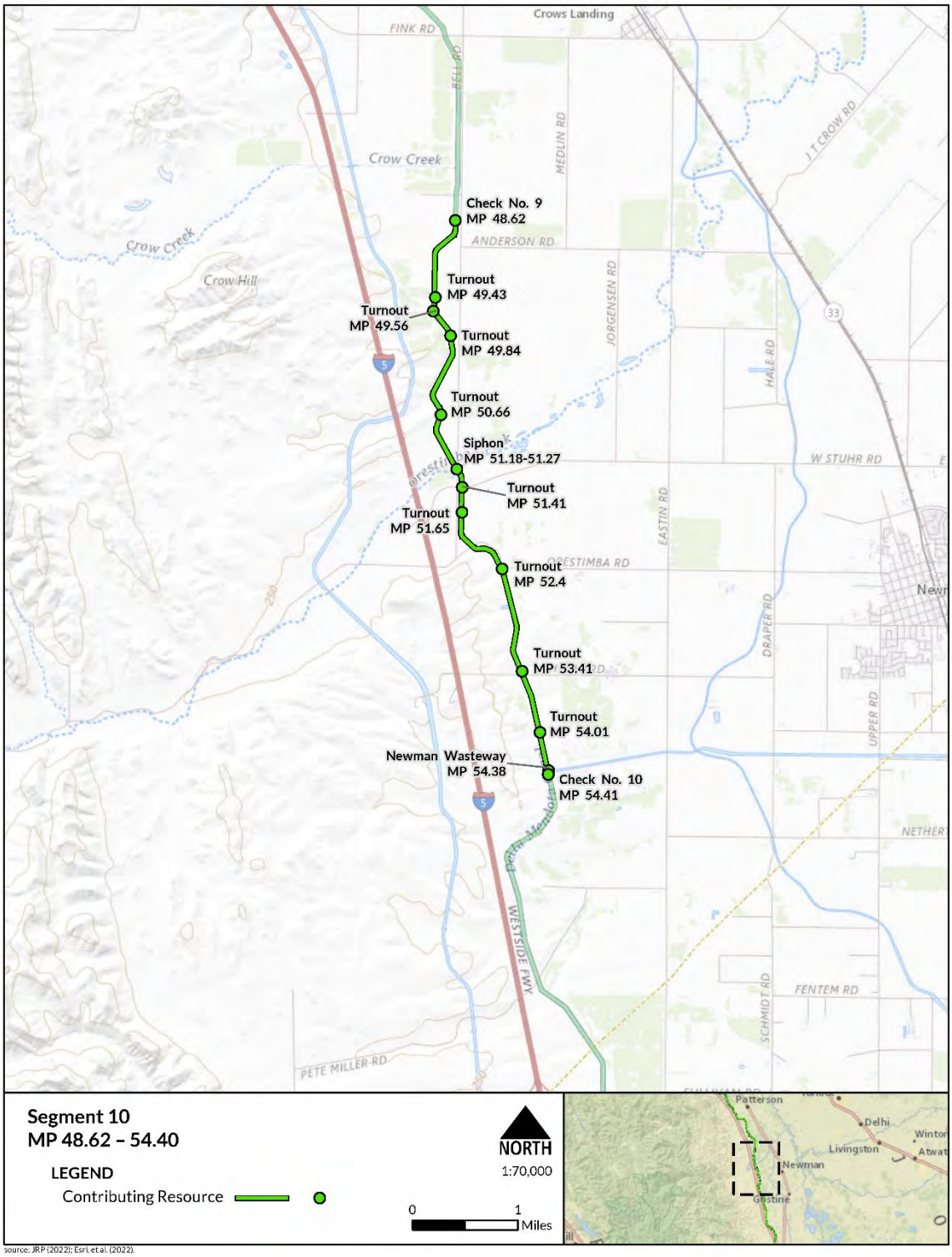

W HAMILTON RD
Westley
FRANK COX RD
COX RD
HOWARD RD
Lateral Four South
VINEYARD AVE
LOQUAT AVE
Del Puerto Creek
Lateral Five South
Lateral Six South
ROGERS RD
FRUIT AVE
SYCAMORE AVE
MAGNOLIA AVE
LEMON AVE
Check No. 6
MP 34.42
Turnout
MP 34.55
Turnout
MP 35.18
Turnout
MP 36.39
Turnout
MP 36.68
Turnout
MP 36.01
ZACHARIAS RD
EUCALYPTUS AVE
Siphon
MP 37.24-37.31
Turnout
MP 37.58
Turnout
MP 38.15
Check No. 7
MP 38.68
BALDWIN RD
Lateral M
DEL PUERTO CANYON RD
Patterson
Lateral Six South
Hirshfield Lateral
STANISLAUS COUNTY
DIABLO GRANDE PKWY
WARD AVE
W MARSHALL RD
OAK FLAT RD
Segment 7
MP 34.42 – 38.67
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Modesto
Waterford
Turlock
Delhi
Livingston
Newman
source: JRP (2022); Esri, et al. (2022).

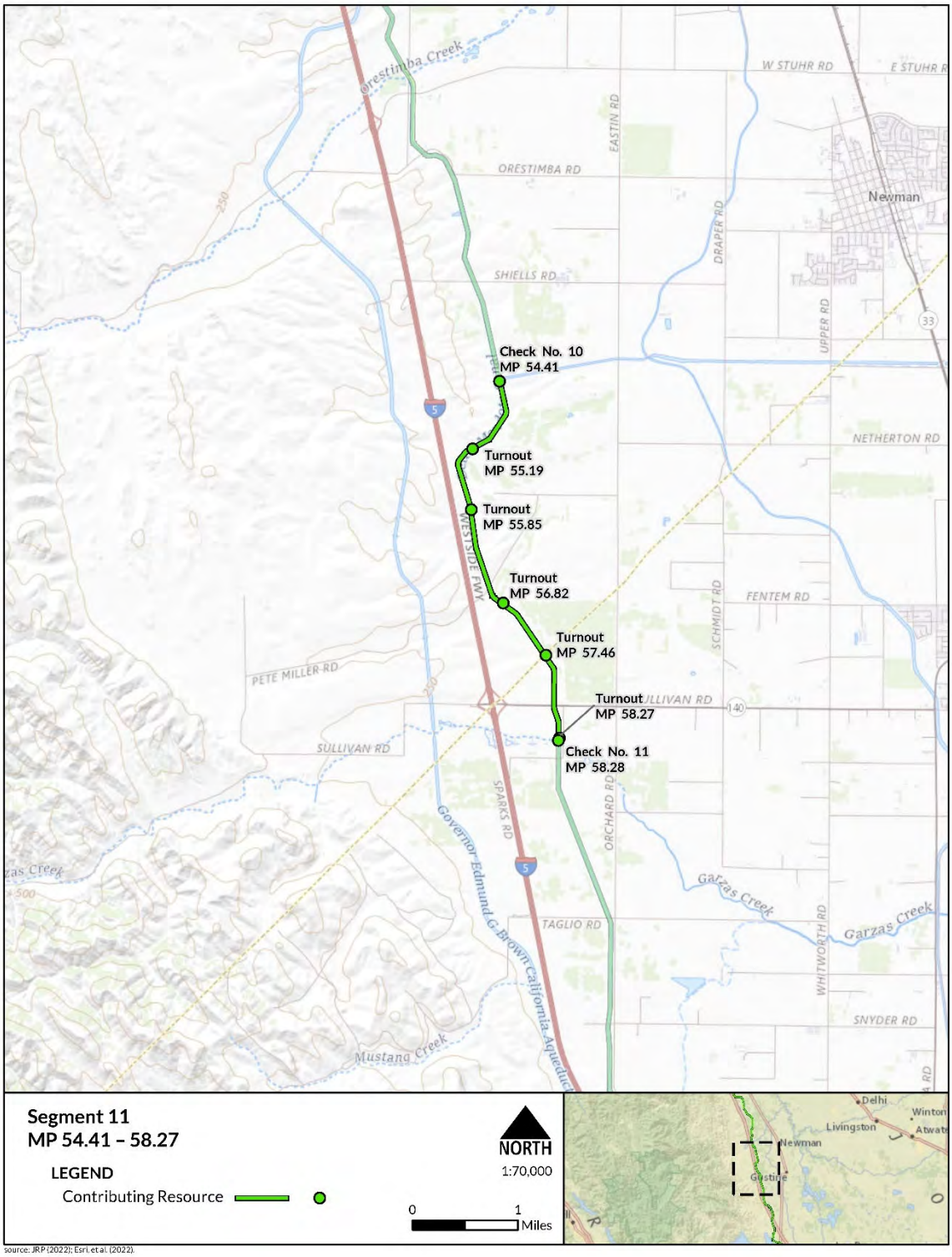

Check No. 7
MP 38.68
Turnout
MP 38.8
Turnout
MP 39.22
Turnout
MP 39.78
Turnout
MP 41.03
Turnout
MP 42.08
Turnout
MP 42.68
Turnout
MP 41.53
Turnout
MP 43.22
Turnout
MP 43.73
Turnout
MP 44.22
Check No. 8
MP 44.26
Patterson
STANISLAUS COUNTY
Crows Land
Crow Creek
Salado Creek
Segment 8
MP 38.68 – 44.25
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Modesto
Turlock
Delhi
Livingston
Newman
source: JRP (2022); Esri, et al. (2022).

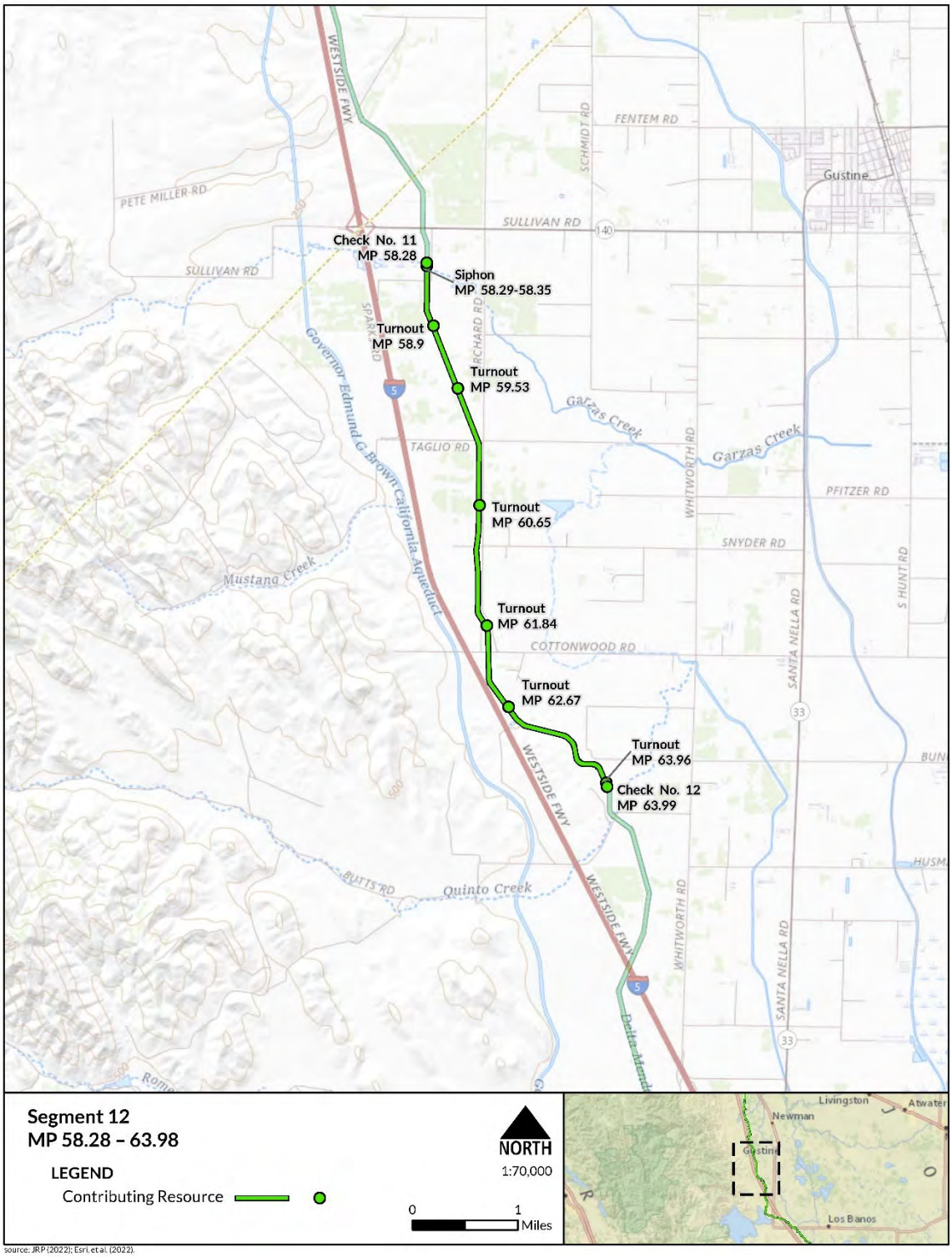

Patterson
Lateral Six South
Hirshfield Lateral
Governor Edmund G Brown California Aqueduct
Salado Creek
Crow Creek
Crow Hill
Orestimba Creek
W MARSHALL RD
E MARSHALL RD
FINK RD
W STUHR RD
ALMOND AVE
POMELO AVE
APRICOT AVE
POMEGRANATE AVE
PRUNE AVE
LOCUST AVE
WARD AVE
ARMSTRONG RD
MORAN RD
CROWS LANDING RD
KILBURN
J T CROW RD
MEDLIN
JORGENSEN RD
HALE RD
EASTIN RD
DIABLO GRANDE PKWY
Crows Landing
Check No. 8
MP 44.26
Turnout
MP 45.2
Turnout
MP 45.38
Turnout
MP 46.02
Turnout
MP 46.83
Turnout
MP 47.37
Turnout
MP 47.87
Turnout
MP 48.14
Turnout
MP 48.6
Check No. 9
MP 48.62
Segment 9
MP 44.26 – 48.61
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Turlock
Delhi
Livingston
Newman
Gustine
source: JRP (2022); Esri, et al. (2022).

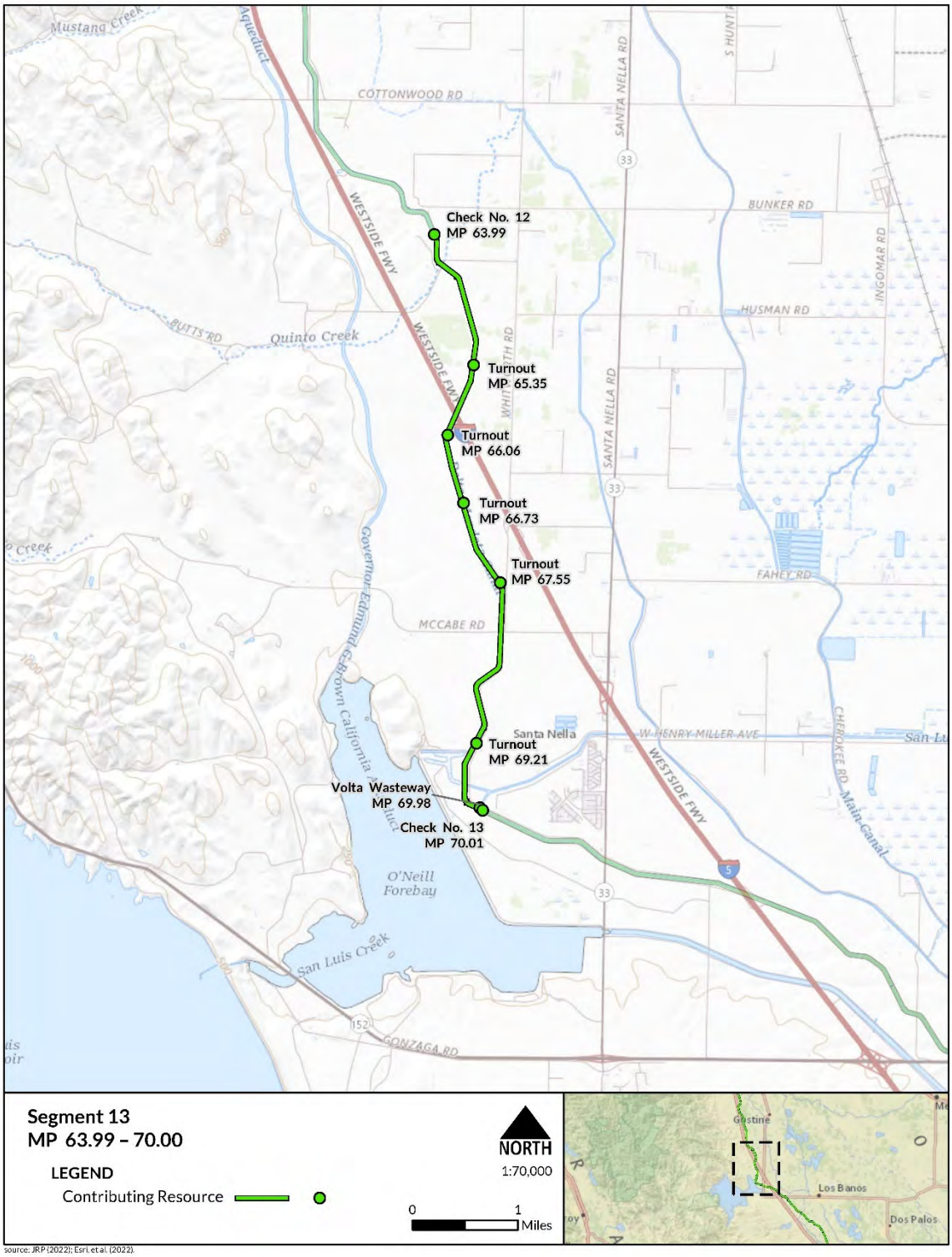

Check No. 7
MP 38.68
Turnout
MP 38.8
Turnout
MP 39.22
Turnout
MP 39.78
Turnout
MP 41.03
Turnout
MP 41.53
Turnout
MP 42.08
Turnout
MP 42.68
Turnout
MP 43.22
Turnout
MP 43.73
Turnout
MP 44.22
Check No. 8
MP 44.26
Patterson
STANISLAUS COUNTY
Crows Land
Modesto
Turlock
Delhi
Livingston
Newman
Segment 8
MP 38.68 – 44.25
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
source: JRP (2022); Esri, et al. (2022).

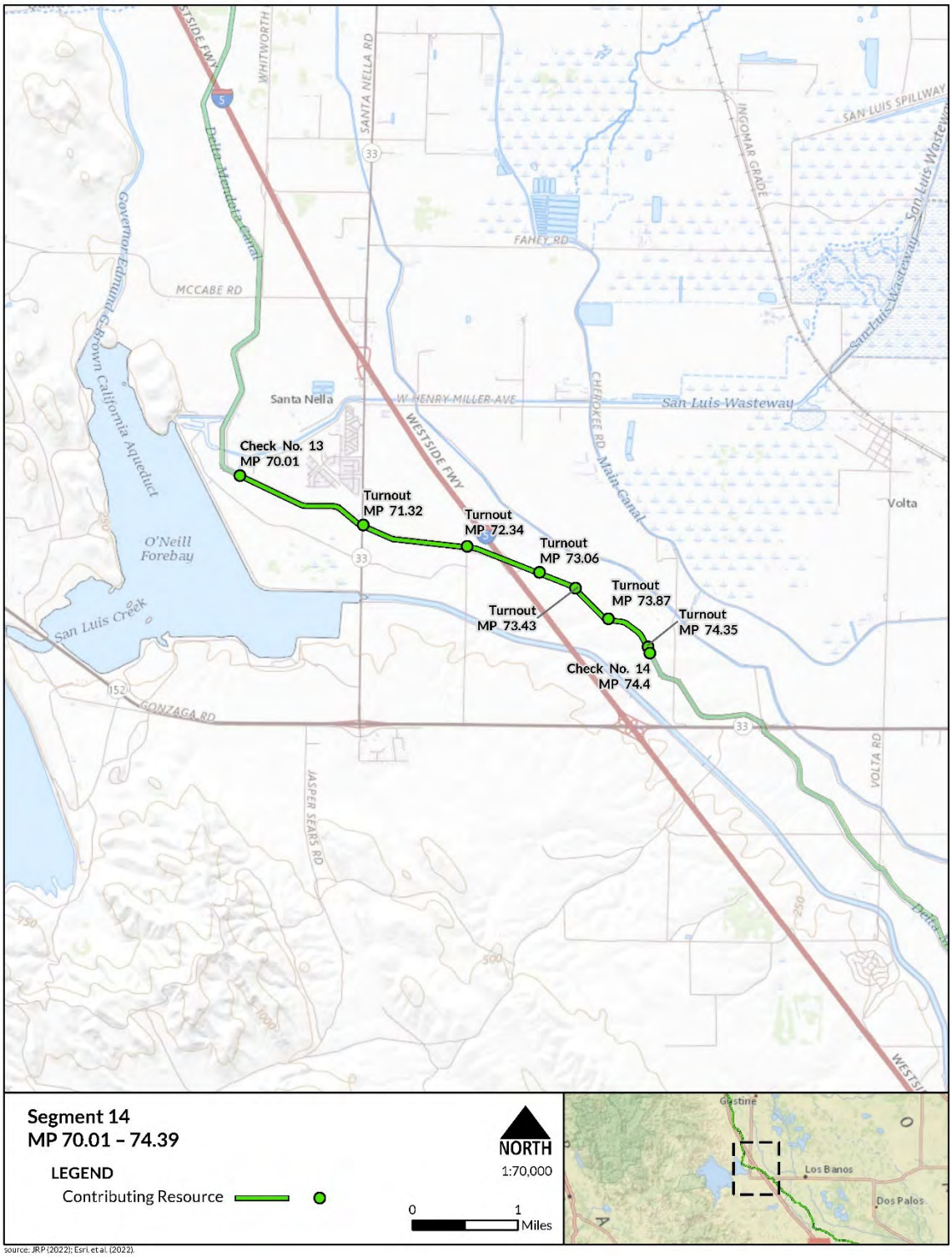

Patterson
Lateral Six South
Hirshfield Lateral
Governor Edmund G Brown California Aqueduct
Salado Creek
Crow Creek
Crow Hill
Orestimba Creek
W MARSHALL RD
E MARSHALL RD
FINK RD
W STUHR RD
Crows Landing
ALMOND AVE
POMELO AVE
APRICOT AVE
POMEGRANATE AVE
PRUNE AVE
LOCUST AVE
WARD AVE
ARMSTRONG RD
MORAN RD
JORGENSEN RD
HALE RD
EASTIN RD
MEDLIN RD
J T CROW RD
DIABLO GRANDE PKWY
Check No. 8
MP 44.26
Turnout
MP 45.2
Turnout
MP 45.38
Turnout
MP 46.02
Turnout
MP 46.83
Turnout
MP 47.37
Turnout
MP 47.87
Turnout
MP 48.14
Turnout
MP 48.6
Check No. 9
MP 48.62
Segment 9
MP 44.26 – 48.61
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Turlock
Delhi
Livingston
Newman
Gustine
source: JRP (2022); Esri, et al. (2022).


Crows Landing
FINK RD
Crow Creek
MEDLIN RD
J T CROW RD
ANDERSON RD
Crow Hill
JORGENSEN RD
HALE RD
W STUHR RD
EASTIN RD
DRAPER RD
UPPER RD
FENTEM RD
SCHMIDT RD
PETE MILLER RD
WESTSIDE FWY
Check No. 9
MP 48.62
Turnout
MP 49.43
Turnout
MP 49.56
Turnout
MP 49.84
Turnout
MP 50.66
Siphon
MP 51.18-51.27
Turnout
MP 51.41
Turnout
MP 51.65
Turnout
MP 52.4
Turnout
MP 53.41
Turnout
MP 54.01
Newman Wasteway
MP 54.38
Check No. 10
MP 54.41
Segment 10
MP 48.62 – 54.40
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Patterson
Delhi
Livingston
Newman
Gustine
source: JRP (2022); Esri, et al. (2022).

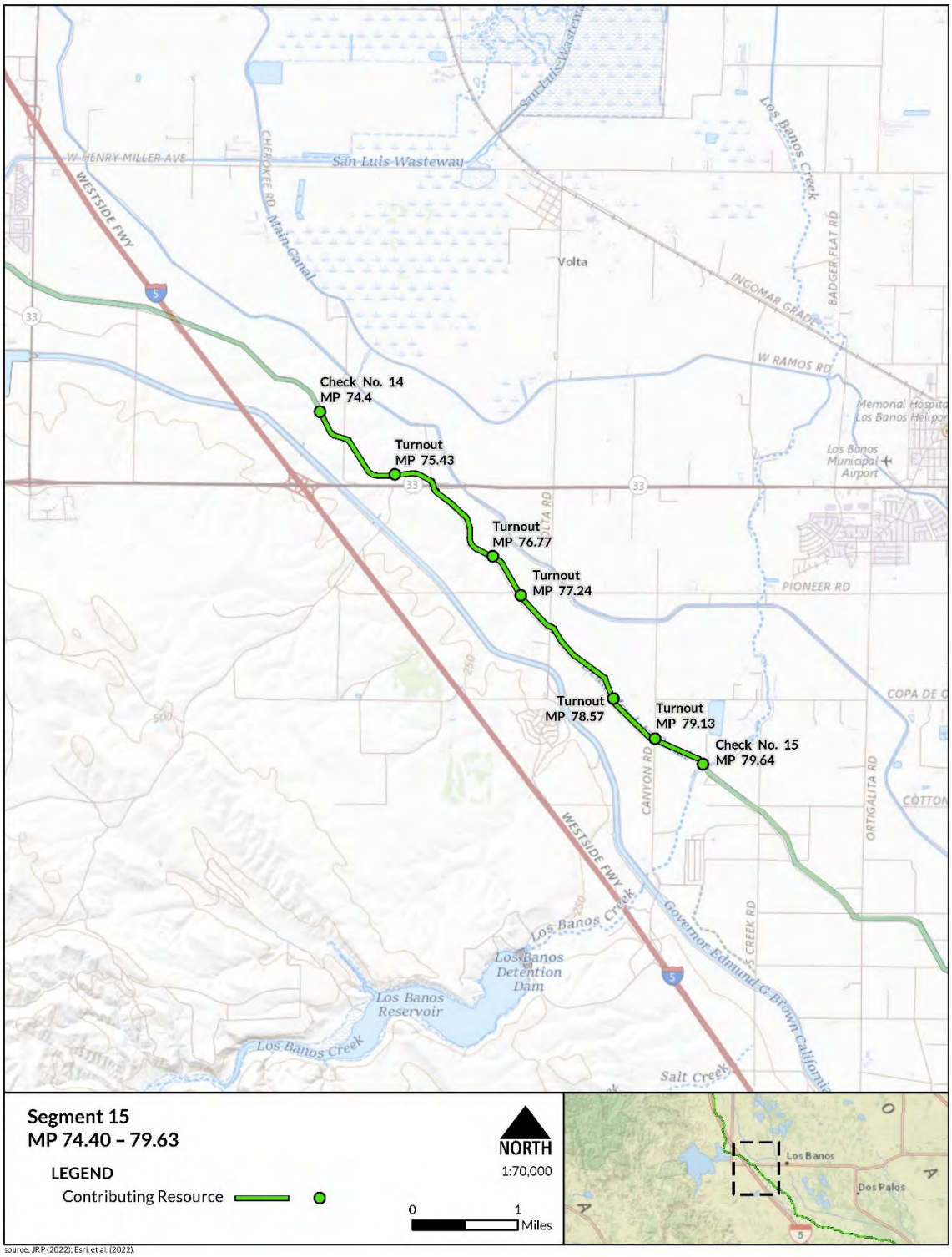

Orestimba Creek
W STUHR RD
E STUHR R
EASTIN RD
ORESTIMBA RD
Newman
DRAPER RD
SHIELLS RD
UPPER RD
Check No. 10
MP 54.41
Turnout
MP 55.19
Turnout
MP 55.85
Turnout
MP 56.82
Turnout
MP 57.46
Turnout
MP 58.27
Check No. 11
MP 58.28
NETHERTON RD
WESTSIDE FWY
SCHMIDT RD
FENTEM RD
PETE MILLER RD
ILLIVAN RD
SULLIVAN RD
SPARKS RD
ORCHARD RD
Governor Edmund G. Brown California Aqueduct
Garzas Creek
TAGLIO RD
WHITWORTH RD
SNYDER RD
Mustang Creek
Segment 11
MP 54.41 – 58.27
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Delhi
Livingston
Newman
Gustine
source: JRP (2022); Esri et al. (2022).


Check No. 11
MP 58.28
Siphon
MP 58.29-58.35
Turnout
MP 58.9
Turnout
MP 59.53
Turnout
MP 60.65
Turnout
MP 61.84
Turnout
MP 62.67
Turnout
MP 63.96
Check No. 12
MP 63.99
WESTSIDE FWY
SULLIVAN RD
FENTEM RD
PETE MILLER RD
SCHMIDT RD
RICHARD RD
SPARKS RD
Governor Edmund G. Brown California Aqueduct
Garzas Creek
TAGLIO RD
WHITWORTH RD
PFITZER RD
SNYDER RD
Mustang Creek
COTTONWOOD RD
SANTA NELLA RD
S HUNT RD
BUTTS RD
Quinto Creek
Gustine
Segment 12
MP 58.28 – 63.98
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Livingston
Atwater
Newman
Los Banos
source: JRP (2022); Esri, et al. (2022).

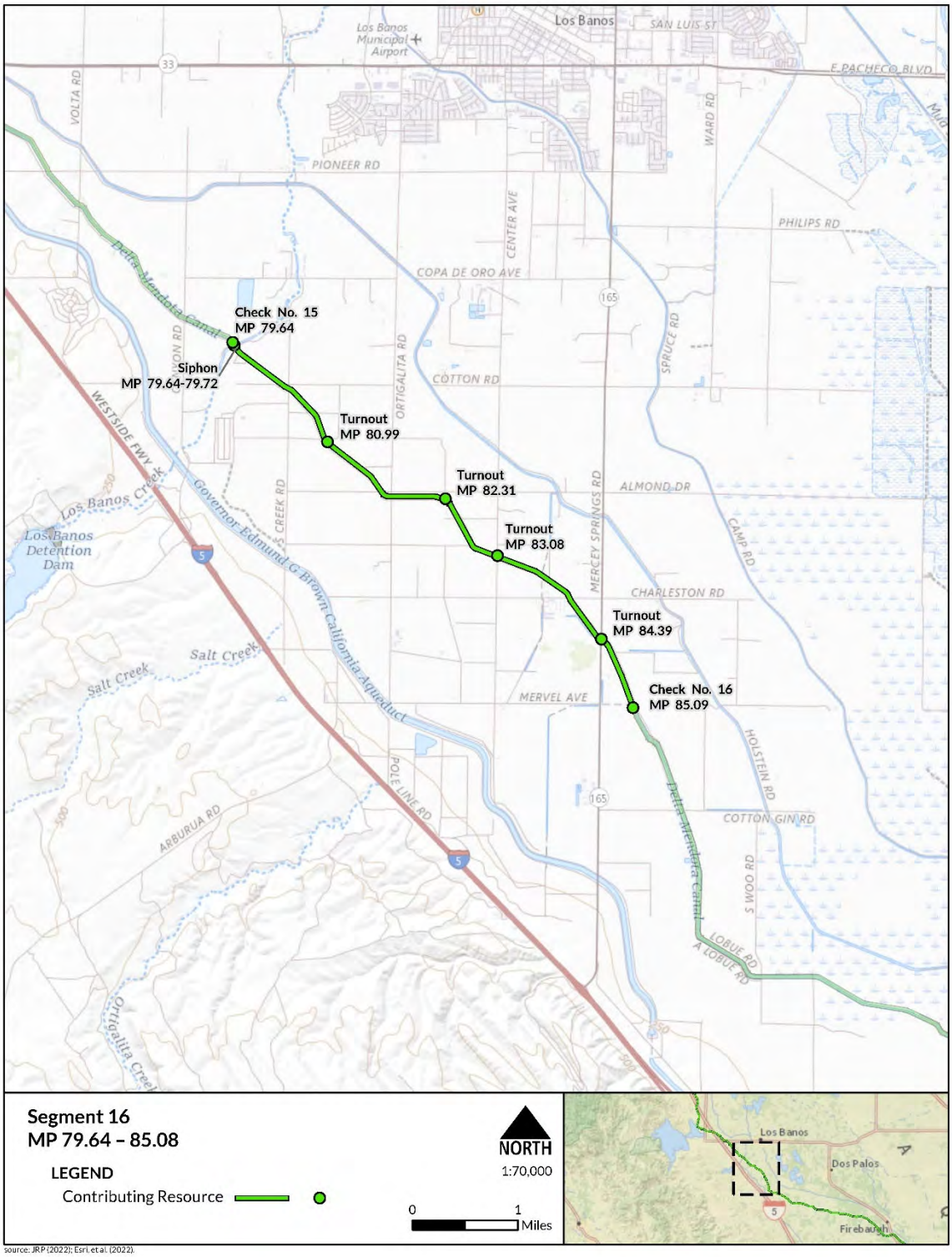

Check No. 12
MP 63.99
Turnout
MP 65.35
Turnout
MP 66.06
Turnout
MP 66.73
Turnout
MP 67.55
Turnout
MP 69.21
Volta Wasteway
MP 69.98
Check No. 13
MP 70.01
Segment 13
MP 63.99 – 70.00
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
COTTONWOOD RD
BUNKER RD
HUSMAN RD
FAHEY RD
MCCABE RD
W HENRY MILLER AVE
GONZAGA RD
SANTA NELLA RD
WESTSIDE FWY
Mustang Creek
Quinto Creek
San Luis Creek
O'Neill Forebay
Santa Nella
Los Banos
Dos Palos
source: JRP (2022); Esri, et al. (2022).

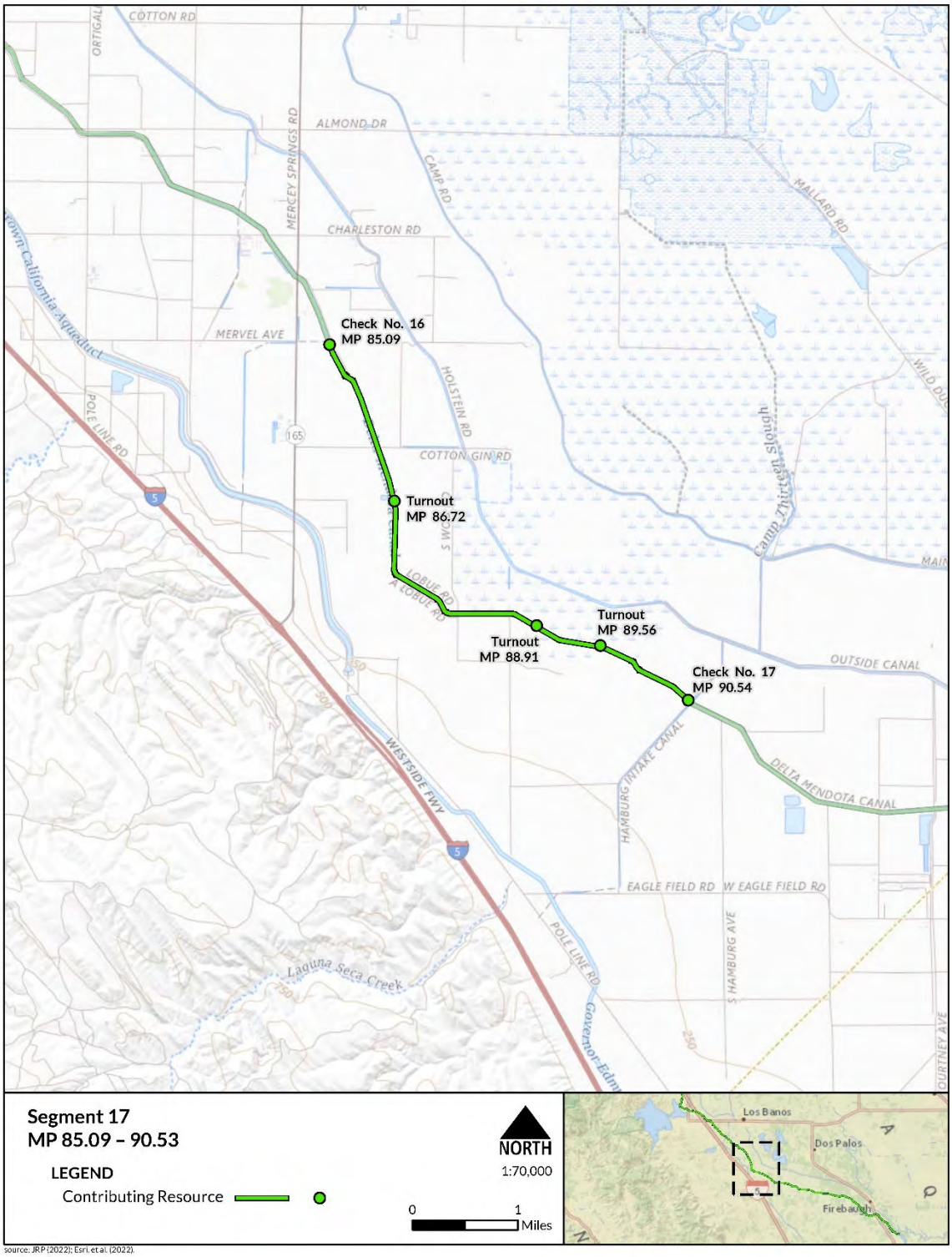


source: JRP (2022); Esri, et al. (2022).

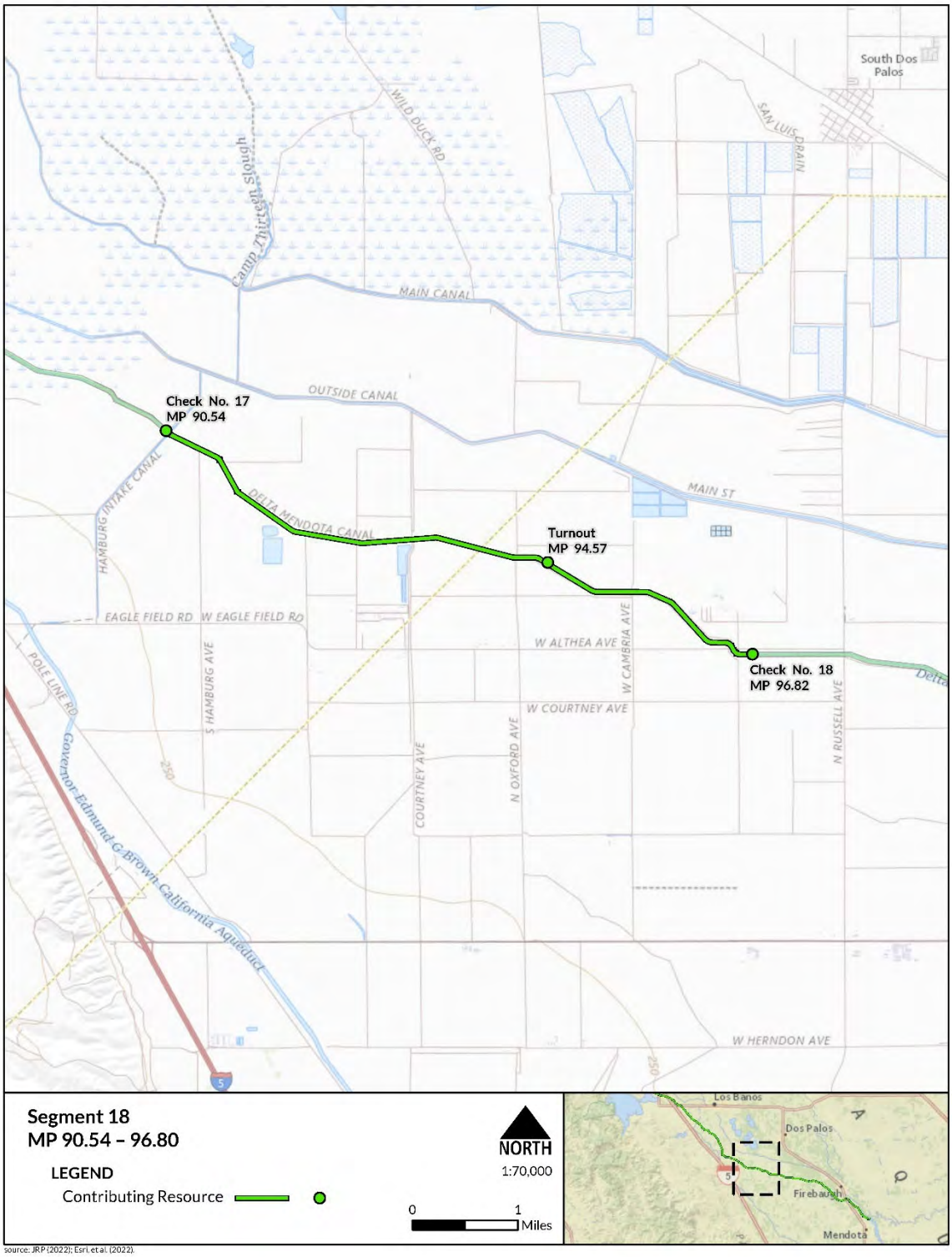


source: JRP (2022); Esri, et al. (2022).

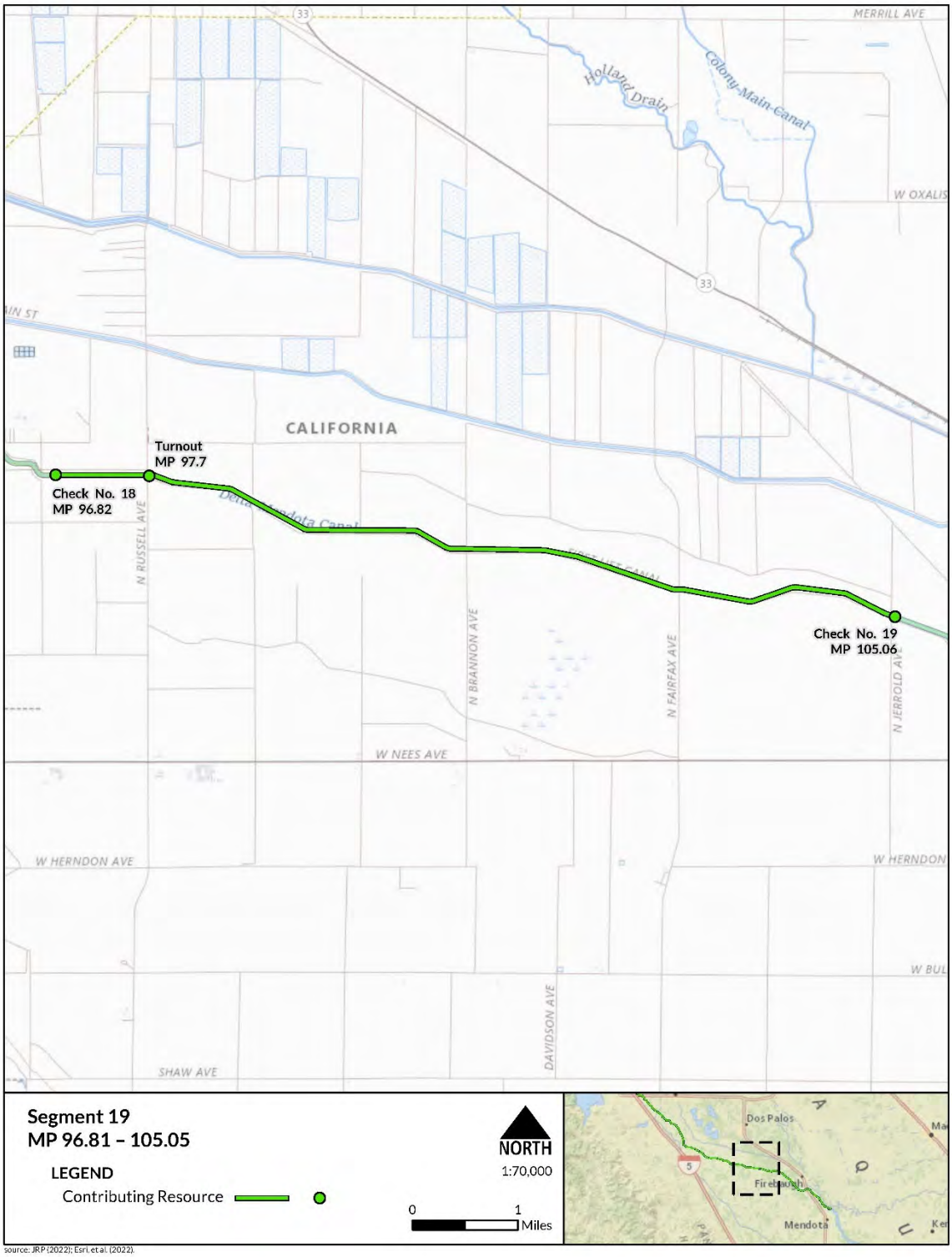

Los Banos
Los Banos Municipal Airport
SAN LUIS ST
E PACHECO BLVD
VOLTA RD
PIONEER RD
WARD RD
CENTER AVE
PHILIPS RD
COPA DE ORO AVE
Delta-Mendota Canal
Check No. 15
MP 79.64
Siphon
MP 79.64-79.72
ORTIGALITA RD
COTTON RD
SPRUCE RD
WESTSIDE FWY
Turnout
MP 80.99
Turnout
MP 82.31
Turnout
MP 83.08
Los Banos Creek
Los Banos Detention Dam
CREEK RD
Governor Edmund G Brown California Aqueduct
MERCEY SPRINGS RD
ALMOND DR
CAMP RD
CHARLESTON RD
Turnout
MP 84.39
Salt Creek
Check No. 16
MP 85.09
MERVEL AVE
HOLSTEIN RD
POLE LINE RD
ARBURUA RD
COTTON GIN RD
Delta-Mendota Canal
S WOOD RD
LOBUE RD
A LOBUE RD
Ortigalita Creek
Segment 16
MP 79.64 – 85.08
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Los Banos
Dos Palos
Firebaugh
source: JRP (2022); Esri, et al. (2022).

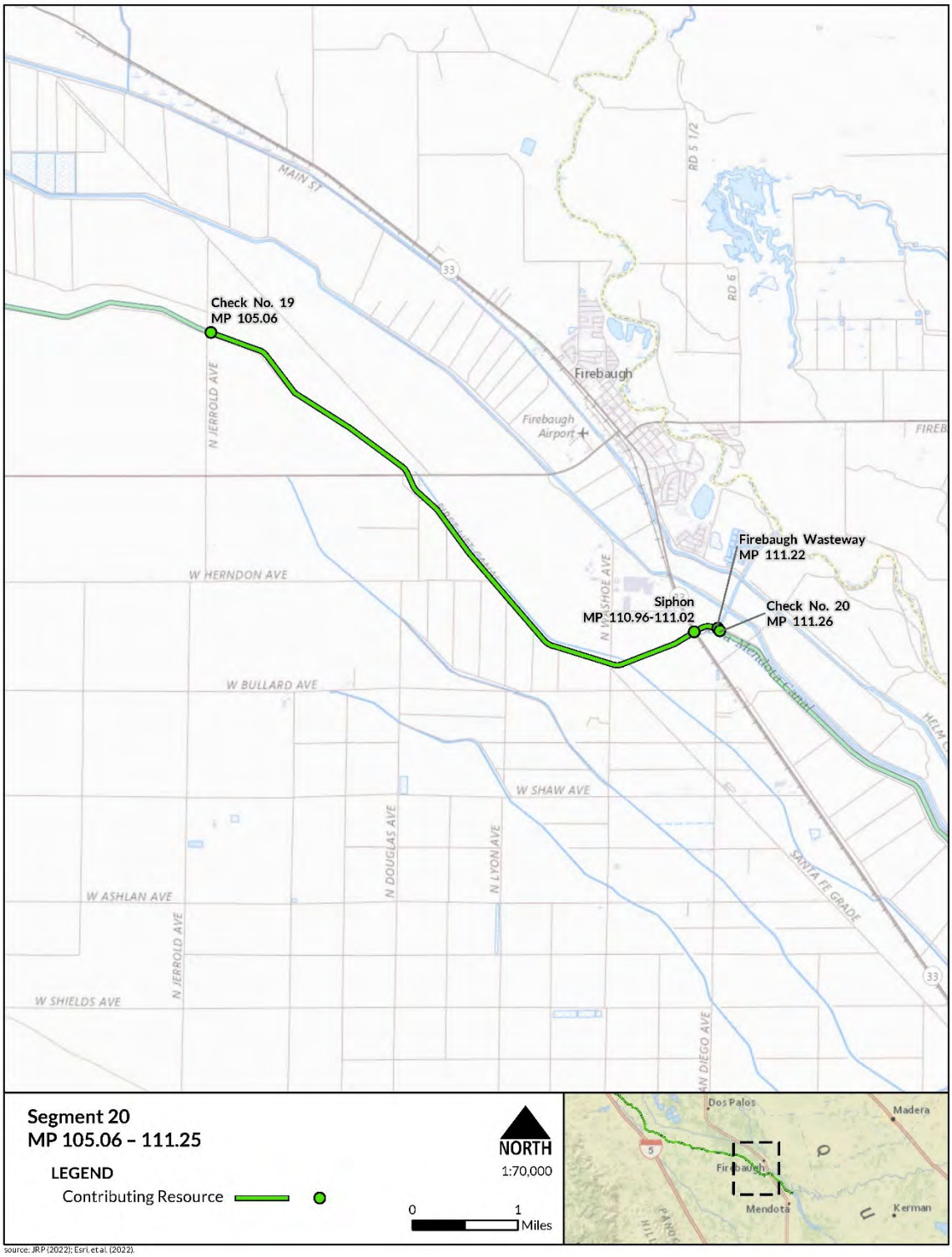


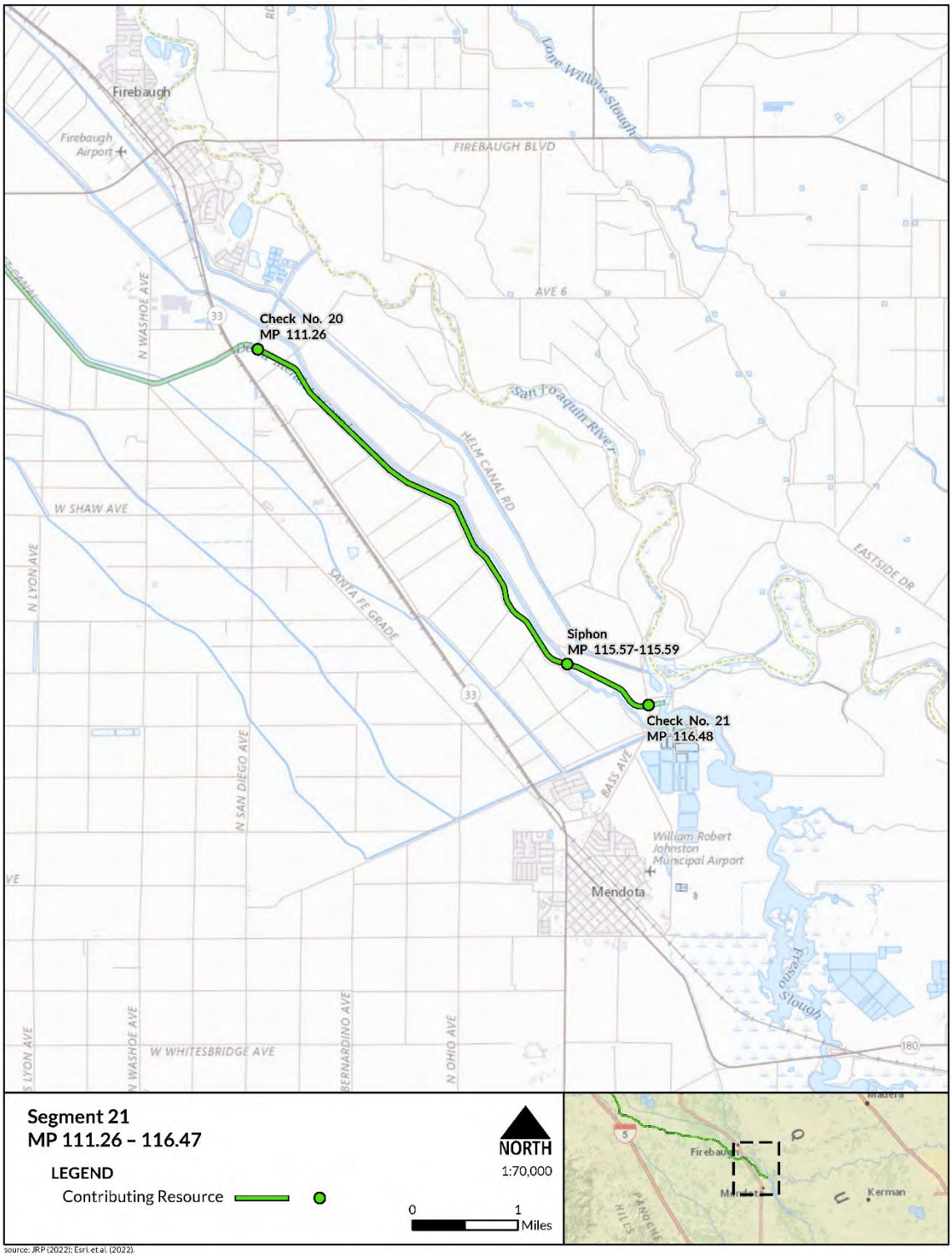
source: JRP (2022); Esri, et al. (2022).



source: JRP (2022); Esri, et al. (2022).


MERRILL AVE
Holland Drain
Colony Main Canal
W OXALIS
33
CALIFORNIA
Turnout
MP 97.7
Check No. 18
MP 96.82
Check No. 19
MP 105.06
N RUSSELL AVE
N BRANNON AVE
N FAIRFAX AVE
N IERROLD AVE
W NEES AVE
W HERNDON AVE
W HERNDON
DAVIDSON AVE
SHAW AVE
Segment 19
MP 96.81 – 105.05
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Dos Palos
Firebaugh
Mendota
5
source: JRP (2022); Esri, et al. (2022).


Check No. 19
MP 105.06
Firebaugh
Firebaugh Airport
Firebaugh Wasteway
MP 111.22
Siphon
MP 110.96-111.02
Check No. 20
MP 111.26
MAIN ST
RD 5 1/2
RD 6
N JERROLD AVE
N WALNUT SHOE AVE
W HERNDON AVE
W BULLARD AVE
W SHAW AVE
W ASHLAN AVE
W SHIELDS AVE
N DOUGLAS AVE
N LYON AVE
SAN DIEGO AVE
SANTA FE GRADE
Segment 20
MP 105.06 – 111.25
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Dos Palos
Madera
Mendota
Kerman
source: JRP (2022); Esri, et al. (2022).


Firebaugh
Firebaugh Airport
FIREBAUGH BLVD
Lone Willow Slough
AVE 6
N WASHOE AVE
Check No. 20
MP 111.26
San Joaquin River
HELM CANAL RD
W SHAW AVE
N LYON AVE
SANTA FE GRADE
EASTSIDE DR
Siphon
MP 115.57-115.59
Check No. 21
MP 116.48
BASS AVE
N SAN DIEGO AVE
William Robert Johnston Municipal Airport
Mendota
Fresno Slough
W WHITESBRIDGE AVE
S LYON AVE
N WASHOE AVE
BERNARDINO AVE
N OHIO AVE
180
33
Segment 21
MP 111.26 – 116.47
LEGEND
Contributing Resource
NORTH
1:70,000
0
1
Miles
Madera
Firebaugh
Kerman
PANOCHE HILLS
source: JRP (2022); Esri, et al. (2022).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary # _____
HRI # _____
Trinomial _____
NRHP Status Code 3S
Other Listings _____
Review Code _____ Reviewer _____ Date _____

***Resource Name or #** (Assigned by recorder) San Luis Drain

P1. Other Identifier: San Luis Drain

***P2. Location:** ☐ **Not for Publication** ☒ **Unrestricted** ***a. County** Fresno

and (P2b and P2c or P2d. Attach a Location Map as necessary.)

***b. USGS 7.5' Quad** See Continuation Sheet **Date** _____ **T** __; **R** __; _____ **¼ of Sec** ; __ **B.M.**

c. Address NA City _____ Zip _____

d. UTM: (give more than one for large and/or linear resources) Zone _____; _____mE/ _____mN
Segment recorded from UTM Zone 10S, 725735.70mE / 4081383.62mN at the north, to Zone 10S, 734830.29mE / 4070262.12mN at the south.

e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate)
Assessor Parcel Numbers: 008-02-031ST; 012-03-018ST; 012-03-023; 012-03-030ST; 012-06-034ST;012-07-024ST; 012-07-026ST; 012-13-022ST; 012-13-024ST; 013-03-051ST; 013-28-008ST; 013-28-010ST; 013-28-023ST; 019-26-002ST.

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries)

This form records one linear segment and two point-observations along the San Luis Drain (SLD), a component of the San Luis Unit of the Central Valley Project (CVP) (**Photograph 1**). The San Luis Drain spans roughly 87 miles between a point in the vicinity of the unincorporated community of Five Points in western Fresno County at the south end to the Kesterson Reservoir near the city of Gustine in western Merced County at the north end. San Luis Drain is a concrete-lined, trapezoidal drainage canal flanked by two compacted earth embankment levees, with numerous major and minor appurtenant structures distributed throughout its span—including check structures, pipe crossings, siphons, and a trapezoidal crossing in the drain recorded herein. SLD mile posts (M.P.) run north to south, and the structure is recorded herein at three locations (i.e., the study area for this form) between Firebaugh and Mendota in Fresno County, in the vicinity of and where the drainage canal crosses the area of potential effects (APE) for the project cited in *P11. See attached Linear Feature Records for descriptions of points, appurtenant structures, and the canal segment recorded on this form.

***P3b. Resource Attributes:** (List attributes and codes) HP20 – Canal / Aqueduct

***P4. Resources Present:** ☐ Building ☒ Structure ☐ Object ☐ Site ☐ District ☐ Element of District ☐ Other (Isolates, etc.)

P5a. Photo or Drawing (Photo required for buildings, structures, and objects.)



P5b. Description of Photo: (View, date, accession #) **Photograph 1:** San Luis Drain with Delta-Mendota Canal (background left); camera facing east, July 20, 2022.

***P6. Date Constructed/Age and Sources:**
☒ Historic ☐ Prehistoric ☐ Both
1973 (U.S. Bureau of Reclamation)

***P7. Owner and Address:**
U.S. Department of the Interior
Bureau of Reclamation
Mid Pacific Regional Office
2800 Cottage Way
Sacramento, CA 95825

***P8. Recorded by:** (Name, affiliation, address)
Samuel Skow & Danielle Baza
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

***P9. Date Recorded:** July 20, 2022

***P10. Survey Type:** (Describe) Intensive

***P11. Report Citation:** (Cite survey report and other sources, or enter "none.") JRP Historical Consulting, LLC, "Finding of Eligibility Delta-Mendota Canal Subsidence Correction Project," 2022, prepared for US Bureau of Reclamation and San Luis & Delta-Mendota Water Authority.

***Attachments:** ☐ None ☒Location Map ☒ Sketch Map ☒ Continuation Sheet ☒ Building, Structure, and Object Record ☐ Archaeological Record ☐ District Record ☒ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐Other (list) _____

***NRHP Status Code** 3S

***Resource Name or #** (Assigned by recorder) San Luis Drain

B1. Historic Name: San Luis Interceptor Drain

B2. Common Name: San Luis Drain

B3. Original Use: Drainage B4. Present Use: Drainage

***B5. Architectural Style:** Utilitarian

***B6. Construction History:** (Construction date, alteration, and date of alterations) San Luis Drain segments constructed 1969-1973; service discontinued in 1986; various appurtenant inlet drains added at unknown dates.

***B7. Moved?** ☒ **No** ☐ **Yes** ☐ **Unknown** **Date:** _____ **Original Location:** _____

***B8. Related Features:** Kesterson Reservoir; other San Luis Unit features of the Central Valley Project.

B9. Architect: U.S. Department of the Interior (USDI), Reclamation, Central Valley Project, West San Joaquin Division – San Luis Unit – California b. Builder: Multiple (see Continuation Sheet)

***B10. Significance: Theme** Environmental History **Area** United States

Period of Significance 1982-1988 **Property Type** Drainage canal **Applicable Criteria** A/1

(Discuss importance in terms of historical or architectural context as defined by theme, period, and geographic scope. Also address integrity.)

This evaluation concludes that the recorded segment and point observations of the San Luis Drain are significant under National Register of Historic Places (NRHP) Criterion A / California Register of Historical Resources (CRHR) Criterion 1, as well as meet the standards under Criteria Consideration G, and retain sufficient historic integrity to their period of significance, 1982-1988. The resource is significant for its important associations with the Kesterson Reservoir ecological disaster, an environmental crisis that drew national attention to the issue of toxic selenium contamination and contributed to a dramatic policy shift toward agricultural drainage disposal practices in the United States. The recorded segment and point observations have been evaluated in accordance with Section 106 of the National Historic Preservation Act of 1966 (as amended) (54 U.S.C. 306108) and its implementing regulations (36 CFR Part 800), and Section 15064.5(a)(2)-(3) of the CEQA Guidelines, using the criteria outlined in Section 5024.1 of the California Public Resources Code (see Continuation Sheet).

B11. Additional Resource Attributes: (List attributes and codes) _____

***B12. References:** Robert Autobee, "San Luis Unit, West San Joaquin Division, Central Valley Project" (Denver, Colorado: Bureau of Reclamation History Program, unpublished manuscript, 1995); Philip Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley* (Berkeley: University of California Press, 2011); See footnotes.

B13. Remarks:

***B14. Evaluator:** Samuel Skow, JRP Historical Consulting, LLC

***Date of Evaluation:** August 2022

(This space reserved for official comments.)

Sketch map with north arrow required

See Continuation Sheet.

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____

***Resource Name or #** (Assigned by recorder): San Luis Drain

***Recorded by:** S. Skow and D. Baza

***Date:** July 20, 2022

L1. Historic and/or Common Name: San Luis Drain

L2a. Portion Described: ☐ Entire Resource ☐ Segment ☒ Point Observation **Designation:** SLD-1 (M.P. 119.31)

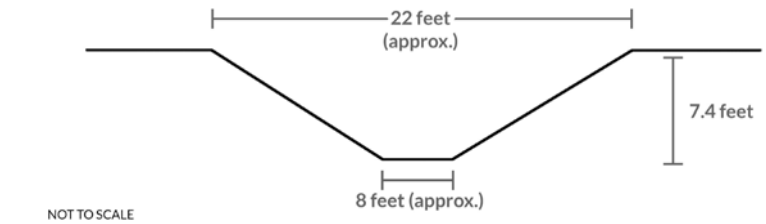
***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) This point of San Luis Drain is located at the intersection of West Nees Avenue and the Outside Canal on the western outskirts of the community of Firebaugh. UTM: Zone 10S, 725721.12mE / 4081354.59mN

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
At this recorded point, San Luis Drain contains a concrete check structure where the canal crosses beneath West Nees Avenue in a concrete siphon with concrete wingwalls (**Photograph 2** and **Photograph 3**).The check structure (at SLD M.P. 119.31) is comprised of a concrete deck with metal handrails and it is separated from the public thoroughfare by chain-link fencing. The concrete-lined, trapezoidal drainage canal has an elevated right bank and a lower left bank, both with 1 ½: 1 slope. Some vegetative overgrowth is present along the earth embankment and in the canal bed. Parallel dirt and gravel operating and maintenance (O&M) roads extend along the levee crests on both sides of the drain.

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width:** 22 feet (approx.)
b. **Bottom Width:** 8 feet
c. **Height or Depth:** 7.4 feet
d. **Length of Segment:** n/a

L4e. Sketch of Cross-Section (not to scale) **Facing:** South



L5. Associated Resources: San Luis Unit canals and water control features

L8a. Photograph, Map, or Drawing.



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This resource is located in a rural agricultural area of Fresno County on the outskirts of the city of Firebaugh. The terrain is generally flat.

L7. Integrity Considerations: None.

L8b. Description of Photo, Map, or Drawing:
Photograph 2: Upstream view of San Luis Drain at Checkpoint 37 (M.P. 119.31) from south side of W. Nees Ave.; camera facing southeast, July 20, 2022.

L9. Remarks:

L10. Form prepared by:
Samuel Skow
JRP Historical Consulting, LLC
2850 Spafford St., Davis, CA 95618

L11. Date: July 20, 2022



Photograph 3: Downstream view of San Luis Drain from north side of W. Nees Ave.; camera facing northwest, July 20, 2022.

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____

***Resource Name or #** (Assigned by recorder): San Luis Drain

***Recorded by:** S. Skow and D. Baza

***Date:** July 20, 2022

L1. Historic and/or Common Name: San Luis Drain

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation:** SLD-2 (M.P. 121.36-125.92)

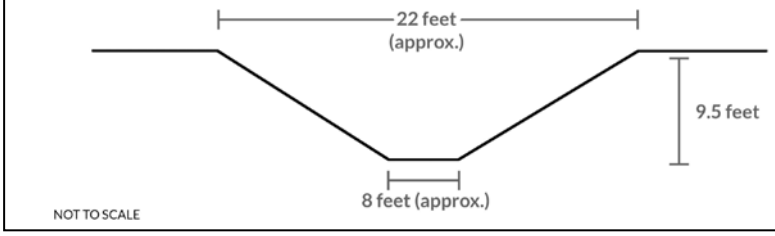
***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) This segment of San Luis Drain is located where the drainage canal intersects and extends parallel to the Delta-Mendota Canal between Firebaugh and Mendota. UTM: Zone 10S, 727802.66mE / 4079226.53mN (north endpoint); 733108.67mE / 4074269.88mN (south endpoint)

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
This approximately five-mile recorded segment of the San Luis Drain is within the APE for the project cited in *P11. From the north, the canal extends southeast parallel to the Union Pacific Railroad (UPRR) / State Route (SR) 33 transportation corridor, which it traverses at a 90-degree angle underground via concrete siphon turning at Check Structure 38 (M.P. 121.38) before turning southeast 90 degrees and passing below the Delta-Mendota Canal (DMC) via similar precast concrete pressure pipe (**Photograph 4 – Photograph 6**). From here, the San Luis Drain extends southeasterly and parallel to the DMC for roughly 4.5 miles before veering south and exiting the APE just east of the intersection of the DMC and Outside Canal (**Photograph 1, Photograph 7,** and **Photograph 8**) (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width:** 22 feet (approx.)
b. **Bottom Width:** 8 feet
c. **Height or Depth:** 9.5 feet
d. **Length of Segment:** 5 miles (approx.)

L4e. Sketch of Cross-Section (not to scale) **Facing:** North



L8a. Photograph, Map, or Drawing.



L5. Associated Resources: San Luis Unit canals and water control features

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This resource is located in a rural agricultural area of Fresno County between the cities of Firebaugh and Mendota. The terrain is generally flat.

L7. Integrity Considerations: Inlet pipes added sometime after initial construction period (1969-1974).

L8b. Description of Photo, Map, or Drawing:
Photograph 4: Downstream view of San Luis Drain from O&M road, with UPRR / SR 33 corridor (background right); camera facing northwest, July 20, 2022.

L9. Remarks:

L10. Form prepared by:
Samuel Skow
JRP Historical Consulting, LLC
2850 Spafford St., Davis, CA 95618

L11. Date: July 20, 2022

L3. Description (Continued):

The concrete-lined, trapezoidal drainage canal has an elevated right bank and a lower left bank, both with 1 ½: 1 slope. Vegetative overgrowth is prominent throughout several sections of the canal bed. Parallel dirt and gravel O&M roads extend along the levee crests on both sides of the drain. In this segment, the San Luis Drain features three check structures, including Check 38 and Check 39, which are connected to siphons that traverse SR 33 and Sierra Avenue, respectively, and Check 40, a standalone structure (**Photograph 5, Photograph 7,** and **Photograph 9**). As described above, the concrete check structures comprise decks with metal handrails that span the width of the drain, with wingwalls channeling flows through two 4.5-foot-wide openings with wood flashboards to control access. This segment likewise features a trapezoidal crossing—an approximately 15-foot-wide and roughly 12-foot-tall, reinforced concrete vehicular bridge—a stainless steel safety ladder affixed with galvanized metal chain link, and various inlet pipes added after the original period of construction (1972-1973) (**Photograph 6**, **Photograph 8,** and **Photograph 10** - **Photograph 12**).

Photographs:



Photograph 5: Downstream view of San Luis Drain from right-bank O&M road, with Check Structure 38 (center) and SR 33 (background); camera facing southwest, July 20, 2022.



Photograph 6: Upstream view of San Luis Drain from right bank O&M road, with non-original inlet drain (center right) and Delta-Mendota Canal left-bank levee (background); camera facing east, July 20, 2022.



Photograph 7: Upstream view of San Luis Drain at Check Structure 39 (M.P. 121.91), with DMC (left); camera facing southeast, July 20, 2022.



Photograph 8: Upstream view of San Luis Drain, with non-original inlet drain (center) and DMC Outside Canal siphon (background center); camera facing northeast, July 20, 2022.



Photograph 9: Downstream view of San Luis Drain at Check Structure 40 (M.P. 124.42); camera facing northwest, July 20, 2022.



Photograph 10: Downstream view of San Luis Drain trapezoidal crossing at M.P. 125.59; camera facing north, July 20, 2022.



Photograph 11: Downstream view of San Luis Drain stainless steel safety ladder (partially obscured by erosion from the embankment); camera facing northwest, July 20, 2022.



Photograph 12: Upstream view of San Luis Drain, with non-original inlet pipe; camera facing southeast, July 20, 2022.

L1. Historic and/or Common Name: San Luis Drain

L2a. Portion Described: ☐ Entire Resource ☐ Segment ☒ Point Observation **Designation**: SLD-3 (M.P. 129.07)

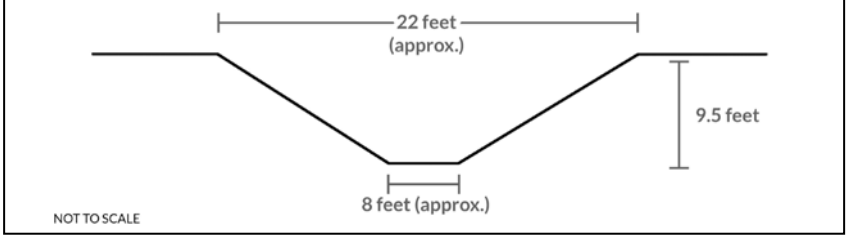
***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) This point of San Luis Drain is located at the intersection of Marie Street and West Belmont Avenue in the city of Mendota. UTM: Zone 10S, 734852.23mE / 4070263.39mN

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)
At this recorded point, San Luis Drain contains a concrete check structure where the canal crosses beneath Marie Street, West Belmont Avenue, and the UPRR tracks in a concrete siphon with concrete wingwalls (**Photograph 13** and **Photograph 14**). Comprising a concrete deck with metal handrails, the check structure is separated from the public thoroughfare by chain-link fencing. The concrete-lined, trapezoidal drainage canal has an elevated right bank and a lower left bank, both with 1 ½: 1 slope. Vegetative overgrowth is prominent throughout several sections of the canal bed. Parallel dirt and gravel O&M roads extend along the levee crests on both sides of the drain.

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width**: 22 feet (approx.)
b. **Bottom Width**: 8 feet
c. **Height or Depth**: 9.5 feet
d. **Length of Segment**: n/a

L4e. Sketch of Cross-Section (not to scale) **Facing**: South



L5. Associated Resources: San Luis Unit canals and water control features

L8a. Photograph, Map, or Drawing.



L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This resource is located in an industrial section of the small city of Mendota in rural Fresno County. The terrain is generally flat.

L7. Integrity Considerations: None.

L8b. Description of Photo, Map, or Drawing:
Photograph 13: Downstream view of San Luis Drain from north side of Marie Street; camera facing north, July 20, 2022.

L9. Remarks:

L10. Form prepared by:
Samuel Skow
JRP Historical Consulting, LLC
2850 Spafford St., Davis, CA 95618

L11. Date: July 20, 2022

Photograph:



Photograph 14: Upstream view of San Luis Drain from south side of West Belmont Avenue, with Check Structure 42 (M.P. 129.07); camera facing south, July 20, 2022.

P2b. Location (continued):

USGS 7.5' QUAD	DATE	TOWNSHIP / RANGE	SECTION(S)	BASE MERIDIAN
Firebaugh	2021	T12S / R13E	29 and 32	Mount Diablo
		T13S / R13E	3, 4, 10, 11, 13, 14, and 24	
Mendota	2021	T13S / R15E	31	
Tranquility	2021	T14S / R15E	6	

B9b. Builders (continued):

Builder	Canal Segment(s)	Completion Date	Description of Work
Oscar C. Holmes, Inc., and Holmes-Clair, Inc.	Various	1970	Construction of pipe portions of canal crossings (DC-6681)
Gordon H. Ball, Inc.	M.P. 78.64 – 104.05 and Kesterson Reservoir	Pre-1973	Earthwork, concrete lining, and structures and Kesterson Reservoir first stage (DC-6823)
Carl W. Olson & Sons Co.	M.P. 104.05 – 119.33	1970	Earthwork, concrete lining and structures (DC-6703)
Ball, Ball & Brosamer Co.	M.P. 119.33 – 137.77	1973	Earthwork, concrete lining and structures (DC-6948)

Builder	Canal Segment(s)	Completion Date	Description of Work
Darkenwald Construction Co., Inc.	(about) M.P. 131.00 – 137.5	Pre-1973	Earthwork and structures (DC-6611)
Ball, Ball & Brosamer Co.	M.P. 137.77 – 163.47	1973	Earthwork, concrete lining and structures (DC-6958)

B10. Significance (continued):

Historic Context

The San Luis Drain recorded on this form was constructed in sections between 1969 and 1973 as part of the San Luis Unit addition to the Central Valley Project, which expanded the federal water-distribution network to irrigators in the western San Joaquin Valley. The following provides a broad historical overview of the San Luis Unit, chronicles the development of the San Luis Drain, and discusses the significance and lasting impact of the Kesterson Reservoir ecological disaster in the early to mid-1980s. For a discussion of the original Central Valley Project, see the DPR 523 form set prepared for the Delta-Mendota Canal appended to the report cited in *P11.

Central Valley Project – San Luis Unit

The San Luis Drain was constructed as a critical element of the San Luis Unit, a joint state-federal expansion of the Central Valley Project (CVP) to distribute irrigation water to farmers on the west side of the San Joaquin Valley in the 1960s.

As compared to the east side of the valley, agricultural development arrived comparably late to the arid west side of Merced, Fresno, and Kings counties. Through the turn of the twentieth century, the regional economy revolved around ranching—primarily sheepherding—with an economic boom period of oil and coal strikes, which attracted railroads and light municipal development to the area. Irrigation efforts were modest during this period, with farmers digging small canals from the San Joaquin River and repurposing abandoned mining ditches. But, beginning in the 1910s, an influx of local farmers, aided by advances in turbine pump technology, began to extract increasing quantities of high-quality groundwater, converting acres of former pasturage to irrigable lands and progressively pushing ranchers west into the Coast Range foothills. By 1922, 33,000 acres had been irrigated, and by 1948, following the introduction of cotton, hay, grain, alfalfa, and sugar beet crops to the region and boosted by wartime demand, that total had exponentially increased to 484,000 acres. At this time, regional irrigation farmers primarily discharged drainage wastewater into the San Joaquin River and/or its tributaries. However, this growing dependence on underground water resources severely depleted the groundwater table, leading to a 10-foot-per-year drop in the 1930s, with farmers drilling wells as deep as 2,000 feet below the surface. By the early 1950s, the aquifer overdraft reached 500,000 acre-feet per year, an increase from 100,000 annual acre-feet in 1929. In 1942, in response to the growing threat of water scarcity, landowners in western Fresno and Kings counties—among whom several owned over 1,000 acres each in the San Joaquin Valley—established the Westside Landowners Association and began petitioning the US Bureau of Reclamation (Reclamation) to divert surface water from the CVP to the west side of the valley. In response, Reclamation determined that water resources at existing facilities at Shasta Dam on the Sacramento River and Friant Dam on the San Joaquin River would be insufficient to meet the permanent needs of westside farmers and that the CVP would require expansion to meet this growing demand.[1]

To raise political support for transferring water resources to the western San Joaquin Valley, the Westside Landowners Association was reorganized in 1952 as the Westlands Water District (WWD). The new irrigation district was comprised of various incorporated interests—including the Southern Pacific Railroad Company, Standard Oil, and the J. G. Boswell Company, one of the largest agricultural entities in the world—with a service area stretching almost 70 miles between Mendota in Fresno County to Kettleman City in Kings County encompassing 399,000 acres, which was ultimately expanded to 600,000

[1] Robert Autobee, "San Luis Unit, West San Joaquin Division, Central Valley Project" (Denver, Colorado: Bureau of Reclamation History Program, unpublished manuscript, 1995), 5-7, available at https://www.usbr.gov/projects/pdf.php?id=109 (accessed July 2022); Philip Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley* (Berkeley: University of California Press, 2011), 200-202.

acres in 1965 following a merger with the Westplains Water Storage District. In 1955, Reclamation released a feasibility study for delivering water to the westside, which it named the "San Luis Unit," and detailed an elaborate expansion of the existing CVP, whereby surplus water from the Sacramento-San Joaquin Delta would be delivered south via the Delta-Mendota Canal and pumped into a new storage reservoir: the San Luis Reservoir, with a one-million-acre-foot storage capacity, to be located in the inner Coast Range foothills roughly due west from Los Banos in Merced County. The study likewise identified the need for drainage facilities, as the west side experienced poor drainage conditions resulting from the impermeable Corcoran clay layer. To meet increased drainage needs attendant with the expansion of the water-delivery system, Reclamation envisioned an intricate system of underground drains for roughly 96,000 acres of the San Luis service area that would drain saline subsurface groundwater away from low-lying croplands into an open surface interceptor drain (that became the San Luis Drain, recorded on this form), which would convey the water north for release into the Sacramento-San Joaquin Delta. During this same period, the California Department of Water Resources (DWR) produced the California Water Plan as part of the State Water Project (SWP). The water plan included the Feather River Project, which proposed erecting the Oroville Dam on the Feather River; developing a statewide aqueduct system to convey water to the San Francisco Bay Area, the west side of the San Joaquin Valley, and south to Southern California; and constructing a storage reservoir at the San Luis site. In addition to conflict between state and federal authorities concerning their overlapping systems, opposition to the westside expansion of the CVP arose from other contingents as well, namely: groups that argued that the project would serve an area dominated by large landowners in defiance of the 1902 Reclamation Act, which stipulated a 160-acre limit on all lands served by federal irrigation; and water agencies located downstream from the San Luis Unit's service areathat would receive the west side's drainage flows. Following years of negotiations, which included an explicit 160-acre limitation for all lands served by the San Luis Unit along with the inclusion of a drainage provision for affected water agencies, the U.S. Congress passed and U.S. President Dwight Eisenhower signed into law the San Luis Act in 1960, which authorized the annual export of about 1.25 million acre-feet of water to the western San Joaquin Valley to irrigate approximately 500,000 acres in Merced, Fresno, and Kings counties. The act likewise provided for the return of said irrigation water to the Sacramento-San Joaquin Delta as drainage wastewater via proposed interceptor drain (ultimately constructed as the drain recorded on this form).[2]

In 1961, Reclamation and the State of California, which had authorized the SWP with the passage of the Burns-Porter Act of 1959 and narrowly passed bond measures to fund its construction in November 1960, officially resolved the overlapping areas of the CVP and SWP by entering into an agreement to jointly operate the San Luis Unit (**Figure 1**). Reclamation would construct and DWR would operate and maintain the San Luis Dam and Reservoir, now to be enlarged to over two million acre-feet—the largest off-stream reservoir in the United States—to accommodate both projects. In 1963, Morrison-Knudsen Company, Inc., Utah Construction and Mining Company, and Brown and Root, Inc. won the joint contract to build the dam and reservoir, which they completed in August 1967. Transporting SWP water from the Sacramento-San Joaquin Delta to the reservoir, the California Aqueduct would be known as the San Luis Canal where it delivered federal water to the San Luis Unit service area between the reservoir and Kettleman City, south of which it would resume its SWP designation and function: to supply irrigation water to farmers in Kings and Kern counties and in Southern California. Under Reclamation in the San Luis Unit, the San Luis Canal was constructed in five reaches between 1963 and 1968, when water released near Los Banos was finally received in Kettleman City. The San Luis facilities continue to serve the SWP and CVP, and presently comprise of the Governor Edmund G. Brown California Aqueduct / San Luis Canal; B. F. Sisk San Luis Dam; San Luis Reservoir; O'Neill Forebay and Dam, where CVP water from the Delta-Mendota Canal is impounded for distribution; the William R. Gianelli Pumping-Generating Plant, which pumps water from O'Neill Forebay into San Luis Reservoir for distribution via the San Luis Canal; the Dos Amigos Pumping Plant, a secondary pumping facility on the San Luis Canal; and the Los Banos and Little Panoche detention dams and reservoirs, which provide flood protection for the San Luis Canal, Delta-Mendota Canal, and various populated areas. Federal-only facilities include the O'Neill Pumping Plant and Intake Canal; Coalinga Canal, a distribution structure erected to sustain the local mining industry, encourage local agriculture, and provide clean drinking water to the city of Coalinga; Pleasant Valley Pumping Plant, which pumps CVP water into the Coalinga Canal; and the San Luis

[2] Autobee, "San Luis Unit," 7; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 202-205; U.S. Bureau of Reclamation (Reclamation), "San Luis Unit, Central Valley Project, California: A Report on the Feasibility of Water Supply Development" (Sacramento, California: Reclamation Region 2, 1955); Philip Garone, "The Tragedy at Kesterson Reservoir: A Case Study in Environmental History and a Lesson in Ecological Complexity," *Environs* 22, no. 2 (Spring 1999): 114-15.

Drain, discussed below.[3]

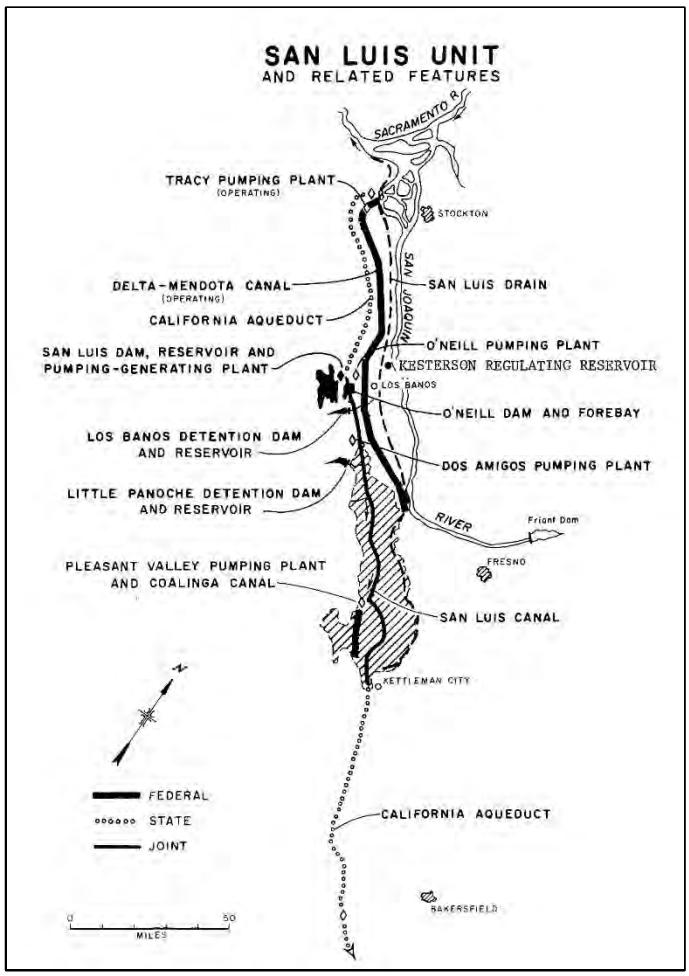


Figure 1: Map of "San Luis Unit and Related Features," ca. 1972.[4]

San Luis Drain

While construction forged ahead on the water storage and distribution elements of the joint state-federal San Luis Unit, the development of drainage facilities lagged. According to the San Luis Act of 1960, drainage infrastructure would either be built by DWR as a "master drain" for the entire San Joaquin Valley or by Reclamation as a smaller interceptor drain for those lands in the San Luis service area. Initially opting out of constructing the master drain, DWR reversed its position in 1964, proposing an approximately 280-mile, concrete-lined structure to extend north from Bakersfield in Kern County to a discharge point near the city of Antioch in Contra Costa County in the Sacramento-San Joaquin Delta, thereby serving the entire western San Joaquin Valley. Construction was stalled, however, when the Contra Costa County Water Agency objected to the plan because it would discharge nitrogen-rich saline drainage that may also contain pesticide residues into its freshwater resources. State and federal officials drafted several alternatives to the Antioch outfall, which included diluting discharge flows in natural streams like the San Joaquin River and Salt Slough or storing drainage in evaporation ponds. Reclamation and other supporters

[3] Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 208-209; Autobee, "San Luis Unit," 9, 14-17; California Department of Water Resources, "San Luis," 2022, https://water.ca.gov/Programs/State-Water-Project/SWP-Facilities/San-Luis (accessed August 2022).

[4] U.S. Bureau of Reclamation, "San Luis Unit and Related Features" (March 1972), dwg. no. 805-208-1947, reprinted in W. Turrentine Jackson and Alan M. Paterson, "The Sacramento-San Joaquin Delta: The Evolution and Implementation of Water Policy, an Historical Perspective" (Davis: California Water Resources Center, University of California, Davis, Contribution No. 163, June 1977), 137.

of the drain in the San Joaquin Valley did not accept these alternatives, however, because they failed to remove salt from the region, or they continued to utilize the San Joaquin River as a drain. Meanwhile, opposition to the Antioch outfall spread throughout the San Francisco Bay / Sacramento-San Joaquin Delta region, where congressional representatives called for investigations into the drain's pollution potential. In response, in early 1965 U.S. President Lyndon Johnson removed the San Luis Drain from the federal budget while requesting a $300,000 appropriation to fund an environmental investigation into a joint state-federal master drain by the U.S. Public Health Service. Two years later, the Federal Water Pollution Control Administration, subsequently tasked with the investigation, issued a comprehensive report that conditionally endorsed the drain, identifying fertilizer-derived nitrogen as the most dangerous pollutant and discounting subsurface drainage as a source of toxic pesticide residue. While nitrogen treatment and removal studies continued, the report advised partial construction of the San Luis Drain to enable drainage storage, which continued to threaten groundwater resources and agricultural output. In 1967, following the election of Ronald Reagan as California governor, DWR again reversed its position on the drain, finding no political support among San Joaquin Valley farmers for repayment rates at $18 per acre-foot and lacking even 25 percent of the upfront capital drainage construction costs. Responsibility for maintaining compliance with the San Luis Act of 1960 was retained by Reclamation alone, which was then being sued by the Central California Irrigation District for failing to provide drainage in accordance with the act; meanwhile, water deliveries were slated to begin as early as 1968.[5]

Following DWR's abandonment of the regionwide master drain, Reclamation set about designing and constructing an interceptor drain, initially conceived as a 188-mile structure to serve the area between Kettleman City in Kings County to the south and an undetermined discharge point in the Sacramento-San Joaquin Delta to the north. Until a final outfall location was made available, the drain was to empty into Kesterson Reservoir— a proposed complex of 12 interim storage ponds outside of Gustine in Merced County used to store and partially evaporate drainage flows (discussed below). This drainage network was to be developed alongside a drainage collection system constructed by Reclamation for the WWD, which would be comprised of underground concrete pipelines that gathered irrigation drainage from buried drainage pipes installed on private farms. In 1968, Reclamation began SLD's first phase of construction between Tranquility in Fresno County and Kesterson Reservoir. That March, the Sacramento-based Darkenwald Construction Company, Inc. won the first contract for a seven-mile stretch of drain excavation along with 11 irrigation crossings, five road crossings, and two encasement pipes between Highway 180 and Adams Avenue in Fresno County (south of the study area). That October, Menlo Park-based firms, Oscar C. Holmes, Inc. and Holmes-Clair, Inc., won the joint contract to construct precast concrete pipe portions of siphons below the Laguna, Main, Outside, and Bass Avenue / Intake canals, and—in the study area described above—the Delta-Mendota Canal (M.P. 121.50). In January 1969, San Mateo-based contracting company, Carl W. Olson & Sons, Inc., was awarded the contract to construct roughly 15 miles of earthwork, concrete lining, and structures between Dos Palos in Merced County and Firebaugh—including Check 37 recorded herein (M.P. 119.31). Work was slated to begin that April and involved a unique construction method to accommodate for the groundwater level located above the drain floor.[6] As explained by journalist Joe Thome, "Although several excavation techniques were tried and varying ones are being used, the best method has proven to be a sled system developed and built right on the job. It is called a 'pre-trimmer [(**Figure 2**)].'" Thome continues:

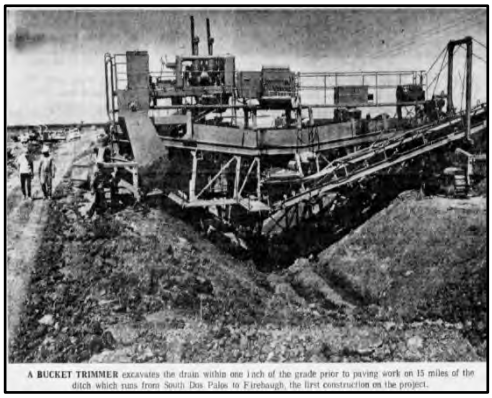
[5] Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 209-212; Jackson and Paterson, "The Sacramento-San Joaquin Delta," 139-143.

[6] Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 210; Jackson and Paterson, "The Sacramento-San Joaquin Delta," 144; "Major Recent Contract Awards," *Reclamation Era* 54, no. 2 (May 1968): 54; U.S. Bureau of Reclamation, "San Luis Unit, Central Valley Project: Plan for Disposal of Subsurface Agricultural Drainage" (Sacramento, California: USBR Region 2, June 1969), 17-21, on file at USBR Library, Sacramento, California; U.S. Bureau of Reclamation, Office of Design and Construction, "Designers' Operating Criteria: San Luis Drain, San Luis Unit, West San Joaquin Division, Central Valley Project, California" (Denver, Colorado: USBR, January 1975), 4; Memo Re: Field Inspection for Transfer from Construction to O&M Status for: Stage 1 Kesterson Reservoir and the Three Completed Reaches of the San Luis Drain—Specification Nos. DC-6611, DC-6681, DC-6703, DC-6823—San Luis Unit, CVP, California (December 17, 1973), ff. San Luis Drain (Spec. No. DC-6611), on file at USBR Library, Sacramento, California; "Major Recent Contract Awards," *Reclamation Era* 55, no. 1 (February 1969): n.p.; "Bureau Awards Contract for San Luis Drain," *The Fresno Bee* (January 17, 1969): 12A; "Reservoir Job Contract Due Danville Firm," *Salinas Californian* (March 7, 1969): 13; "Work on First Section of San Luis Drain Begins," *The Modesto Bee* (April 6, 1969): C4.

The 'pre-trimmer' is pulled along the drain alignment as it excavates the drain to within six inches of the final cut. It also simultaneously excavates three trenches, each 14 inches wide, extending below the rough cut [sic] drain bottom. The center trench, extending about 30 inches below the drain bottom, is used by the contractor to 'de-water' the immediate drain route to allow further excavation and placing of the lining. The two trenches, which run along each edge of the eight-foot wide [sic] bottom, will function to collect and hold water and keep it from lifting the lining out of the ground. In the center trench the contractor lays a 4-inch perforated plastic pipe, which is covered with gravel, and ground water is pumped out at points 1,000 feet apart. The outer trenches, similarly built but only 15 inches deep, will be connected to the canal portion by weep valves, spaced 10 feet apart. This will allow water to seep into the canal through these valves, when it builds up in the trench, and will thus relieve uplift pressure which could 'float' the concrete lining. The action of the valve will, however, prevent drain water from going from the drain canal back into the trench.[7]



SHAPING THE ROUGH cut of the drain, the pretrimmer utilizes a sled system to excavate it to within six inches of the final cut.



A BUCKET TRIMMER excavates the drain within one inch of the grade prior to paving work on 15 miles of the ditch which runs from South Dos Palos to Firebaugh, the first construction on the project.



THE FINAL STEP—A huge paving train moves along a stretch of the San Luis Drain south of South Dos Palos, laying a concrete V which will carry off brackish irrigation water.

Figure 2: Published photographs of San Luis Drain construction between Dos Palos and Firebaugh, 1969.[8]

Progress on the construction of San Luis Drain, however, was stalled by budget cuts. In April 1969, U.S. President Richard Nixon slashed $2 million from the San Luis Drain budget (among other cuts to the CVP), pushing the timeline back one year, with Carl Olson & Sons (discussed above) completing construction of their section in January 1970. That July, Gordon H. Ball, Inc., based in Danville, Contra Costa County, won the contract for the northernmost 26-mile stretch of earthwork, concrete lining, and structures between Gustine and Dos Palos, along with the 1,283-acre, 12-pond, Kesterson Reservoir, all outside the study area. As mentioned, while the drain's discharge point in the Delta was debated, Kesterson continued to function as a drainage detention and evaporation facility.[9] Aided by advanced technology, Ball reportedly streamlined the canal excavation method employed by Carl Olson & Sons, Inc. (described above), as reported in *Construction Methods & Equipment*, "By mounting a specially-designed digging unit on a canal trimmer, [Gordon H. Ball, Inc.] gained a one-pass machine that simultaneously excavates canal finger drains, trims slopes and bottom, lays continuous plastic pipe, backfills, and screeds drains level with the slopes. Any area passed over by the machine is immediately ready for concreting."[10] In June 1972, Ball, Ball & Brosamer of Danville won construction contracts for an approximately 18-mile stretch of earthwork, concrete lining, and structures comprising the bulk of the study area (M.P. 119.33 – 137.77), along with the southernmost segment terminating at Five Points, outside the study area. For much of the segment in the study area, Reclamation adapted a preexisting earth-lined drainage canal originally dug by the Firebaugh Canal Company around the same time that the Delta-

[7] Joe Thome, "San Luis Drain Paving Begins Near South Dos Palos," *The Modesto Bee* (August 18, 1969): B2.
[8] Bee Photos, published in Thome, "San Luis Drain Paving Begins Near South Dos Palos."
[9] Memo Re: Field Inspection for Transfer from Construction to O&M Status for: Stage 1 Kesterson Reservoir and the Three Completed Reaches of the San Luis Drain—Specification Nos. DC-6611, DC-6681, DC-6703, DC-6823—San Luis Unit, CVP, California (December 17, 1973), ff. San Luis Drain (Spec. No. DC-6611), on file at USBR Library, Sacramento, California; Michael Green, "Budget Cut Costs CVP $11.7 Million," *The Modesto Bee* (April 16, 1969): A2; "San Luis Drain May be Finished in 6 or 7 Years," *The Fresno Bee* (April 4, 1970): 6B; "San Luis Drain is Year Ahead," *The Modesto Bee* (October 1, 1970): C1.
[10] David C. Etheridge, "Hybrid Rig is Versatile Canal Builder," *Construction Methods & Equipment* (October 1972): 61.

Mendota Canal was built, rerouting the earth-lined drain (Drain U-121.2, recorded and evaluated on a separate DPR 523 form attached to the report cited in *P11) immediately adjacent to the San Luis Drain segment (**Figure 3**). Ball, Ball & Brosamer completed all work the following year, when construction on the San Luis Drain was halted altogether (**Figure 4**).[11]



Figure 3: Excerpt of 1957 aerial photograph, with Firebaugh Canal Company drain (indicated by arrows) in same alignment as San Luis Drain, adjacent to Delta Mendota Canal.[12]

[11] Memo Re: Field Inspection for Transfer from Construction to O&M Status for: Stage 1 Kesterson Reservoir and the Three Completed Reaches of the San Luis Drain—Specification Nos. DC-6611, DC-6681, DC-6703, DC-6823—San Luis Unit, CVP, California (December 17, 1973), ff. San Luis Drain (Spec. No. DC-6611), on file at USBR Library, Sacramento, California; Michael Green, "Budget Cut Costs CVP $11.7 Million," *The Modesto Bee* (April 16, 1969): A2; "San Luis Drain May be Finished in 6 or 7 Years," *The Fresno Bee* (April 4, 1970): 6B; Declaration of Taking, United States of America vs. Redfern Ranches, No. F-232, October 4, 1968, 5629 O.R. 444, Fresno County Recorder, Fresno, California; Aero Exploration Co., Flight ABI, Frame ABI-18G-51, February 13, 1950, 1:20,000, flown for U.S. Department of Agriculture (USDA) – Production and Marketing, available at http://malt.lib.csufresno.edu/MALT/ (accessed July 2022); Cartwright and Company, Flight ABI-1957, Frame ABI-29T-138, June 22, 1957, 1:20,000, flown for USDA – Commodity Stabilization Service, available at https://mil.library.ucsb.edu/ap_indexes/FrameFinder/ (UCSB; accessed July 2022); "San Luis Drain Takes Shape in Fresno County," *The Fresno Bee* (September 16, 1973): C1.

[12] Cartwright and Company, Frame ABI-29T-138, 1957, UCSB.



Figure 4: Archival photograph of Ball, Ball & Brosamer constructing outlet transition at UPRR / SR 33 siphon undercrossing, September 20, 1973. San Luis Drain indicated by arrows. Note Delta-Mendota Canal next to the SLD in the middle ground.[13]

Collectively, Gordon H. Ball, Inc., and Ball, Ball & Brosamer constructed 69.51 miles of the extant San Luis Drain, nearly 80 percent of the completed structure, along with the Kesterson Reservoir evaporation ponds. Hailing from a contracting family, Gordon H. Ball began his career working for his father, N. M. Ball, an early proponent of underground concrete irrigation construction who branched out into highway building in the 1920s. Following his father's death in 1935, Gordon Ball partnered with his two brothers forming N. M. Ball Sons, which took on numerous military projects during World War II, including 200 miles of roads for the Hanford Atomic Energy Plant in Hanford, Washington. In the early 1950s, Gordon split off from his brothers, ultimately incorporating as Gordon H. Ball, Inc., in 1957, and was active throughout California, Oregon, Washington, and Hawaii, specializing in concrete paving, as well as highway and bridge construction. In addition to the company's work on the San Luis Drain and Kesterson Reservoir, other CVP work included the Tehama-Colusa Canal and preliminary work for the proposed but never built Auburn Dam (the contract for which issued to Auburn Constructors, a joint venture between Gordon H. Ball, Inc., Guy F. Atkinson Company, and the Arundel Corporation). By 1975, the company had been purchased and operated as a subsidiary of Dillingham Corporation. Some later projects included: the Woodburn-Hayesville Interchange on Interstate 5 between Salem and Portland, Oregon; the Stapleton International Airport runway in Denver, Colorado; runways at Mather and McLellan air force bases in Sacramento; a cofferdam and forebay for a powerhouse at Grand Coulee Dam in Washington; a subway tunnel for the Washington Metropolitan Area Transit Authority (jointly built with the J. F. Shea Company, Inc., and Norair Engineering); and numerous sections of highway throughout California and Oregon, including

[13] F. A. Shrader, Photograph No. CN805-243-9106NA: San Luis Drain, San Luis Unit, Bureau of Reclamation, Central Valley Project, California (August 20, 1973), available at U.S. Bureau of Reclamation, California-Great Basin Digital Library, https://usbr.contentdm.oclc.org/digital/collection/p15911coll7/id/3074/rec/7 (accessed August 2022).

California State Route 99 in Bakersfield, and Interstate 5 north of Los Angeles.[14] Ball, Ball & Brosamer was formed as joint venture between Gordon H. Ball's two sons, Gordon N. Ball and Dennis W. Ball, and Robert G. Brosamer. In addition to its work on the San Luis Drain, other CVP work includes rehabilitation of a portion of the Friant-Kern Canal, with other works for Reclamation including installation of the Gallegos Canyon Siphons as part of the Navajo Indian Irrigation Project in New Mexico and the Sonoqui Dike in Arizona. As with Gordon H. Ball, Inc., Ball, Ball & Brosamer was most actively involved in heavy highway construction. Gordon N. Ball went on to form Gordon N. Ball, Inc., and Robert Brosamer formed R & L Brosamer, Inc, both active firms based in the San Francisco Bay Area.[15]

The San Luis Drain was ultimately built out to about half of its proposed alignment, extending from a point near Five Points in Fresno County north to Kesterson Reservoir, when construction was halted in 1973 (**Figure 5**). Construction of the southernmost 29 miles of canal between Five Points and Kettleman City was impeded by a federal spending freeze that year and funding was never reinstated for its completion. The northernmost 75 miles between Kesterson Reservoir and the proposed Delta discharge outfall faced mounting opposition, not only from environmentalists in the San Francisco Bay Area, who claimed that nitrate-rich drainage water would cause algal blooms and compromise regional ecology, but also over half of all landowners along the proposed canal route between Kesterson and Antioch, most of whom saw the open canal as a loss to their property for the benefit of farmers further south. As a result, the San Luis Drain remained unfinished, and the 12 evaporation ponds at Kesterson Reservoir functioned as the ultimate discharge terminus through 1986, when use of the reservoir and drain was ultimately discontinued following the ecological disaster at Kesterson, discussed below.[16]

[14] "Small Staff Takes on Big Highway Program," *Contractors and Engineers* (January 1965): 35; "Major Recent Contract Awards," *Reclamation Era* 58, no. 2 (May 1972): 33; "Scrapers are Modified to Haul 26-yd Payloads," *Construction Methods & Equipment* 43, no. 9 (September 1961): 86; "Slip-form Machine Paves Three Lanes in One Pass," *Contractors and Engineers* 60, no. 7 (July 1963): 64; "80-ton Bottom-dump Trains Clock Million Yards Monthly," *Roads and Streets* 112, no. 8 (August 1969): 40; "How Ball Handles Maintenance on Oregon's Biggest Highway Job," *Western Construction* 50, no. 10 (October 1975): 24; "Slipform Lanes 50 Feet Wide and 18 Inches Deep," *Western Construction* 50, no. 12 (December 1975): 26; "Aggregate Base and CTB Mixed in Pugmill Plant," *Contractors and Engineers Magazine* 69, no. 5 (May 1972): 16; "Auburn Dam," *Compressed Air Magazine* 80, no. 11 (November 1975): 18; "Blaw-Knox Road and Airport Duo-forms Speed Air Base Paving," *Construction Methods & Equipment* 41, no. 5 (May 1959): 241; "Loaders, Trucks, and Scrapers Move Million Yards a Month," *Contractors & Engineers Magazine* 67, no. 11 (November 1970): 11; "Subway Contractors Overcome Poor Soil Conditions," *Contractors & Engineers Magazine* 68, no. 1 (January 1971): 18;

[15] "Irrigation Trickles," *Irrigation Journal* 27, no. 3 (May-June 1977): 34; "Contractors," *Western Construction* 50, no. 7 (July 1975): 127; U.S. Department of Interior, *Decisions of the United States Department of the Interior Vol. 93, January-December 1986* (Washington, D.C.: U.S. Government Printing Office, 1987), 144; "County Repays FAA $480,000 for False Billing," Los Angeles Times (June 29, 2000): B1; "Gordon N. Ball, Inc.," NewBayBridge.org, n.d. https://www.newbaybridge.org/the_builders/gordon_ball/ (accessed August 2022); "Featured Projects," Gordon N. Ball Inc., 2017, http://ballconco.com/featured-projects/ (accessed August 2022); Robert L. "Bob" Brosamer, "Message from Bob Brosamer," R & L. Brosamer, Inc. [newsletter] (Spring 2001): 2, available at https://www.thenewsletterguy.com/samples/CustomerNewsletters/RLBrosamer.pdf (accessed August 2022).

[16] Jackson and Paterson, "The Sacramento-San Joaquin Delta," 144; William Schiffman, "San Luis Project is Dwindling," Merced *Sun-Star* (October 29, 1973): 2; "Landowners Oppose San Luis Interceptor Drain as Proposed," Newman *Index* (December 14, 1972): 8.

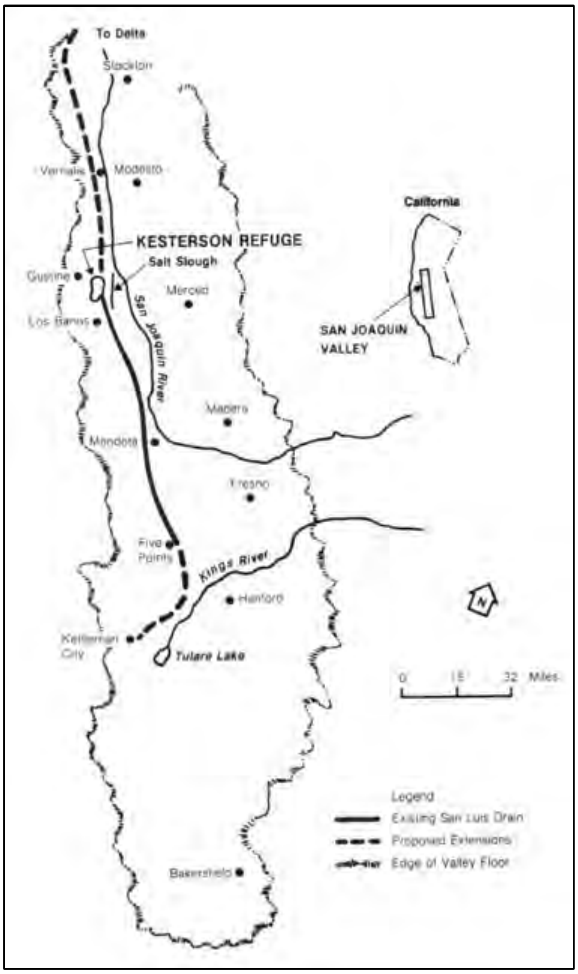


Figure 5: Location of the completed San Luis Drain, from Five Points to Kesterson Reservoir, with proposed segments at north and south ends, no date.[17]

Ecological Disaster at Kesterson Reservoir[18]

As discussed above, the ultimate build-out of the San Luis drainage system terminated at Kesterson Reservoir, a roughly 1,283-acre complex of 12, roughly 100-acre evaporation and seepage ponds separated by earthen berms with a combined storage capacity of 4,330 acre-feet (**Figure 6**). Completed in 1971, Kesterson Reservoir was contained within the larger Kesterson National Wildlife Management Area, created via joint agreement in 1970 between Reclamation and the U.S. Fish

[17] U.S. Bureau of Reclamation, untitled map of San Luis Drain, no date, reprinted in Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 211.

[18] The following provides an overview of the ecological disaster at Kesterson Reservoir in the mid-1980s. For a detailed scholarly account, see: Philip Garone, "The Tragedy at Kesterson Reservoir: A Case Study in Environmental History and a Lesson in Ecological Complexity," *Environs* 22, no. 2 (Spring 1999): 107-144; and the expanded chapter, "Tragedy at Kesterson Reservoir" in Philip Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley* (Berkeley: University of California Press, 2011). For a journalistic account, see: Russell Clemings, *Mirage: The False Promise of Desert Agriculture* (San Francisco: Sierra Club Books, 1996); and Tom Harris, *Death in the Marsh* (Washington, D.C.: Island Press, 1991). Since the closure of the Kesterson Reservoir, Reclamation and recipients of CVP irrigation water in the western San Joaquin Valley have struggled with the issue of drainage up to the present. However, this study does not discuss this ongoing aspect of the history of the San Luis Drain. For more information on the evolution of Reclamation's drainage policies in the twenty-first century, see: Kathleen Nitta, "A Tale of Two Water Districts: The Future of Agriculture in California's San Joaquin Valley Lies in Compromise Over Drainage," *Golden Gate University Environmental Law Journal* 5, no. 2 (May 2012): 439-480; and Nigel W. T. Quinn, "Policy Innovation and Governance for Irrigation Sustainability in the Arid, Saline San Joaquin River Basin," *Sustainability* (2020), available at https://escholarship.org/uc/item/7dn0w5g2 (accessed July 2022).

and Wildlife Service (USFWS), which would manage the area as a wildlife refuge. Historically, the area contained within Kesterson had been used for cattle ranching and waterfowl hunting, a popular area among local duck clubs. With about half of the fall and winter marsh acreage comprised of seasonally flooded grasslands and other copious food sources, Kesterson was a key stopping point on the Pacific Flyway for migratory birds and other grazing animals. As a partial remediation for summer water scarcity, the Grasslands Water District, under contract with Reclamation, was to furnish several thousand acre-feet of water per year. At the same time, surface agricultural drainage water began flowing into the Kesterson Reservoir via the San Luis Drain in 1972—one year prior to the completion of construction of the reaches further south. Diluted with irrigation-quality water supplied by the Grasslands Water District, the discharge initially produced high-quality wetland habitat between 1972 and 1978, fostering breeding activities among various duck species that nested there in the spring. In 1975, Reclamation officially changed the status of Kesterson from a regulating reservoir to a terminal holding reservoir for storing and concentrating drainage water for release into the San Joaquin River during sufficiently high flows. Meanwhile, in compliance with the San Luis Act of 1960, Reclamation developed the WWD Drainage Collector System, comprised of a network of plastic drains lain six-to-eight feet below the ground surface, between 1976 and 1980. In 1978, for the first time, Reclamation began conveying subsurface irrigation drainage water to Kesterson Reservoir, and by 1981, virtually all the inflow that the SLD conveyed to Kesterson consisted of subsurface water, which contained higher concentrations of trace elements, saline, and other contaminants leached into the soil than surface drainage.[19]

For about a decade prior to the development of the San Luis drainage facilities, state and federal agencies had warned against reusing drainage water. As early as 1960, DWR had identified irrigated agricultural drainage as a key source of water quality degradation in the lower San Joaquin Valley, specifically regarding drainage waters in the Panoche Fan area of the WWD (located in the vicinity west of Firebaugh and Mendota) as "unusable for beneficial purposes" (**Figure 7**).[20] Four years later, DWR discovered selenium in water sampled from this area. As discussed below, selenium is the natural mineral trace element that later caused the ecological disaster at Kesterson Reservoir. In 1961, scientists with the U.S. Department of Agriculture reported on the high probability of selenium in alkali soils, such as those prevalent in the arid San Joaquin Valley. The USFWS warned Reclamation the following year about the risks of toxins bioaccumulating in various organisms exposed to agricultural drainage, as well as the potential harms posed to humans that consumed them. In 1963, the USFWS likewise warned that agricultural contaminants rendered irrigation drainage water unsuitable for wetlands habitat restoration. That same year, the agency further warned that impounded agricultural irrigation drainage water would likely contaminate groundwater, a warning reissued in 1977 by the California State Water Resources Control Board (SWRCB), which determined that the groundwater below Kesterson would ultimately be contaminated should the area continue to serve as the terminus of the San Luis Drain.[21]

[19] Reclamation, "Designers' Operating Criteria: San Luis Drain," 7; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 212-213; S. M. Benson, M. Delamore, and S. Hoffman, "Kesterson Crisis: Sorting Out the Facts" (prepared for the U.S. Department of Energy under Contract Number DE-AC03-76SF00098, July 1990), 2; U.S. Department of the Interior, "Kesterson Reservoir Closure and Cleanup Plan: State Water Resources Control Board Order No. WQ 85-1 for Cleanup and Abatement of Kesterson Reservoir" (July 5, 1985), 2-3; Arnold Schultz, "Background and Recent History," in *Selenium and Agricultural Drainage: Implications for San Francisco Bay and the California Environment, Proceedings of the Second Selenium Symposium, March 23, 1985, Berkeley, California* (Berkeley, California: Bay Institute of San Francisco, 1986), 6.

[20] DWR, "Lower San Joaquin Valley Water Quality Investigation: Bulletin No. 89" (Sacramento: California Department of Water Resources, 1960), 95, qtd. in Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 215.

[21] H. W. Lakin, "Geochemistry of Selenium in Relation to Agriculture," in Selenium in Agriculture" (Washington, D.C.: U.S. Department of Agriculture, Agricultural Research Service, Agriculture Handbook No. 200, 1961), 12; S. B. Moore, "Fish and Wildlife Resources and Agricultural Drainage in the San Joaquin Valley, California: Vol. 1" (Sacramento: San Joaquin Valley Drainage Program, 1990), 3-6; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 215.

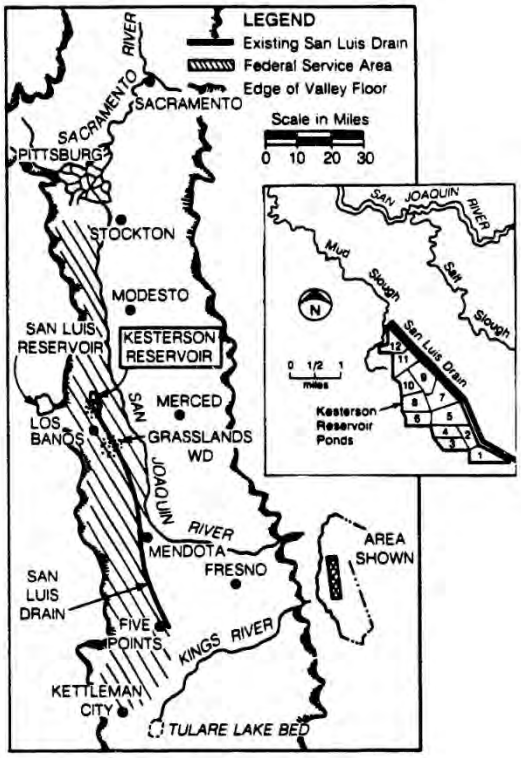


Figure 6: Location map of Kesterson Reservoir, Merced County, showing 12 evaporation ponds in inset, ca. 1990.[22]

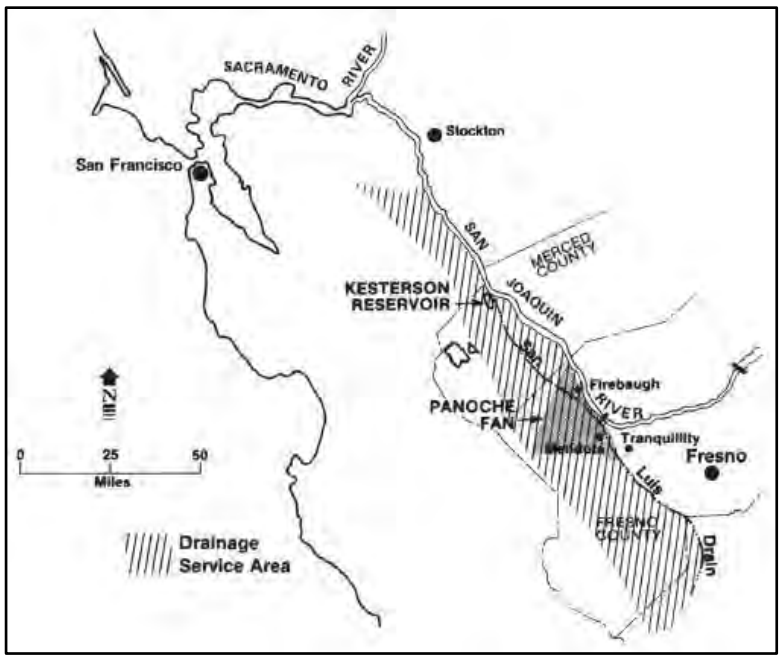


Figure 7: Map of San Luis drainage service area, showing Panoche Fan area—source of high quantities of selenium that contaminated Kesterson Reservoir.[23]

[22] Benson, Delamore, and Hoffman, "Kesterson Crisis," 2.
[23] U.S. Bureau of Reclamation, untitled map of San Luis drainage service area, no date, reprinted in Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 207.

As various agencies had warned, discharging subsurface irrigation drainage via the SLD for indefinite storage in the wetland habitat at Kesterson had disastrous consequences. In 1982 following four years of receiving WWD wastewater in the SLD that was sent to Kesterson Reservoir, perennial cattails were dying off, algal blooms were present throughout the pond complex, the migratory bird population had decreased substantially, and all but one fish species—the mosquitofish—had completely died off. Scientists found the highest recorded selenium concentrations of any living fish among Kesterson mosquitofish. The following summer, USFWS biologists reported that roughly 10 percent of all nests among Kesterson's resident waterfowl breeding populations contained one or more chicks with various developmental deformities. Noting multiple similarities between these deformities and those reported among chicken populations in South Dakota raised on seleniferous soils in the 1930s, the USFWS issued a series of memoranda calling attention to the growing crisis at Kesterson and expressing concern over using agricultural wastewater for habitat management. Around this time, the USFWS closed the Kesterson wildlife refuge to the public and began a hazing program to ward off migrating waterfowl. The following year, scientists also found adult birds dead from selenium poisoning, with one final estimate of at least 1,000 migratory birds, including adults, chicks, and embryos having died of selenium toxicosis from bioaccumulation between 1983 and 1985; scientists have since come to refer to these symptoms of selenium poisoning as the "Kesterson Syndrome." In August 1983, U.S. Geological Survey (USGS) scientists conducted tests in the Kesterson collection ponds, the San Luis Drain, drainage effluents, and shallow groundwater, finding dangerous levels of selenium—140-1,400 micrograms per liter (µ/L), as opposed to that found in typical freshwater, 0.2-0.4 µ/L. Additional testing by the USGS found elevated levels of selenium throughout the WWD service area, from Los Banos to Kettleman City. In September, regional media picked up the Kesterson story and followed the unfolding saga for the next few years—the story even featured on CBS' *60 Minutes*, which fueled public outrage with graphic images of deformed birds and reports of bureaucratic negligence. In March 1984, adjoining landowners, discovering sick and deformed birds on their property, petitioned the Central Valley Regional Water Quality Control Board and ultimately, the SWRCB to take enforcement action against Reclamation.[24]

Compelled by state authorities, Reclamation finally addressed the crisis at Kesterson. Following two hearings in December 1984 and February 1985, and under the authority of the state Porter-Cologne Water Quality Control Act and the Toxic Pits Cleanup Act of 1984, the SWRCB issued Cleanup and Abatement Order No. WQ 85-1, which required the U.S. Department of Interior to resolve the problems at Kesterson and ordered Reclamation to submit a cleanup and abatement plan within five months. The following month, at a House Subcommittee on Water and Power Resources congressional hearing in Los Banos, the Department of Interior dramatically announced its decision to close Kesterson Reservoir and the San Luis Drain and to immediately cease all irrigation water deliveries to the WWD service area that drained into Kesterson for fear of violating the Migratory Bird Treaty Act. Shortly thereafter, Department of Interior amended this arrangement with WWD, which pledged to reduce the export of drainage wastewater by 20 percent every two months beginning in September 1985, plugging all subsurface drains by July 1986. In October 1986, Reclamation, in cooperation with the USFWS and the U.S. Army Corps of Engineers, submitted its environmental impact statement for the Kesterson cleanup project, which offered four solutions, ordered least to most expensive: a flexible response plan; an immobilization plan; a wetland restoration / onsite disposal plan; and an offsite disposal plan.[25] Reclamation proposed a phased approach, graduating from the flexible response plan to the onsite disposal plan as necessary. The SWRCB rejected the phased approach and ordered Reclamation to implement the onsite disposal plan, which called for the excavation, disposal, and replacement of the uppermost six-inch soil layer, including vegetation. However, subsequent studies showed that selenium had concentrated in shallow groundwater at comparable levels to the drainage ponds, indicating that their release into the wetland would render the ponds as toxic as before. Therefore, in July 1988 the SWRCB ordered Reclamation to fill all low-lying areas where ephemeral pools formed six inches above the

[24] Michael K. Saiki, "Concentrations of Selenium in Aquatic Food Chain Organisms and Fish Exposed to Agricultural Tile Drainage Water," in *Selenium and Agricultural Drainage: Implications for San Francisco Bay and the California Environment, Proceedings of the Second Selenium Symposium, March 23, 1985, Berkeley, California* (Berkeley, California: Bay Institute of San Francisco, 1986), 6; Theresa S. Presser and Ivan Barnes, "Selenium Content in Waters Tributary to and in the Vicinity of Kesterson NWR" (Menlo Park, California: U.S. Geological Survey, 1984), 16; Deborah Blum, "Mineral is Linked to Bird Deformities," *The Fresno Bee* (September 21, 1983): 1; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 217-231.

[25] U.S. Bureau of Reclamation, "Final Environmental Impact Statement, Kesterson Program, Merced and Fresno Counties, California" (Sacramento: U.S. Department of the Interior, Bureau of Reclamation, 1986).

expected seasonal groundwater level by January 1, 1989. By November 1988, Reclamation contractors had filled about 710 low-lying acres of the former reservoir with 1,050,437 cubic yards of imported earth, converting the former wetland to an upland habitat and attracting a variety of terrestrial bird species. By the early 1990s, selenium concentrations among plants and animals at Kesterson had stabilized.[26]

The Kesterson disaster fundamentally transformed scientific understanding of selenium-contaminated irrigation drainage, spurring advances in environmental research, wetlands preservation, and governmental policy. Prior to Kesterson, selenium contamination research was largely confined to problems at the individual farm scale, such as how the trace element contaminates crops and impairs livestock. However, following the demonstrated dangers of high selenium concentrations in irrigation drainage at Kesterson, environmental scientists better understood the problem to be an environmental protection issue at the watershed scale with major consequences for irrigation management throughout the western United States. California emerged (and remains) as a global center for selenium contamination research and environmental management. As early as 1985, government scientists began proactively testing for selenium concentrations throughout the Central Valley, with USFWS biologists detecting high rates of selenium poisoning among plants, insects, birds, and fish in the Tulare Basin. Around that same time, as part of the Department of Interior's National Irrigation Water Quality Program, scientists investigated all federal irrigation and drainage facilities for concentrated toxins, finding Kesterson-level rates of selenium toxicosis at five sites in the western United States. By the early 1990s, scientists had established firm links between human activity and high selenium concentrations, identifying sites of irrigated agriculture, mining, and fossil fuel refinement as areas of particular concern. Researchers likewise noted intensified rates of bioaccumulation and biomagnification in aquatic ecosystems, particularly wetland habitats like Kesterson, where selenite—one of the element's primary dissolved forms—was observed to readily concentrate in stagnant areas among various invertebrates and fish species before spreading up the food chain and throughout the ecosystem.[27]

In response to heightened awareness and a more refined understanding of aquatic selenium contamination, environmental managers in California and elsewhere developed new water quality regulations and environmental management strategies. In 1987, the U.S. Environmental Protection Agency (EPA) established new criteria for imposing maximum limits for selenium concentrations in freshwater and saltwater environments, based partly on observed laboratory results and partly on field studies—including those conducted at Kesterson Reservoir. These standards were made legally binding for 14 states, including California, with the promulgation of the 1992 Water Quality Standards. Noting excessive selenium concentrations in the area surrounding Kesterson, between 1988 and 1990 the California Legislature added 8,224 acres of grasslands watershed marshes, a section of the lower San Joaquin River downstream from subsurface drainage, Salt Slough, and Mud Slough to California's Clean Water Act section 303(d) list of impaired waters. In 1996, Reclamation and the San Luis & Delta-Mendota Water Authority developed the Grasslands Bypass Project to rectify this problem in accordance with total maximum daily load limits for selenium and best management practices introduced that same year by the Central Valley Regional Water Quality Control Board. The Grasslands Bypass Project incorporates the northernmost 28 miles of the San Luis Drain in Merced County to discharge drainage water into Mud Slough for release into the San Joaquin River. Discharges are closely and regularly monitored for selenium, salinity, boron, molybdenum and various nutrients by the USFWS, California EPA, the Central Valley Regional Water Quality Control Board, and California Department of Fish and Wildlife.[28] According to Reclamation, "Since

[26] Garone, "The Tragedy at Kesterson Reservoir," 122-123; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 229.

[27] Matteo Francesco Kausch, "From Soil Aggregate to Watershed, from California's Central Valley to the Salton Sea – Agricultural Selenium Contamination Across Ecosystems, Scales, and Disciplines" (PhD. diss., University of California, Berkeley, Spring 2013), 9-13; Arnold Schultz, "Highlights Since Selenium II," in *Selenium and Agricultural Drainage: Implications for San Francisco Bay and the California Environment, Proceedings of the Third Selenium Symposium, March 15, 1986, Berkeley, California*, ed. Alice Q. Howard (Berkeley, California: Bay Institute of San Francisco, 1989), 5, 7; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 231-235.

[28] Kausch, "From Soil Aggregate to Watershed, from California's Central Valley to the Salton Sea," 9-13; Garone, *The Fall and Rise of the Wetlands of California's Great Central Valley*, 231-235; U.S. Environmental Protection Agency, "Ambient Water Quality Criteria for Selenium – 1987" (EPA-440/5-87-006, September 1987), 25, available at https://www.epa.gov/sites/default/files/2019-03/documents/ambient-wqc-selenium-1987.pdf (accessed August 2022); U.S. EPA, "Section 319: Nonpoint Source Program Success Story

the implementation of the [Grasslands Bypass Project], all discharges of drainage water from the Grassland Drainage Area into wetlands and refuges have been eliminated. The Project has reduced the load of selenium discharged from the Grassland Drainage Area by 61 percent (from 9,600 lbs. to 3,000 lbs.)."[29] Perhaps most importantly, the disaster at Kesterson illustrated an urgent ecological need to reform the CVP—which had historically served the interests of agribusinesses—to incorporate environmental stewardship among its mandates. In 1992, the U.S. Congress passed the Central Valley Project Improvement Act (CVPIA) into law, which mandated reform of the CVP to better protect, restore, and enhance fish and wildlife habitat by placing environmental goals on par with irrigation and domestic water usage. Some environmental policy changes implemented under the Act include: the dedication of 800,000 acre-feet of water per year to fish and wildlife along with firm water commitments to Central Valley wildlife refuges; the restoration of anadromous fish populations; the establishment of a habitat restoration fund financed by water and power users; and the installation of mitigative technology at various sites, including temperature control devices and fish passage infrastructure. The Act also stipulates that the CVP would establish no new contracts until it had achieved its environmental goals. Since the passage of the CVPIA, Reclamation, in partnership with various federal, state, and local agencies, has implemented aquatic habitat improvement projects on the American, Stanislaus, Yuba, and Upper Sacramento rivers and Clear, Mill, and Deer creeks; provided annual water allotments and upgraded or built conveyance facilities to 19 federal, state, and private managed wetlands; and funded independent restoration programs on the San Joaquin and Trinity rivers through the habitat restoration fund.[30]

NRHP / CRHR Evaluation

Criteria for Evaluation

The eligibility criteria for designating historic properties under federal and state criteria are essentially the same. The criteria for listing properties in the National Register of Historic Places (NRHP) are codified in 36 CFR 60 and expanded upon in numerous guidelines published by the National Park Service. Buildings, structures, objects, sites, and districts listed in, eligible for listing in, or that appear eligible for listing in the NRHP are considered historic properties under the regulations for Section 106 of the National Historic Preservation Act (NHPA). Eligibility for listing buildings, structures, objects, sites, and districts (i.e., historic properties) in the NRHP rests on twin factors of *historic significance* and *integrity*. A resource must have both significance and integrity to be considered eligible. Loss of integrity, if sufficiently great, will overwhelm the historic significance a property may possess and render it ineligible. Likewise, a property can have complete integrity, but if it lacks significance, it must also be considered ineligible. Historic significance is judged by applying the NRHP criteria, identified as Criteria A through D. The NRHP guidelines state that a historic property's "quality of significance in American history, architecture, archeology, engineering, and culture" must be determined by meeting at least one of the four main criteria. Properties may be significant at the local, state, or national level. The NRHP criteria are:

Criterion A: association with "events that have made a significant contribution to the broad patterns of our history;"

Criterion B: association with "the lives of persons significant in our past;"

– California Grasslands Bypass Project Reduces Selenium in the San Joaquin Basin" (September 2011), https://www.epa.gov/sites/default/files/2015-10/documents/ca_sanjoaquin.pdf (accessed August 2022).

[29] U.S. Bureau of Reclamation, "Grassland Bypass Project," July 29, 2020, https://www.usbr.gov/mp/grassland/ (accessed August 2022).

[30] U.S. Bureau of Reclamation, " Central Valley Project Improvement Act (CVPIA)," April 27, 2022, https://www.usbr.gov/mp/cvpia/ (accessed August 2022); U.S. Bureau of Reclamation, "Central Valley Project Improvement Act: Fact Sheet," October 2021, https://www.usbr.gov/mp/mpr-news/docs/factsheets/cvpia.pdf (accessed August 2022); U.S. Bureau of Reclamation, "CVP Habitat Restoration," February 2022, https://www.usbr.gov/mp/mpr-news/docs/factsheets/habitat-restoration.pdf (accessed August 2022); California Department of Fish and Wildlife, "Refuge Water Supply Program," n.d., https://wildlife.ca.gov/Conservation/Watersheds/Refuge-Water (accessed August 2022).

Criterion C: resources "that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values;"

Criterion D: resources "that have yielded, or may be likely to yield, information important to history or prehistory."[31]

Integrity is determined through applying seven factors to the historic resource: location, setting, design, workmanship, materials, feeling, and association. These seven can be roughly grouped into three types of integrity considerations. Location and setting relate to the relationship between the property and its environment. Design, materials, and workmanship, as they apply to historic buildings, relate to construction methods and architectural details. Feeling and association are the least objective of the seven criteria and pertain to the overall ability of the property to convey a sense of the historical time and place in which it was constructed.

Central Valley Project Draft Multiple Property Listing

In 2009, Reclamation prepared a *Draft National Register of Historic Places Multiple Property Documentation Form: Central Valley Project* (CVP MPL).[32] The CVP MPL identifies the period of significance for the CVP as 1935 when the project received its first authorizations to 1956 when the last of the major project components was completed. However, as stated, "This MPL is also designed to be easily amended as more project engineering features become historic," as with the multiple elements that comprise the San Luis Unit, the bulk of which were constructed by the late 1960s, and the San Luis Drain, which was constructed between 1969 and 1973—all of which were identified in the section "CVP Engineering Features 1957-2000: An Overview."[33] The document provides registration criteria regarding NRHP significance and integrity. The subsections of the registration requirements relied upon for this evaluation of San Luis Drain for individual eligibility for listing in the NRHP are the subsections for "Canals" and "Drains" as quoted below.[34] The NRHP and CRHR evaluation of San Luis Drain contained in this report utilizes in part the framework provided in the CVP MPL.

The following is excerpted from the CVP MPL:

Main Canals

Main canals form the CVP's primary arteries. These canals consist of Contra Costa (the first built and operational), Madera, Delta-Mendota (both intake and distribution sections), Delta Cross Channel, and the Friant-Kern, all built and operational before 1952. The longest main canal is the Friant-Kern Canal at 151.8 miles, while the shortest is the Delta Cross Channel at 1.2 miles. All main canals are located on Reclamation fee title or easement land.

Appurtenant Features: Conveyance; Regulating; Water Management; Protective; and Miscellaneous Structures and Objects

1. Conveyance Structures

Conveyance structures are features such [as] inverted siphons, drops, chutes, flumes, tunnels, and pipelines that are used to safely transport water from one location to another traversing various existing natural and manmade topographic features along the way.

2. Regulating Structures

[31] USDI, National Park Service, *Guidelines for Applying the National Register Criteria for Evaluation, National Register Bulletin 15* (Washington, D.C.: USDI, National Park Service, 1990, rev. 1997).
[32] Jim Bailey, "National Register of Historic Places Multiple Property Documentation Form, Central Valley Project: Planning and Construction of the First Four Divisions, 1935-1956," draft prepared for Reclamation, 2009, updated 2018.
[33] Bailey, draft CVP MPL (2009, updated 2018), 100-105, 107.
[34] For San Luis Drain, this evaluation uses the CVP MPL evaluative framework for "canals" and "drains," the latter classification largely grouped with minor lateral and sub-lateral canals, because the drain recorded on this form is an explicitly identified engineering feature—the only drain identified as such in the document—and possesses numerous appurtenant structures; Bailey, draft CVP MPL (2009, updated 2018), 105.

Regulating structures are used to raise, lower, or control the release and volume of the water flow. Regulating structures that are located at the source of the water supply include headworks and turnouts. Headworks control the release of water into the canal and are often located downstream from a major diversion or storage facility. Regulating structures located along the course of a canal include turnouts, checks, check-drops, and diversion structures. The smaller regulating structures like checks and turnouts are basic components of an irrigation system.

3. Protective Structures

Protective structures protect the canal system and adjacent property from damage which would result from uncontrolled storm runoff or drainage water, or an uncontrolled excess of flow within the canal. Several different types of structures perform this function, including overchutes, drainage inlets, siphon spillways, and wasteways.

4. Water Measurement Structures and Objects

Water measurement structures are used to gauge water flow and ensure its equitable distribution. Many different types of water measurement structures are used in irrigation systems. The type most commonly used in Reclamation systems are Parshall flumes, weirs, open-flow meters, and constant head orifices.

Drains

Drains are water conveyance structures (either open channels or buried pipes) that carry excess water away from irrigated agricultural fields to prevent rising water tables. A drain classification was instituted by Reclamation in 1920 that categorized drains into three classes according to their size and relative importance. Class I or "deep drains" are the largest and most significant, with Class III being the smallest and least significant.[35]

Significance

In conjunction with the storage and diversion dams, canals form the CVP's backbone. They provide the means to transfer, transport, and deliver water through the system and ultimately to the water users. Traversing across hundreds of miles, the canals form a significant feature of the physical landscape and define the geographical limits of the project. In keeping with the original CVP plan of large-scale water transfers, canals are the primary means behind the geographical redistribution of fresh water from the valley's wetter northern reaches to the drier southern stretches.[36]

The need for continual maintenance and repairs to canals requires special consideration of integrity. Irrigation systems are constantly evolving as features are upgraded, repaired, or replaced. Alterations made to canals during the period of significance and even subsequent to that may not nullify eligibility if a canal retains certain basics. Most important are integrity of location, association, and overall design configuration of the prism (i.e. depth and width). A canal which has retained its original form and associated appurtenant features has a high degree of integrity. It is not uncommon for a canal lining to be replaced, or for previously unlined segments to be lined. Such changes may not preclude a canal's eligibility if they do not significantly damage the canal's historic association or its overall design. If in addition to integrity of association, location, and overall design, the historical setting and feeling of a canal are maintained, then the likelihood is even higher that an altered canal would be eligible. On the other hand, if an entire canal is piped, it would no longer convey any of its original design, workmanship, materials, or historical association and would not be contributing. Conversely, partial piping of a significant canal may not preclude eligibility if a majority of a canal is still open and intact.[37]

Secondary to the canals in distributing water are the thousands of laterals and their appurtenant features. As with canals, many appurtenant features are upgraded, altered, or even replaced over time due to the constant ongoing maintenance needs. For laterals to be considered contributing, they must exhibit a high level of integrity, and serve as principal laterals or incorporate a larger number of contributing appurtenant features. Because of the vast number of appurtenant features and the many miles of laterals, it may only be appropriate to identify representative samples of contributing elements. In unusual cases, laterals

[35] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 124.
[36] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 125.
[37] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 126-127.

and appurtenant features may have individual significance if they are: surviving examples of a rare type of design or construction; of innovative engineering design that impacted subsequent designs; or were specifically designed to meet an unusual engineering challenge.[38]

Sub-lateral canals and their branches are not considered as contributing resources to the CVP. The small size of sub-laterals does not make a significant contribution to the function or design of the CVP and are not individually eligible. Sub-laterals could, however, be eligible if they are associated with a historic farm or district where the impact the lateral has in combination with the other resources is substantial.[39]

The evaluation of the significance of drains is similar to that of laterals. The principal, or Class I drains, are contributing features if they retain a high level of integrity and fall within the period of significance. Class II and III drains are not considered contributing resources. In unusual cases, drains may have individual significance if they fall within the period of significance and are: rare, surviving examples of a type of design or construction, of innovative engineering design that impacted subsequent designs, or were specifically designed to meet an unusual engineering challenge. Like laterals and sub-laterals, drains are considered as ineligible components of the CVP.[40]

Registration Requirements

The period of significance for historic CVP water conveyance structures begins in 1937 with the initial construction of the first CVP canal, the Contra Costa Canal, and ends in 1952 with the completion of the Friant-Kern, Delta-Mendota, and Delta Cross Channel canals. Like the dams, these canals are part of the initial CVP authorizations.[41]

Water conveyance structures with adequate integrity are considered eligible as part of the multiple property listing for the National Register for the following reasons:

Criterion A: They have had a significant impact on the settlement, agricultural economy, or development patterns of the project area; they have been defining elements in the evolution of the cultural landscape; they are directly associated with important events.

Criterion B: They are the result of the direct efforts of a prominent individual associated with the CVP and are the most prominent feature associated with that individual.

Criterion C: They represent the distinctive characteristics of Reclamation canal design and/or methods of construction used on the CVP; they involved challenging engineering design problems due to topography, grade, length, natural obstacles, and resulted in complex or innovative solutions; they are among the best or a rare surviving example of a distinctive type of water conveyance structure; they represent the evolving technology in design of water conveyance structures; they were identified during the construction period as an individually significant feature; or they embody the work of a significant engineer or builder.

Criterion D: They have the ability to yield information important to understanding the history of the CVP. None of the CVP water conveyance structures are eligible under this criterion.[42]

Evaluation

The following evaluates two point-observations and one linear segment of the San Luis Drain together for individual eligibility for listing in the NRHP and CRHR under the themes and within the framework presented above. This evaluation concludes that the San Luis Drain is historically significant under NRHP / CRHR Criterion A / 1 at the national level for its important association with the ecological disaster at Kesterson Reservoir, an historically significant event that profoundly impacted subsequent governmental policies toward drainage and wildlife habitat management. While this evaluation concludes that the

[38] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 127.
[39] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 127.
[40] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 128.
[41] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 129.
[42] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 129.

San Luis Drain meets NRHP and CRHR criteria, it does not conclude that the entire multi-component resource is eligible for listing in the NRHP and CRHR because assessing the integrity of any part of the San Luis Drain beyond the APE for the project cited in *P11 is outside the scope of this project. This evaluation assesses the historic integrity of one linear segment and two point-observations of the San Luis Drain in and adjacent to the APE and concludes that they retain historic integrity to their period of significance, 1982-1988, and would be contributing elements of the overall San Luis drainage system if the entire linear resource is found to possess sufficient integrity to be listed.

Criteria A and 1

The San Luis Drain does not possess significance under these criteria for its involvement with the CVP. The San Luis Drain, an integral but short-lived component of the San Luis Unit of the CVP, returned subsurface irrigation drainage water from irrigation districts within the San Luis service area between 1972 and 1986. Following decades of lobbying by agricultural interests in the region, Reclamation was authorized in 1960 to deliver irrigation water to the western San Joaquin Valley with the formation of the San Luis Unit, a first in federal-state joint-use facilities. In addition to rallying support for supplementing their depleted groundwater sources with CVP surface water, local irrigators also lobbied for the addition of critical drainage facilities, as the rising groundwater table of highly saline subsurface irrigation wastewater threatened to drown crops and sterilize thousands of acres of valuable agricultural lands. During planning, the San Luis Drain sparked controversy among residents in the San Francisco Bay Area and Sacramento-San Joaquin Delta, where the drain was originally planned to discharge near Antioch in Contra Costa County. Following years of negotiations and federal budgetary constraints, the San Luis Drain was ultimately built out to about half of its intended length, roughly 88 miles, and rather than discharging into the Delta, irrigation wastewater containing high levels of toxic selenium was instead pooled in a complex of evaporation ponds at Kesterson Reservoir near Gustine in Merced County. Following high rates of deformity and death among migratory and nesting waterfowl and other wetland species at Kesterson (discussed below), Reclamation discontinued use of the San Luis Drain and reservoir. The San Luis Drain failed to meet the drainage needs of the San Luis service area, was effectively retired, and is thus not eligible for listing in the NRHP or CRHR under these criteria for its involvement with the CVP.

However, under these same criteria, the San Luis Drain possesses significance for its important association with the ecological disaster at Kesterson Reservoir in the early to mid-1980s and the associated subsequent advances in environmental research / wetlands preservation, along with shifts in governmental reclamation policies and the broadening of CVP's attention to encompass ecological issues that went well beyond its previous focus centered on the interests of agribusiness in the western San Joaquin Valley. According to *National Park Service National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation*, properties like San Luis Drain, the significant associations of which have occurred within a period of less than 50 years ago, must also meet Criteria Consideration G. To meet Criteria Consideration G, the property needs to show that its associations within the last 50 years are of "exceptional importance."[43] The San Luis Drain appears to meet this high threshold, and sufficient historical perspective exists to demonstrate this significance. In the early 1980s, USFWS scientists began to discover high rates of embryonic and infant deformity and adult mortality among various plant, fish, and waterfowl species at Kesterson Reservoir, which they soon traced to toxic exposure to selenium, and as the tragedy unfolded, ultimately culminating in the retirement of the San Luis drainage system in 1986, the ecological crisis at Kesterson Reservoir garnered national attention. The disaster was dubbed an "avian holocaust," and it illustrated the extreme environmental risks posed by selenium-contaminated irrigation drainage, reframing the problem from an individual farm-scale issue to a watershed-level environmental protection crisis.[44] California emerged as a global center for selenium-contamination research and environmental management during this period, with scientists establishing firm links between human activity and sites of selenium concentration. In response, environmental managers at the federal, state, and regional levels instituted a growing body of water quality regulations that established maximum daily load limits for selenium among discharges of agricultural drainage, as illustrated by the Grasslands Bypass Project—a joint-state federal drainage program that monitors drainage for trace elements in the Central Valley Grasslands. Perhaps most importantly, the disaster at Kesterson dramatically illustrated

[43] National Park Service, *National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation*, 1990, rev. 1995, 41, 43.
[44] Harold E. Thomas, "Ode to the San Luis Drain," *Groundwater* 24, no. 1 (January 1986): 79.

the ecological burden that decades of unrestrained and federally subsidized agriculture had placed on the region, leading reformers to fundamentally transform the CVP—which had historically served the interests of agribusinesses—to incorporate environmental stewardship among its mandates. In 1992, the Central Valley Project Improvement Act (CVPIA) was passed into law, which, for the first time, placed wildlife habitat management on equal footing with the agricultural and industrial goals of the CVP. Since the passage of the CVPIA, Reclamation and its federal, state, and local partner agencies have implemented habitat improvement projects on the American, Stanislaus, Yuba, and Sacramento rivers and delivered CVP water to federal, state, and private managed wetlands throughout the state. Most importantly, it has ceased all drainage discharges into wildlife refuges.

As the structural vehicle for delivering selenium-contaminated subsurface irrigation drainage water to Kesterson Reservoir, the San Luis Drain possesses strong and meaningful associations with the Kesterson disaster, an environmental calamity of exceptional historical significance for the critical role it played in transforming governmental policy. Thus, the two point-observations and one linear segment of the San Luis Drain recorded on this form contribute to its significance under these criteria. The period of significance under these criteria dates from 1982, when USFWS scientists first detected selenium toxicosis among various plant and animal species at Kesterson, and 1988, when the U.S. Department of Interior—having discontinued use of the San Luis drainage facilities—remediated the selenium contamination problem at Kesterson by dewatering and infilling the evaporation ponds.

Criteria B and 2

The CVP was the result of the efforts of many individuals and agencies over many years and no one person or group of people rises in the historical record as playing a direct role in its implementation in a way that would be best demonstrated by San Luis Drain; therefore, San Luis Drain is not individually eligible for listing in the NRHP under Criterion B or in the CRHR under Criterion 2.

Criteria C and 3

San Luis Drain does not possess individual eligibility for listing in the NRHP and CRHR under Criterion C or Criterion 3. While the San Luis Drain is a rare structural type (interceptor drain) within the CVP, construction of the structure was ultimately not completed to its full schematics, and it failed to adequately remedy the regional drainage problem (which persists to the present). Originally planned to span 188 miles between Kettleman City in Kings County to a discharge point near Antioch in Contra Costa County, construction on the San Luis Drain was impeded by political opposition and budgetary constraints, and it was ultimately built out to 88 miles—less than half the intended span—from a point near Five Points in Fresno County to the Kesterson Reservoir outside of Gustine in Merced County. The structure is a largely non-operational concrete-lined trapezoidal channel with numerous appurtenant structures—such as checks, siphons, and crossings. The San Luis Drain was designed and built to receive and convey subsurface drainage water from regionally distributed drainage collector systems that were operated by irrigation districts, which in turn collected drainage from underground pipe networks lain on private farms. The San Luis drainage system has largely been retired as designed. It not only was not built out to its full extent, but it also did not meet its the drainage objectives, and thus does not possess significance for its engineering.

Under these same criteria, the San Luis Drain is likewise not significant for its construction methodology. Reclamation had employed large industrial trimmers for canal excavation for decades prior to the construction of the drain recorded on this form. During construction of the Delta-Mendota Canal in particular, contractors navigated the same issues relating to the regional groundwater table elevated above the canal trench. While construction on the San Luis Drain innovated upon and in many ways streamlined earlier methods, this effort did not introduce fundamentally new technologies or methodologies. Therefore, the drain recorded on this form does not possess individual significance in this regard.

Also considered under these criteria, San Luis Drain does not represent the important work of a master engineer or builder. Lead project engineer for San Luis Drain, Edward J. Brannan joined Reclamation in 1937 as a transitman on the Columbia Basin Project before he was promoted to construction engineer on the Spokane Valley Project in Washington in 1965 and ultimately the San Luis Drain in the late 1960s and early 1970s. Brannan does not appear to have developed new designs but

rather follow the standardized designs drafted earlier by Reclamation engineer Harry Raymond McBirney.[45] Additionally, Gordon H. Ball, Inc., and Ball, Ball & Brosamer, who collectively won three construction contracts for San Luis Drain comprising nearly 80 percent of the extant structure (69.51 miles) in addition to Kesterson Reservoir, were the companies responsible for the largest share of the drain's construction. While they were prolific contractors, there is insufficient evidence to support Gordon H. Ball and Ball, and Ball & Brosamer, as master builders. Moreover, both firms appear to have specialized in heavy highway construction, not canal building. While construction of San Luis Drain was a large undertaking for the companies, it does not best represent their body of work. They were most known during the 1960s and 1970s for construction of highways, runways, and general concrete work. San Luis Drain would not best represent the work of any of the other contractors who won contracts for San Luis Drain because their contributions to the project were only to a small fraction of the overall project. For these reasons, the drain recorded on this form is not individually eligible for listing in the NRHP or CRHR under these criteria.

Criteria D and 4

San Luis Drain is not eligible under NRHP Criterion D or CRHR Criterion 4 for information potential because it was designed and built according to well-documented practices, and the project is well documented through drawings, textual records, and photographs.

Character-defining Features, Integrity, and Boundary of San Luis Drain

In general, the character-defining features of the recorded segment of the San Luis Drain are its alignment, the size, shape, and dimensions of the canal prism, and its concrete lining material. Individual elements within the study area that contribute to the significance of San Luis Drain along the approximately five-mile recorded segment are those structures that are directly related to its significance under NRHP Criterion A / CRHR Criterion 1, i.e. structures that directly relate to the conveyance of subsurface irrigation drainage water from the southern terminus in Fresno County north to Kesterson in Merced County. Structures like check structures and siphons that convey and control the water's northerly flow all related directly to the drain's significance and purpose and therefore contribute to the significance of the historic property. Structures in the study area that accommodate pre-existing uses like the Drain U-121.2 undercrossing and trapezoidal road crossing do not contribute to the historical significance of this linear historic property because they are not directly related to the conveyance of subsurface irrigation wastewater, and instead serve ancillary purposes.

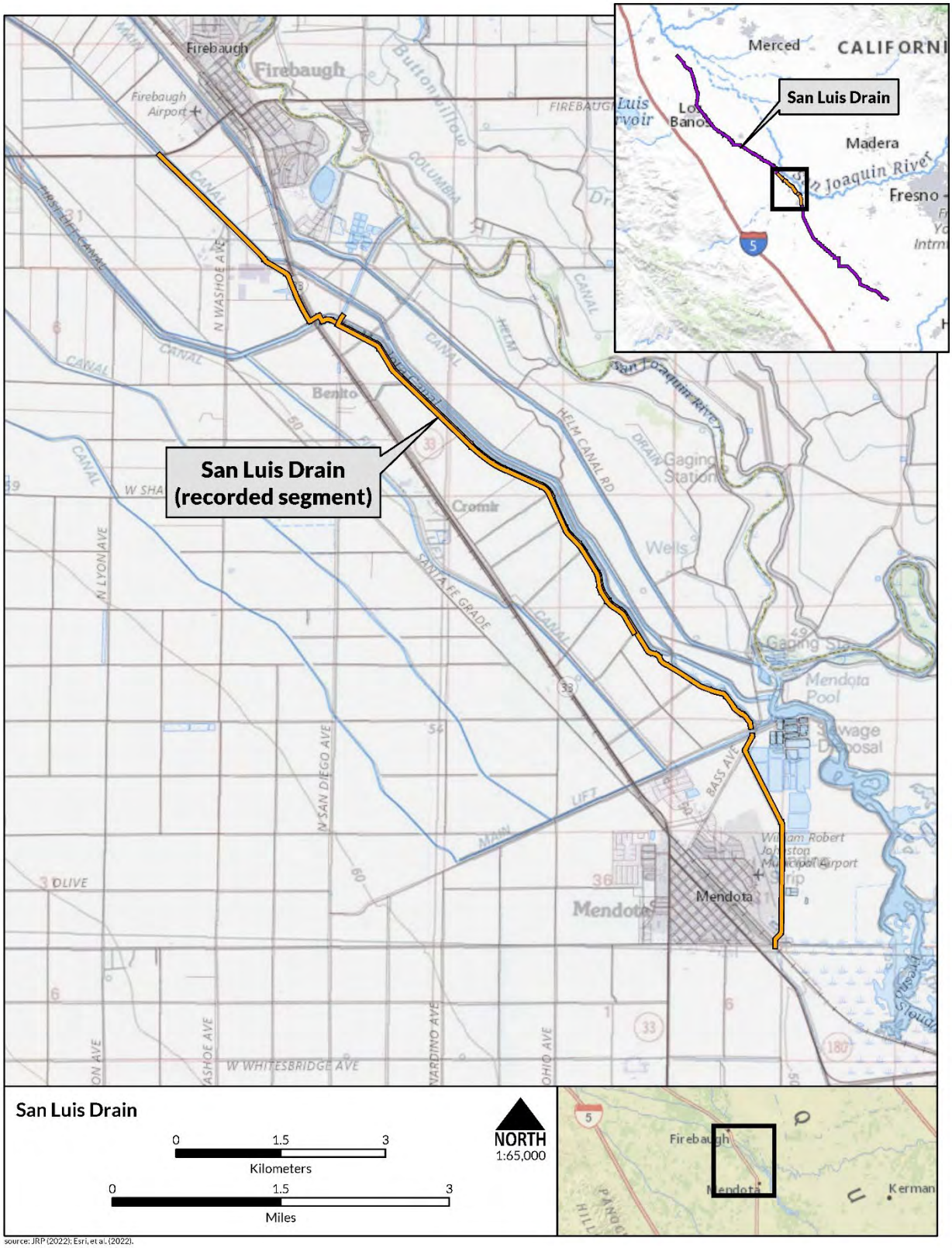
The recorded segment of the San Luis Drain along with its contributing structures all retain historic integrity to their period of significance, 1982-1988, and would contribute to the overall resource if the San Luis Drain possesses sufficient integrity throughout its span. In terms of design and setting, the recorded segment of the San Luis Drain remains in its original location, the setting of which remains defined by flat rural farmland. In terms of design, materials, and workmanship, research did not reveal that any substantial modifications have been made to any of the character-defining features that would reduce the integrity of this segment of the study property. While it is unclear when some inlets were added to the structure, these additions are comparably minor and do not detract from the overall feeling of the resource. The recorded drain segment suffers diminished integrity of association because it is no longer operational.

The boundaries of the San Luis Drain are the channel's right-of-way, encompassing the canal prism and two flanking embankments, between the southern terminus—a point near Five Points in Fresno County—and the northern terminus at the former Kesterson Reservoir.

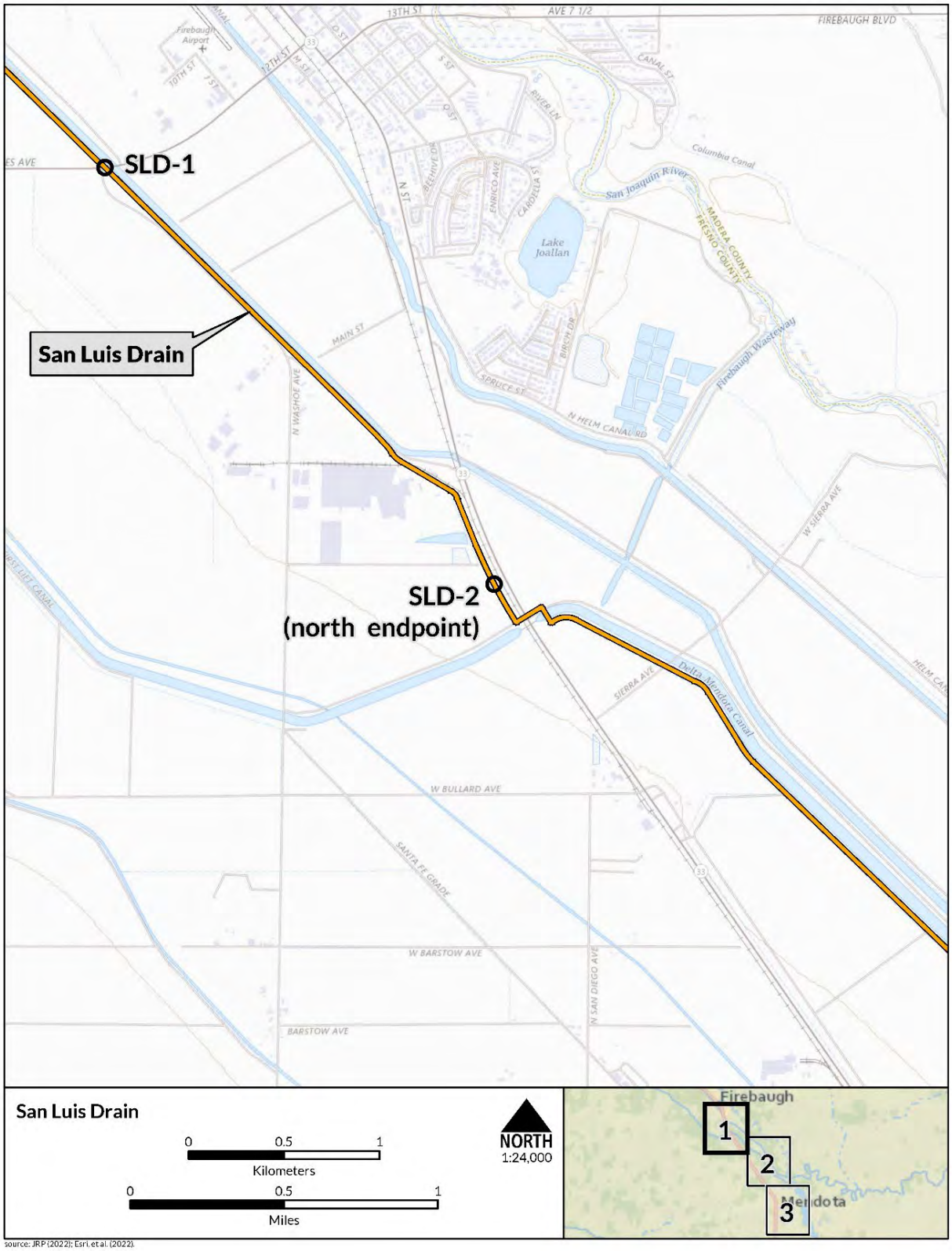
[45] "Water Project Post is Filled," *Spokane Daily Chronicle* (February 16, 1965): 3.

***Resource Name or #** (Assigned by recorder) San Luis Drain

***Map Name:** San Luis Drain – Recorded Segment ***Scale:** 1:24,000 ***Date of map:** 2022



source: JRP (2022); Esri, et al. (2022).

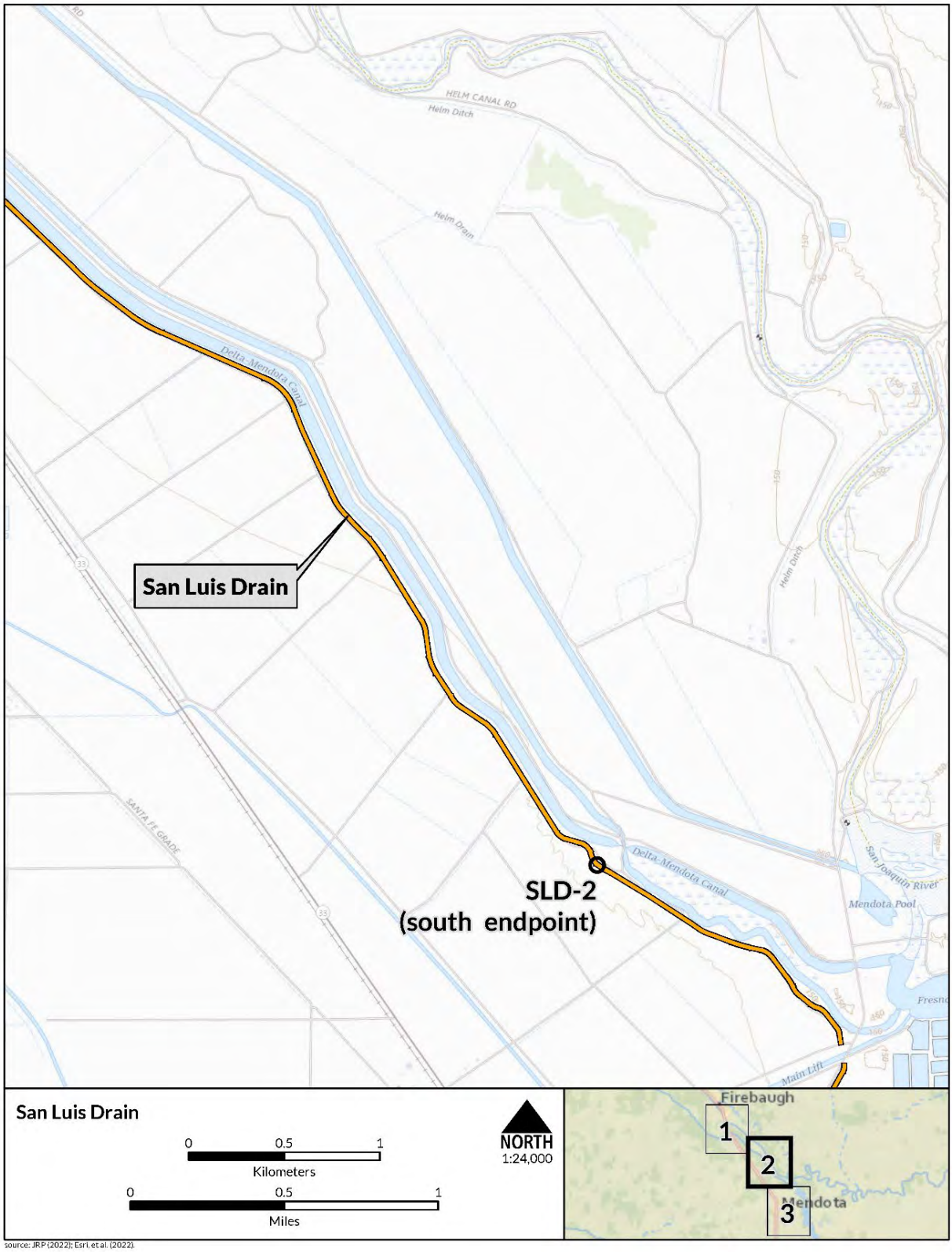


source: JRP (2022); Esri, et al. (2022).

***Resource Name or #** (Assigned by recorder) San Luis Drain

***Drawn by:** JRP Historical Consulting, LLC

***Date of map:** 2022

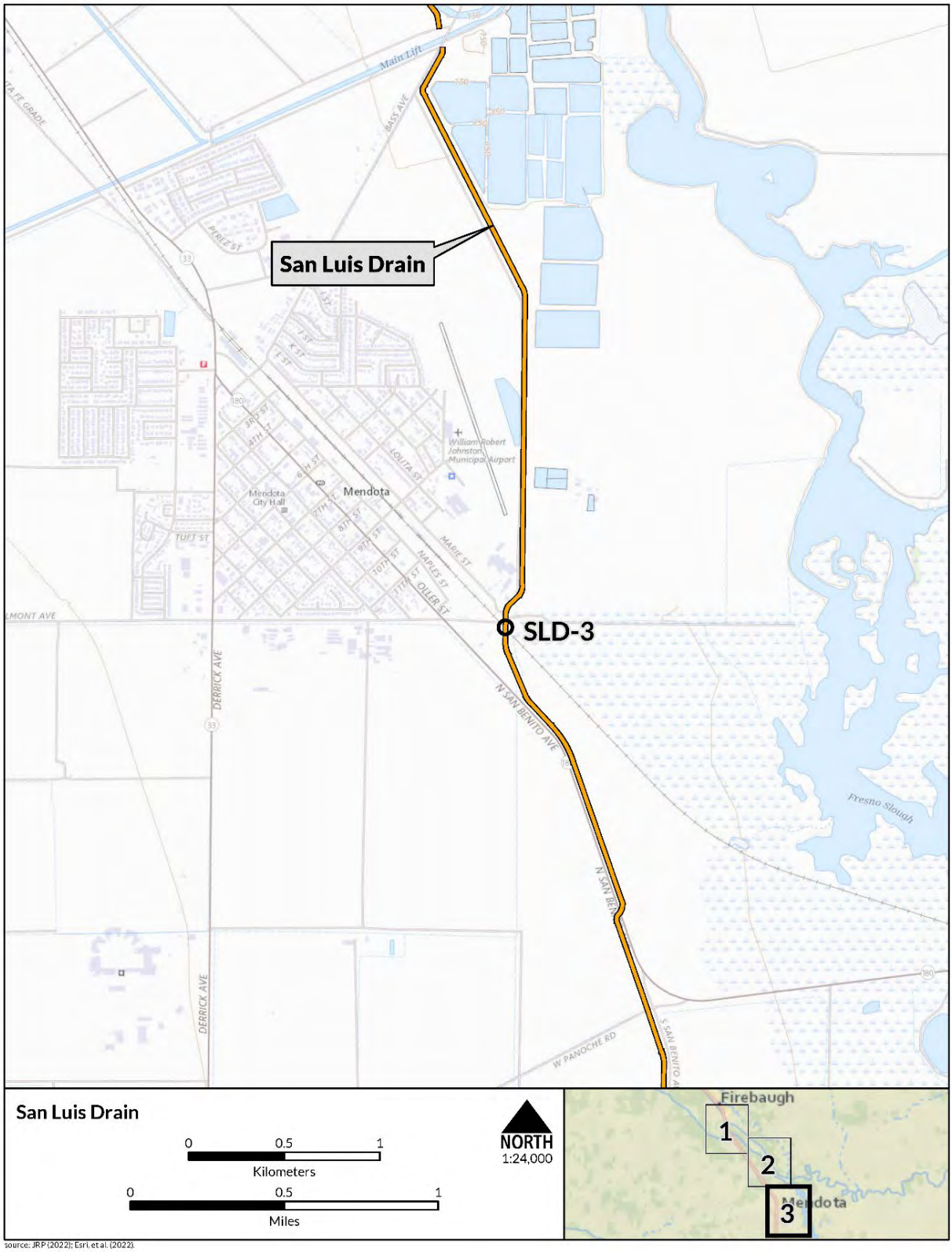


NOTE: Include bar scale and north arrow.

***Resource Name or #** (Assigned by recorder) San Luis Drain

***Drawn by:** JRP Historical Consulting, LLC

***Date of map:** 2022



State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary # _____
HRI # _____
Trinomial _____
NRHP Status Code 6Z
Other Listings _____
Review Code _____ Reviewer _____ Date _____

***Resource Name or #** (Assigned by recorder) Drain U-121.2

P1. Other Identifier: Drain U-121.2

***P2. Location:** ☐ **Not for Publication** ☒ **Unrestricted** ***a. County** Fresno

and (P2b and P2c or P2d. Attach a Location Map as necessary.)

***b. USGS 7.5' Quad** Firebaugh **Date** 2021 **T** 13S; **R** 14E; __ ¼ **of Sec** ; Mount Diablo **B.M.**

c. Address NA City Firebaugh (vic.) Zip _____

d. UTM: (give more than one for large and/or linear resources) Zone _____; _____mE/ _____mN

Segment recorded from Zone 10S, 728390.36mE / 4079117.19mN at the north, to Zone 10S, 732684.75mE / 4074696.30mN at the south.

e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate)

Assessor Parcel Numbers: 012-031-21ST; 012-030-33S; 012-060-59S; 012-070-25S

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries)

This form records Drain U-121.2, a component of the Firebaugh Canal Water District in western Fresno County, between Firebaugh and Mendota (**Photograph 1**). The entire drainage canal is located in and adjacent to the area of potential effects (APE) for the project cited in *P11. See the attached Linear Feature Record for a description of the resource.

***P3b. Resource Attributes:** (List attributes and codes) HP20 – Canal / Aqueduct

***P4. Resources Present:** ☐ Building ☒ Structure ☐ Object ☐ Site ☐ District ☐ Element of District ☐ Other (Isolates, etc.)

P5a. Photo or Drawing (Photo required for buildings, structures, and objects.)



P5b. Description of Photo: (View, date, accession #) **Photograph 1.** Upstream view of Drain U-121.2; camera facing southeast, July 20, 2022.

***P6. Date Constructed/Age and Sources:**
☒ Historic ☐ Prehistoric ☐ Both
ca. 1951; 1973 (Aero Exploration Co.; HistoricAerials.com; U.S. Bureau of Reclamation)

***P7. Owner and Address:**
Firebaugh Canal Water District
2412 Dos Palos Road / Highway 33
Mendota, CA 93640

***P8. Recorded by:** (Name, affiliation, address)
Samuel Skow & Danielle Baza
JRP Historical Consulting, LLC
2850 Spafford Street
Davis, CA 95618

***P9. Date Recorded:** July 20, 2022

***P10. Survey Type:** (Describe) Intensive

***P11. Report Citation:** (Cite survey report and other sources, or enter "none.") JRP Historical Consulting, LLC, "Finding of Eligibility Delta-Mendota Canal Subsidence Correction Project," 2022, prepared for US Bureau of Reclamation and San Luis & Delta-Mendota Water Authority.

***Attachments:** ☐ None ☐ Location Map ☒ Sketch Map ☒ Continuation Sheet ☒ Building, Structure, and Object Record ☐ Archaeological Record ☐ District Record ☒ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐Other (list) _____

***NRHP Status Code** 6Z

***Resource Name or #** (Assigned by recorder) Drain U-121.2

B1. Historic Name: Firebaugh Canal Company Drain

B2. Common Name: Drain U-121.2

B3. Original Use: Drainage B4. Present Use: Drainage

***B5. Architectural Style:** Utilitarian

***B6. Construction History:** (Construction date, alteration, and date of alterations) Drain built ca. 1951; replacement drain constructed in parallel alignment 1973; drainage pipes, pumps, replacement trash screens added at unknown dates.

***B7. Moved?** ☒ **No** ☐ **Yes** ☐ **Unknown** **Date:** _____ **Original Location:** _____

***B8. Related Features:** None

B9. Architect / Engineer: U.S. Department of Interior (USDI), Reclamation, Central Valley Project, Delta-Mendota Canal / West San Joaquin Division – San Luis Unit

b. Builder: United Concrete Pipe Corp. and Vinnell Co., Inc.; Ball, Ball & Brosamer Co.

***B10. Significance: Theme** n/a **Area** n/a

Period of Significance n/a **Property Type** n/a **Applicable Criteria** n/a

(Discuss importance in terms of historical or architectural context as defined by theme, period, and geographic scope. Also address integrity.)

Drain U-121.2 does not meet the criteria for listing in the National Register of Historic Places (NRHP) or the California Register of Historical Resources (CRHR) because it is not historically significant within the context of the Central Valley Project (CVP) or the development of regional agriculture. It is not an historic property under Section 106 of the National Historic Preservation Act nor is it an historical resource for the purposes of the California Environmental Quality Act (CEQA). This resource has been evaluated in accordance with Section 106 of the National Historic Preservation Act of 1966 (as amended) (54 U.S.C. 306108) and its implementing regulations (36 CFR Part 800), and Section 15064.5(a)(2)-(3) of the CEQA Guidelines, using the criteria outlined in Section 5024.1 of the California Public Resources Code (see Continuation Sheet).

B11. Additional Resource Attributes: (List attributes and codes) _____

***B12. References:** U.S. Department of Interior, Reclamation, Central Valley Project, "Delta-Mendota Canal – Sta. 5200+00: Drain Siphon Crossing – Plan, Profile, and Sections," dwg. no. 214-D-16411, August 22, 1949, Specifications No. DC-2857, Reclamation Design & Construction Library, Sacramento, California; Declaration of Taking, United States of America vs. Redfern Ranches, No. F-232, October 4, 1968, 5629 O.R. 444, Fresno County Recorder, Fresno, California; see footnotes.

B13. Remarks:

***B14. Evaluator:** Samuel Skow, JRP Historical Consulting, LLC

***Date of Evaluation:** August 2022

(This space reserved for official comments.)

Sketch map with north arrow required

See Continuation Sheet.

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary # _____
HRI # _____

***Resource Name or #** (Assigned by recorder): Drain U-121.2

***Recorded by:** S. Skow and D. Baza

***Date:** July 20, 2022

L1. Historic and/or Common Name: Drain U-121.2

L2a. Portion Described: ☒ Entire Resource ☐ Segment ☐ Point Observation **Designation:** Drain U-121.2

***b. Location of point or segment:** (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map.) Segment recorded from Zone 10S, 728390.36mE / 4079117.19mN at the north, to Zone 10S, 732684.75mE / 4074696.30mN at the south.

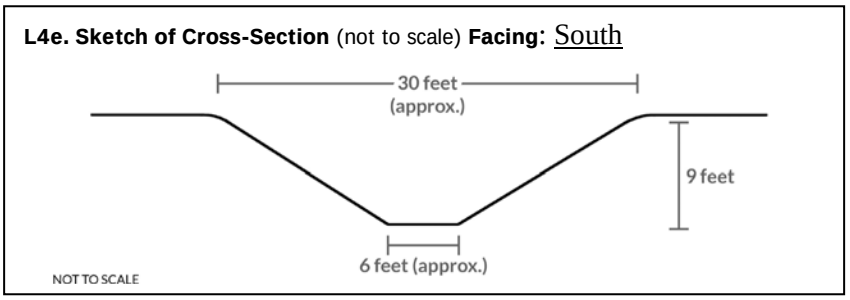
L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.)

Drain U-121.2 is an earth-lined drainage canal that extends roughly five miles from a point in the Northeast ¼, Section 24, Township 13 South, Range 14 East, Mount Diablo Base Meridian (NE ¼ Sec. 24, T13S / R14E, MDBM), northwesterly downstream in a parallel alignment to the adjacent San Luis Drain and Delta Mendota Canal (recorded and evaluated on separate DPR 523 forms appended to the report cited in *P11) to its northern terminus in the NW ¼, Sec. 3, T13S / R14E (**Photograph 2** and **Photograph 3**). Here, the drain is siphoned below the two canals named above into a discharge outlet on the northeast side of the Delta Mendota Canal adjacent to the Firebaugh Wasteway, into which Drain U-121.2 empties via corrugated metal pipe (**Photograph 3** – **Photograph 6**) (see Continuation Sheet). The Firebaugh Wasteway sends water into the San Joaquin River (see Continuation Sheet).

L4. Dimensions: (in feet for historic features and meters for prehistoric features)

a. **Top Width:** 30 feet (approx.)
b. **Bottom Width:** 6 feet
c. **Height or Depth:** 9 feet (approx.)
d. **Length of Segment:** 5 miles (approx.)

L4e. Sketch of Cross-Section (not to scale) **Facing:** South



L8a. Photograph, Map, or Drawing.



L11. Date: July 20, 2022

L5. Associated Resources: Firebaugh Canal Water District canals, drains, and water control features

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.)
This resource is located in a rural agricultural area in Fresno County. The terrain is generally flat.

L7. Integrity Considerations: Canal rerouted in 1973

L8b. Description of Photo, Map, or Drawing:
Photograph 2: Upstream view of Drain U-121-2 San Luis Drain operating and maintenance road (left bank); camera facing southeast, July 20, 2022.

L9. Remarks:

L10. Form prepared by:
Samuel Skow
JRP Historical Consulting, LLC
2850 Spafford St., Davis, CA 95618

L3. Description (continued):

The earth-lined, trapezoidal drainage canal has a slightly elevated right bank and a lower left bank, both with 1 ½: 1 slope. Vegetative overgrowth is prominent in various sections of the canal bed and walls. Parallel dirt and gravel roads extend along the levee crests, with a 14-foot-wide O&M road on the right bank and private farm roads extending the left bank (**Photograph 2**). The drain is conveyed beneath the San Luis Drain and Delta-Mendota Canal via concrete pipe, with a metal trash screen and pump at the inlet, a round concrete manhole tube extending from the siphon through the right bank of the San Luis Drain, and a concrete outlet with wingwalls (**Photograph 3, Photograph 4,** and **Photograph 7**). Other appurtenant structures include a concrete pipe culvert at Sierra Avenue, an assortment of different metal and plastic subsurface inlet drains from the adjoining agricultural lands, and modern pumping equipment (**Photograph 8** – **Photograph 12**).

B10. Significance (continued):

Historic Context

The oldest components of Drain U-121.2 recorded on this form were constructed circa 1951, around the same time that construction was completed on the adjacent Delta-Mendota Canal (DMC) for the Central Valley Project (CVP), with the remainder of the linear resource rerouted to accommodate the 1973 construction of the San Luis Drain, a key component of the San Luis Unit expansion of the CVP. For a discussion of the original CVP, the Delta-Mendota Canal, the San Luis Unit, and the San Luis Drain, see the DPR 523 form sets prepared for the Delta-Mendota Canal and the San Luis Drain appended to the report cited in *P11.

Drain U-121.2

The discharge outlet of the drainage canal recorded on this form was originally constructed sometime between 1950 and 1955, likely around the same time that construction of the DMC was completed in 1951. As originally constructed, the drain occupied the same general alignment as the present-day San Luis Drain, the construction of which enlarged and concreted the formerly earth-lined structure in this section (**Figure 1**). Reclamation drafted plans as early as 1949 for a drain siphon crossing at the location of the underground structure recorded on this form, indicating that the Firebaugh Canal Company—the drain's original owner—may have planned the structure at the location sometime even earlier, but likely after 1939. That year, four subsidiaries of the Miller & Lux Corporation—the Firebaugh Canal Company, the San Joaquin & Kings River Canal & Irrigation Company, Inc., the Columbia Canal Company, and the San Luis Canal Company—all entered into a contract with the federal government to receive CVP water in exchange for relinquishing access to San Joaquin River water, which Reclamation ultimately stored in Friant Reservoir for diversion south to Kern County. These four entities were collectively referred to as the "Exchange Contractors," and they remain active in the region at present as the San Joaquin River Exchange Contractors Water Authority.[1]

The Firebaugh Canal Water District appears to retain ownership of Drain U-121.2. This district was originally formed in 1914 as the Panoche Canal Company, a subsidiary of Miller & Lux, Inc., the single largest cattle, land, and irrigation operation in the western United States, at one time owning or holding leases to over one million acres throughout California, Oregon, and

[1] Aero Exploration Co., Flight ABI, Frame ABI-18G-51, February 13, 1950 (1:20,000), flown for U.S. Department of Agriculture, Production and Marketing, , available at http://malt.lib.csufresno.edu/MALT/ (Fresno State; accessed July 2022); HistoricAerials.com, "Firebaugh, California," 1955, https://historicaerials.com/viewer (accessed July 2022); U.S. Department of Interior, Reclamation, Central Valley Project, "Delta-Mendota Canal – Sta. 5200+00: Drain Siphon Crossing – Plan, Profile, and Sections," dwg. no. 214-D-16411, August 22, 1949, Specifications No. DC-2857, Reclamation Design & Construction Library, Sacramento, California; Declaration of Taking, United States of America vs. Redfern Ranches, No. F-232, October 4, 1968, 5629 O.R. 444, Fresno County Recorder, Fresno, California; Decision No. 31861: Before the Railroad Commission of the State of California – Application No. 22391, March 20, 1939, University of California (UC) at Merced, UC Cooperative Extension Archive, available at https://calisphere.org/item/ark:/86071/d2mh9f/ (August 2022); San Joaquin River Exchange Contractors Water Authority (SJRECWA), "Exchange Contractors: History of SJRECWA," http://www.sjrecwa.net/about/history/ (accessed August 2022); Ebasco Services, Inc., "Agricultural Drainwater Management Organizations in the Drainage Problem Area of the Grasslands Area of the San Joaquin Valley," prepared for the San Joaquin Valley Drainage Program, March 1989, 3-3.

Nevada. In 1920, the Panoche company changed its name to the Firebaugh Canal Company and developed an irrigation system of one, 3.5-mile main canal and three approximately 10-mile lateral canals for distributing diversions from the San Joaquin River, the company's primary water source. By 1930, the company had irrigated some 18,354 acres, where farmers mainly grew cotton but also grain, alfalfa, grapes, and beans (**Figure 2**). By the early 1950s, the service area had grown to encompass 22,640 acres in Fresno County near the towns of Firebaugh and Mendota, where farmers produced cotton, rice, alfalfa, sugar beets, vegetables, and grain. By the late 1980s, the Firebaugh Canal Company distributed water through 47 miles of main and lateral canals and disposed of irrigation drainage water in 58 miles of surface drains—nine miles of which drained into the Firebaugh Wasteway (including the drain recorded on this form), with most emptying into the Firebaugh Main Drain, which transported wastewater beyond the service area into the Agatha Drain in Merced County. The company was reincorporated in 1988 as the Firebaugh Canal Water District, and it now distributes water to over 30 farms and provides financial assistance for agricultural water conservation projects.[2]



Figure 1: Excerpt of 1957 aerial photograph, with Firebaugh Canal Company drain (identified with arrows) in same alignment as San Luis Drain, adjacent to Delta Mendota Canal.[3]

[2] California Department of Public Works, *Bulletin No. 36: Cost of Irrigation Water in California, Reports on State Water Plan Prepared Pursuant to Chapter 832, Statutes of 1929* (Sacramento: California State Printing Office, 1930), 82; "Order to Show Cause on Application for Change of Name of Corporation," San Francisco *Recorder* (September 23, 1920): 5; "Third of Lift Canals Completed on West Side," *The Fresno Bee* (March 8, 1929): 2B; Thomas G. Mapel and Thomas H. Means, "Appraisal: Market Value Mutual Water Company Stock Appurtenant to Bureau Lands Fresno County," prepared for United States Department of the Interior, Bureau of Reclamation, April 26, 1951, 4-6, University of California, Riverside, Library, Water Resources Collections and Archives, available at https://calisphere.org/item/ark:/86086/n2zc81q9/ (accessed August 2022); Ebasco, "Agricultural Drainwater Management Organizations in the Drainage Problem Area of the Grasslands Area of the San Joaquin Valley," 4-5 – 4-6; U.S. Department of Agriculture, Soil Conservation Service, *Mendota-Gustine Study: Fresno and Merced Counties, California* (September 1972), 8; SJRECWA, "Member Districts: Firebaugh Canal Water District," 2022, http://www.sjrecwa.net/member-districts/firebaugh-canal-water-district/ (accessed August 2022).

[3] Cartwright and Company, Frame ABI-29T-138, 1957, UCSB.

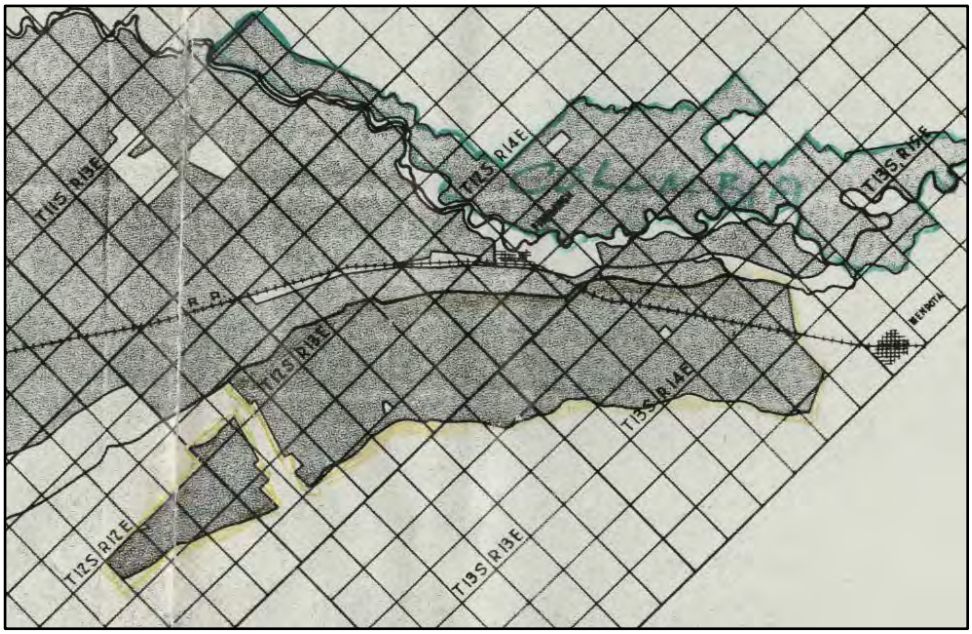


Figure 2: Excerpt of 1939 map showing service areas of San Joaquin River Exchange Contractors; Firebaugh Canal Company (outlined in yellow).[4]

One such farming enterprise serviced by what is now the Firebaugh Canal Water District is Redfern Ranches, Inc., the present and historic owner of 116.18 acres (APN 012-030-33S) containing part of Drain U-121.2 recorded on this form. Redfern Ranches was founded by prominent local farmer, Floyd E. Redfern sometime prior to 1947, the same year that he conveyed that acreage outside of Firebaugh containing a portion of the drain recorded on this form to his business. Born in Nebraska and raised on his family's farm in Dos Palos (about 16 miles north of Drain U-121.2), Floyd Redfern struck out on his own in 1926, initially leasing croplands before purchasing his home ranch south of Dos Palos, where he remained for the duration of his life. By 1942, Redfern was one of the largest rice cultivators in the San Joaquin Valley, expanding up to 1,500 acres by the end of the decade, and reportedly introducing several new practices, like aerial planting and mechanized thresher-and-Caterpillar harvesting. Redfern grew other crops, including alfalfa—which, then as now, was grown at the Firebaugh property near the DMC. Redfern also grew cotton, sugar beets, wheat, and various species of grass, in addition to raising Hereford beef cattle on 13,000 acres outside of Gilroy in Santa Clara County and sheep for wool on 4,000 acres in the western San Joaquin Valley. Redfern was likewise active among various agriculture-related groups. In the 1930s, he was a founding member and vice president of the Merced Production Credit Association, which lent short-term agricultural loans to small farmers in Merced, Mariposa, and western Fresno counties on behalf of the U.S. Farm Credit Administration. The following decade, he also helped found and serve as president of the West Side Alfalfa Pest Control Association. In the 1950s, Redfern was an active participant and booster of the U.S. Department of Agriculture's soil bank reserve program, whereby the federal government subsidized underplanting to discourage overproduction; he was active with the Poso, Panoche, Loma Prieta, and Firebaugh soil conservation districts. Redfern was also an advocate for water efficiency, installing an extensive tailwater return system at his home ranch near Dos Palos that comprised of two holding reservoirs with 15- and 30-horsepower pumps that redistributed the water via concrete pipes. Floyd Redfern had amassed some 26,000 acres throughout the region by the time he died in 1993. His daughter, Suzanne Compte nee Redfern currently owns and operates Redfern Ranches.[5] Research did not

[4] "Exhibit 'A': Map Showing The Service Areas of The San Joaquin & Kings River Canal & Irrigation Company, Incorporated, Columbia Canal Company, San Luis Canal Company, Firebaugh Canal Company," ca. 1939, appended to Decision No. 31861, March 20, 1939.

[5] Fresno County Assessor, property information for APN 012-031-33S, accessed via ParcelQuest.com; Deed, Floyd E. and Gladys W. Redfern to Redfern Ranches, Inc., May 21, 1947 (recorded August 13, 1947), 2543 O.R. 368, Fresno County Recorder, Fresno, California; A. W. Emerson, "Floyd E. Redfern of California—A Profile," *Soil Conservation* 24, no. 12 (July 1959): 281; U.S. Census Bureau, Manuscript Population Schedule: 1900, California, Fresno County, First Township, Enumeration District No. 1, sheet 13A, accessed via Ancestry.com; U.S. Census Bureau, Manuscript Population Schedule: 1910, California, Fresno County, Township 1, Dos Palos Colony (unincorporated), Enumeration District No. 26, sheet 2A (Ancestry.com); "Dos Palos Farmer was a Visionary: Floyd Redfern Dies After

identify other historic-period landowners adjacent to Drain U-121.2; however, aerial satellite imaging and Google Street View appear to indicate that the majority acreage was not planted in orchards until circa 2014.

As it had while building the DMC 18 years earlier, the federal government filed a Declaration of Taking against Redfern Ranches in 1968 for the construction of the San Luis Drain. As part of the project, the original earth-lined drainage canal was enlarged and lined with concrete, and another earth-lined drain was planned along with the "non-exclusive right to discharge drainage water through culverts to be installed by the United States into and to convey drainage water through Drain U-121.2, to be constructed by the United States as a replacement for the Firebaugh Canal Company drain, and in a 24-inch concrete pipe crossing of the San Luis Drain … as a part of said replacement drain."[6] In June 1972, Ball, Ball & Brosamer of Danville won construction contracts for an approximately 18-mile stretch of earthwork, concrete lining, and structures on San Luis Drain comprising that section that traverses the APE for the project cited in *P11, along with the southernmost drain segment where it terminates near Five Points in Fresno County. Included in the design specifications were also plans for Drain U-121.2. Ball, Ball and Brosamer completed all work the following year, when construction on the San Luis Drain was halted altogether (**Figure 3**).[7]

Ball, Ball & Brosamer was formed as joint venture between Gordon H. Ball's two sons, Gordon N. Ball and Dennis W. Ball, and Robert G. Brosamer. In addition to its work on the San Luis Drain, other CVP work included rehabilitation of a portion of the Friant-Kern Canal, with other works for Reclamation including installation of the Gallegos Canyon Siphons as part of the Navajo Indian Irrigation Project in New Mexico and the Sonoqui Dike in Arizona. As with Gordon H. Ball, Inc., Ball, Ball & Brosamer was most actively involved in heavy highway construction. Gordon N. Ball went on to form Gordon N. Ball, Inc., and Robert Brosamer formed R & L Brosamer, Inc, both active firms based in the San Francisco Bay Area.[8]

Helping Set Course for Agriculture," *Merced Sun-Star* (August 21, 1993): A3; "Dos Palos Starts Harvesting of Rice," *Oakland Tribune* (October 11, 1929): 35D; "Rice Being Harvested South of Dos Palos," *The Fresno Bee* (October 7, 1934): 8D; "Largest West Side Rice Crop Being Harvested," *The Fresno Bee* (November 15, 1942): 4D; "Lemoore Now San Joaquin Wool Capital," *Hanford Sentinel* (May 26, 1944): 4; "KMJ Will Broadcast Rice Grower's Talk," *The Fresno Bee* (July 24, 1949): n.p.; "Fresno County Hay Growers Call Lahontan Good Stopgap to Aphid," *The Fresno Bee* (October 27, 1957): 19D; "Loan Group at Merced Named," *The Modesto Bee* (November 30, 1933): 2; "Butterfly War will be Waged on West Side," *The Fresno Bee* (August 4, 1946): n.p.; "67 Producers Paid $5,261,000 in Soil Bank Reserve Program," The San Bernadino County *Daily Sun* (December 24, 1957): B9; Larry D. Adams, "West Side Farms Use Unclaimed Tailwaters," *The Fresno Bee* (April 19, 1970): 3F;

[6] Declaration of Taking, United States of America vs. Redfern Ranches, No. F-232, October 4, 1968, 5629 O.R. 444, Fresno County Recorder, Fresno, California;

[7] Memo Re: Field Inspection for Transfer from Construction to O&M Status for: Stage 1 Kesterson Reservoir and the Three Completed Reaches of the San Luis Drain—Specification Nos. DC-6611, DC-6681, DC-6703, DC-6823—San Luis Unit, CVP, California (December 17, 1973), ff. San Luis Drain (Spec. No. DC-6611), on file at USBR Library, Sacramento, California; ff. San Luis Drain (Spec. No. DC-6948), on file at USBR Library, Sacramento, California; "San Luis Drain Takes Shape in Fresno County," *The Fresno Bee* (September 16, 1973): C1.

[8] "Irrigation Trickles," *Irrigation Journal* 27, no. 3 (May-June 1977): 34; "Contractors," *Western Construction* 50, no. 7 (July 1975): 127; U.S. Department of Interior, *Decisions of the United States Department of the Interior Vol. 93, January-December 1986* (Washington, D.C.: U.S. Government Printing Office, 1987), 144; "County Repays FAA $480,000 for False Billing," Los Angeles Times (June 29, 2000): B1; "Gordon N. Ball, Inc.," NewBayBridge.org, n.d. https://www.newbaybridge.org/the_builders/gordon_ball/ (accessed August 2022); "Featured Projects," Gordon N. Ball Inc., 2017, http://ballconco.com/featured-projects/ (accessed August 2022); Robert L. "Bob" Brosamer, "Message from Bob Brosamer," R & L. Brosamer, Inc. [newsletter] (Spring 2001): 2, available at https://www.thenewsletterguy.com/samples/CustomerNewsletters/RLBrosamer.pdf (accessed August 2022).



Figure 3: Excerpt of 1977 aerial photograph, with Drain U-121.2 (identified with arrows) adjacent to segments of San Luis Drain and Delta-Mendota Canal.[9]

NRHP / CRHR Evaluation

Criteria for Evaluation

The eligibility criteria for designating historic properties under federal and state criteria are essentially the same. The criteria for listing properties in the National Register of Historic Places (NRHP) are codified in 36 CFR 60 and expanded upon in numerous guidelines published by the National Park Service. Buildings, structures, objects, sites, and districts listed in, eligible for listing in, or that appear eligible for listing in the NRHP are considered historic properties under the regulations for Section 106 of the National Historic Preservation Act (NHPA). Eligibility for listing buildings, structures, objects, sites, and districts (i.e., historic properties) in the NRHP rests on twin factors of *historic significance* and *integrity*. A resource must have both significance and integrity to be considered eligible. Loss of integrity, if sufficiently great, will overwhelm the historic significance a property may possess and render it ineligible. Likewise, a property can have complete integrity, but if it lacks significance, it must also be considered ineligible. Historic significance is judged by applying the NRHP criteria, identified as Criteria A through D. The NRHP guidelines state that a historic property's "quality of significance in American history, architecture, archeology, engineering, and culture" must be determined by meeting at least one of the four main criteria. Properties may be significant at the local, state, or national level. The NRHP criteria are:

Criterion A: association with "events that have made a significant contribution to the broad patterns of our history;"

Criterion B: association with "the lives of persons significant in our past;"

Criterion C: resources "that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values;"

[9] Flight 1977 FRE, Frame 1977 FRE CO 6-26R, June 26, 1977, flown for U.S. Department of Agriculture – Agricultural Adjustment Administration, Western Division Laboratory, Fresno State.

Criterion D: resources "that have yielded, or may be likely to yield, information important to history or prehistory."[10]

Integrity is determined through applying seven factors to the historic resource: location, setting, design, workmanship, materials, feeling, and association. These seven can be roughly grouped into three types of integrity considerations. Location and setting relate to the relationship between the property and its environment. Design, materials, and workmanship, as they apply to historic buildings, relate to construction methods and architectural details. Feeling and association are the least objective of the seven criteria and pertain to the overall ability of the property to convey a sense of the historical time and place in which it was constructed.

Central Valley Project Draft Multiple Property Listing

In 2009, Reclamation prepared a *Draft National Register of Historic Places Multiple Property Documentation Form: Central Valley Project* (CVP MPL).[11] The CVP MPL identifies the period of significance for the CVP as 1935 when the project received its first authorizations to 1956 when the last of the major project components was completed. However, as stated, "This MPL is also designed to be easily amended as more project engineering features become historic."[12] The document provides registration criteria regarding NRHP significance and integrity. The subsections of the registration requirements relied upon for this evaluation of Drain U-121.2 for individual eligibility for listing in the NRHP are the subsections for "Drains" as quoted below. The NRHP and CRHR evaluation of Drain U-121.2 contained in this report utilizes in part the framework provided in the CVP MPL.

The following is excerpted from the CVP MPL:

Drains

Drains are water conveyance structures (either open channels or buried pipes) that carry excess water away from irrigated agricultural fields to prevent rising water tables. A drain classification was instituted by Reclamation in 1920 that categorized drains into three classes according to their size and relative importance. Class I or "deep drains" are the largest and most significant, with Class III being the smallest and least significant.[13]

Significance

In conjunction with the storage and diversion dams, canals form the CVP's backbone. They provide the means to transfer, transport, and deliver water through the system and ultimately to the water users. Traversing across hundreds of miles, the canals form a significant feature of the physical landscape and define the geographical limits of the project. In keeping with the original CVP plan of large-scale water transfers, canals are the primary means behind the geographical redistribution of fresh water from the valley's wetter northern reaches to the drier southern stretches.[14]

The need for continual maintenance and repairs to canals requires special consideration of integrity. Irrigation systems are constantly evolving as features are upgraded, repaired, or replaced. Alterations made to canals during the period of significance and even subsequent to that may not nullify eligibility if a canal retains certain basics. Most important are integrity of location, association, and overall design configuration of the prism (i.e. depth and width). A canal which has retained its original form and associated appurtenant features has a high degree of integrity. It is not uncommon for a canal lining to be replaced, or for previously unlined segments to be lined. Such changes may not preclude a canal's eligibility if they do not significantly damage the canal's historic association or its overall design. If in addition to integrity of association, location, and overall design, the historical setting and feeling of a canal are maintained, then the likelihood is even higher that an altered canal would be eligible.

[10] USDI, National Park Service, *Guidelines for Applying the National Register Criteria for Evaluation, National Register Bulletin 15* (Washington, D.C.: USDI, National Park Service, 1990, rev. 1997).
[11] Jim Bailey, "National Register of Historic Places Multiple Property Documentation Form, Central Valley Project: Planning and Construction of the First Four Divisions, 1935-1956," draft prepared for Reclamation, 2009, updated 2018.
[12] Bailey, draft CVP MPL (2009, updated 2018), 100-105, 107.
[13] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 124.
[14] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 125.

On the other hand, if an entire canal is piped, it would no longer convey any of its original design, workmanship, materials, or historical association and would not be contributing. Conversely, partial piping of a significant canal may not preclude eligibility if a majority of a canal is still open and intact.[15]

Secondary to the canals in distributing water are the thousands of laterals and their appurtenant features. As with canals, many appurtenant features are upgraded, altered, or even replaced over time due to the constant ongoing maintenance needs. For laterals to be considered contributing, they must exhibit a high level of integrity, and serve as principal laterals or incorporate a larger number of contributing appurtenant features. Because of the vast number of appurtenant features and the many miles of laterals, it may only be appropriate to identify representative samples of contributing elements. In unusual cases, laterals and appurtenant features may have individual significance if they are: surviving examples of a rare type of design or construction; of innovative engineering design that impacted subsequent designs; or were specifically designed to meet an unusual engineering challenge.[16]

Sub-lateral canals and their branches are not considered as contributing resources to the CVP. The small size of sub-laterals does not make a significant contribution to the function or design of the CVP and are not individually eligible. Sub-laterals could, however, be eligible if they are associated with a historic farm or district where the impact the lateral has in combination with the other resources is substantial.[17]

The evaluation of the significance of drains is similar to that of laterals. The principal, or Class I drains, are contributing features if they retain a high level of integrity and fall within the period of significance. Class II and III drains are not considered contributing resources. In unusual cases, drains may have individual significance if they fall within the period of significance and are rare, surviving examples of a type of design or construction, of innovative engineering design that impacted subsequent designs, or were specifically designed to meet an unusual engineering challenge. Like laterals and sub-laterals, drains are considered as ineligible components of the CVP.[18]

Registration Requirements

The period of significance for historic water conveyance structures begins in 1937 with the initial construction of the first CVP canal, the Contra Costa Canal, and ends in 1952 with the completion of the Friant-Kern, Delta-Mendota, and Delta Cross Channel canals. Like the dams, these canals are part of the initial CVP authorizations.[19]

Water conveyance structures with adequate integrity are considered eligible as part of the multiple property listing for the National Register for the following reasons:

Criterion A: They have had a significant impact on the settlement, agricultural economy, or development patterns of the project area; they have been defining elements in the evolution of the cultural landscape; they are directly associated with important events.

Criterion B: They are the result of the direct efforts of a prominent individual associated with the CVP and are the most prominent feature associated with that individual.

Criterion C: They represent the distinctive characteristics of Reclamation canal design and/or methods of construction used on the CVP; they involved challenging engineering design problems due to topography, grade, length, natural obstacles, and resulted in complex or innovative solutions; they are among the best or a rare surviving example of a distinctive type of water conveyance structure; they represent the evolving technology in design of water conveyance structures; they were identified during the construction period as an individually significant feature; or they embody the work of a significant engineer or builder.

[15] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 126-127.
[16] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 127.
[17] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 127.
[18] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 128.
[19] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 129.

Criterion D: They have the ability to yield information important to understanding the history of the CVP. None of the CVP water conveyance structures are eligible under this criterion.[20]

Evaluation

The following evaluates Drain U-121.2 in its entirety for individual eligibility for listing in the NRHP and CRHR under the themes and within the framework presented above.

Criteria A and 1

Drain U-121.2, which encompasses the entire length of the drainage canal, does not have direct associations with significant historic events, trends, or patterns of development at the local, state, or national level, and thus is not eligible for listing under NRHP Criterion A or CRHR Criterion 1. The drainage canal recorded on this form was built around the same time as the Delta-Mendota Canal as a minor irrigation drainage discharge structure. As a minor component of the CVP, this basic earth-lined wastewater conveyance lacks meaningful associations to the larger themes and points of significance discussed above. The drain is likewise not significant for its associations with the Firebaugh Canal Company, a subsidiary of Miller & Lux. The drain recorded on this form was constructed circa 1951, well after Miller & Lux and their agent entities began construction of the earliest irrigation works to provide water to the western San Joaquin Valley and therefore it is not associated with the pioneering period of irrigated agriculture in the region. The drain is a common mid-twentieth-century wastewater conveyance structure, a common addition to the region as it began to receive increasing quantities of imported CVP surface water, and as such is not eligible for listing in the NRHP or the CRHR under these criteria.

Criteria B and 2

The canal is not eligible for listing under NRHP Criterion B or CRHR Criterion 2 for meaningful associations with the lives of individuals important to history. Floyd E. Redfern may have played a prominent role in the regional agricultural economy, both as a productive farmer and as a financial organizer and governmental program booster, but he does not appear to have fundamentally changed the industry. On the whole, while his regional contributions to rice cultivation, farm finance, and efficient water use are notable, they do not elevate him to the status of historically significant under these criteria.

Criteria C and 3

Drain U-121.2 is not eligible for listing under NRHP Criterion C or CRHR Criterion 3 for design, method of construction, or representation of the work of a master engineer or builder. There is no indication that the canal applied anything other than standard methods in widespread use in the San Joaquin Valley in the twentieth century. Indeed, basic earthen canals date back thousands of years across a broad swath of global civilizations, and their construction has continued to follow the same general principles as demonstrated by the canal recorded on this form. Drain U-121.2 is a typical earthen canal, principally comprised of an excavated ditch flanked by compacted earthen banks, with culverts, a siphon, and a network of subsurface metal and plastic drainage pipes.

Drain U-121.2 does not represent the important work of a master engineer or builder. Lead project engineer for the larger San Luis Drain project—of which the Drain U-121.2 reroute was a small part—Edward J. Brannan joined Reclamation in 1937 as a transitman on the Columbia Basin Project before he was promoted to construction engineer on the Spokane Valley Project in Washington in 1965 and ultimately the San Luis Drain in the late 1960s and early 1970s. Brannan does not appear to have developed new designs but rather followed the standardized designs drafted earlier by Reclamation engineer Harry Raymond McBirney.[21] Additionally, Ball, Ball & Brosamer won two construction contracts for San Luis Drain, including the Drain U-121.2 reroute project. A prolific joint venture, Ball, Ball & Brosamer's status as master builders is somewhat debatable. Moreover, both firms appear to have specialized in heavy highway construction. While construction of Drain U-121. was a large undertaking for the companies, it does not best represent their body of work.

Criteria D and 4

[20] Excerpted from Bailey, draft CVP MPL (2009, updated 2018), 129.
[21] "Water Project Post is Filled," *Spokane Daily Chronicle* (February 16, 1965): 3.

Drain U-121.2 is not eligible under NRHP Criterion D or CRHR Criterion 4 for information potential because it was designed and built according to well-documented practices, and the project is well documented through drawings, textual records, and photographs.

Integrity

Drain U-121.2 along with its contributing structures retains integrity to its period of reconstruction, 1973. In terms of design and setting, the drain recorded on this form remains in its original location, the setting of which remains defined by flat rural farmland. In terms of design, materials, and workmanship, research did not reveal that any substantial modifications have been made to outside of the 1973 reroute. While some inlet drains appear to have been added at some unknown date, these additions are comparably minor and do not detract from the overall feeling of the drain. Drain U-121.2 continues to function as a drain and thus retains integrity of association. However, the drain recorded on this form lacks significance under all NRHP / CRHR Criteria and is therefore not eligible for listing in either register.

Photographs:



Photograph 3: Downstream view of Drain 121.2 inlet to drain undercrossing; camera facing west, July 20, 2022.



Photograph 4: Upstream view of Drain U-121.2 outlet to drain undercrossing, with Delta-Mendota Canal recorder house (background left); camera facing south, July 20, 2022.



Photograph 5: Upstream view of Drain U-121.2 discharge inlet (bottom left) and view of Delta-Mendota Canal recorder house (background center); camera facing south, July 20, 2022.



Photograph 6: Downstream view of Drain U-121.2 discharge point at Firebaugh Wasteway; camera facing southwest, July 20, 2022.



Photograph 7: Upstream view of Drain U-121.2 (right), San Luis Drain (left), and manhole tube (far left); camera facing southeast, July 20, 2022.



Photograph 8: Upstream view of Drain U-121.2 culvert undercrossing at Sierra Avenue; camera facing southeast, July 20, 2022.



Photograph 9: Downstream view of Drain U-121.2 subsurface inlet drainpipe with valve; camera facing northwest, July 20, 2022.



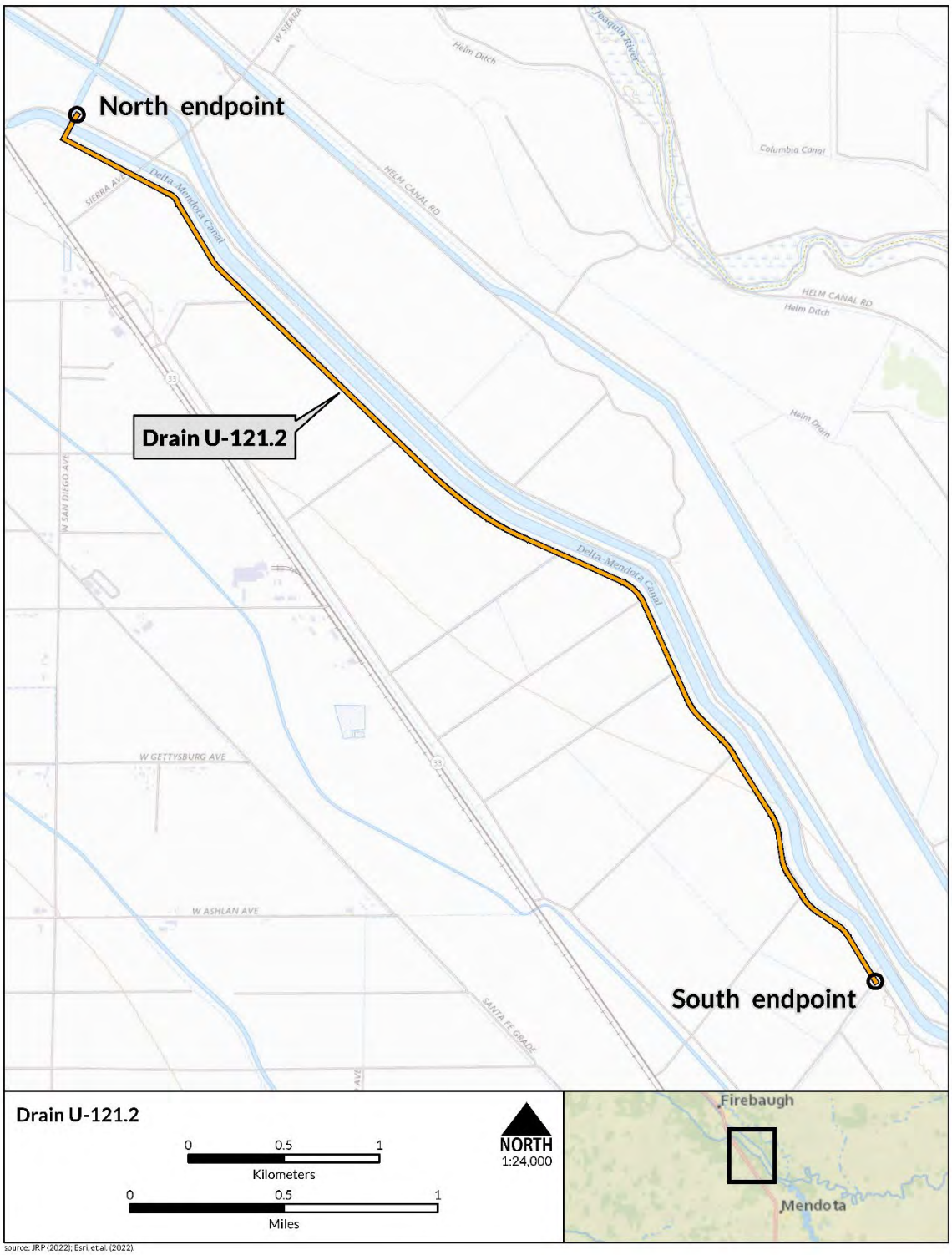
Photograph 10: Upstream view of Drain U-121.2 with extended subsurface inlet drain pipe; camera facing southeast, July 20, 2022.



Photograph 11: Downstream view of Drain U-121.2 corrugated metal and plastic subsurface inlet drainpipes; camera facing southwest, July 20, 2022.



Photograph 12: Downstream view of Drain U-121.2 modern pumping equipment; camera facing northwest, July 20, 2022.


North endpoint
Drain U-121.2
South endpoint
Delta-Mendota Canal
HELM CANAL RD
Helm Ditch
Columbia Canal
Helm Drain
W GETTYSBURG AVE
W ASHLAN AVE
SANTA FE GRADE
N SAN DIEGO AVE
SIERRA AVE
Drain U-121.2
0
0.5
1
Kilometers
0
0.5
1
Miles
NORTH
1:24,000
Firebaugh
Mendota
source: JRP (2022); Esri, et al. (2022).

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary # _____
HRI # _____
Trinomial _____
NRHP Status Code 6Z
Other Listings _____
Review Code _____ Reviewer _____ Date _____

***Resource Name or #** (Assigned by recorder) APN: 251-050-120

P1. Other Identifier: _____

***P2. Location:** ☐ **Not for Publication** ☒ **Unrestricted** ***a. County** San Joaquin
and (P2b and P2c or P2d. Attach a Location Map as necessary.)
***b. USGS 7.5' Quad** Tracy, California **Date** 1980 **T** T3S; **R** 4E; NE ¼ **of Sec** 1; M.D. **B.M.**
c. Address 27655 South Lammers Road City Tracy Zip 95377
d. UTM: (give more than one for large and/or linear resources) Zone _____; _____mE/ _____mN
e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate)
Assessor Parcel Number (APN) 251-050-120

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries)

The property at 27655 South Lammers Road lies on a 5.01-acre lot in Tracy, to the north of the Delta-Mendota Canal right of way. It comprises a main house, animal shelter, and prefabricated secondary home (**See Site Map**). The main house is a wood-framed 1,629 square-foot Ranch style single family residence (**Photograph 1**). Constructed in 1972 on a raised foundation with vents, this single-story house features a slightly irregular rectangle footprint. The wood shingle roof is side-gabled, with a wide eave overhang. The façade and north end of the house is of grooved plywood material, and the rest of the house is clad in stucco. There is a shallow recessed porch with brick veneer and supported by two unadorned square columns. The main entrance is an off-set wooden door with a centered glass panel. There is a wooden deck with lattice protruding on the east side of the residence. Fenestration includes a large metal-framed sliding window in the recessed porch, and smaller sliding windows in both directions. There is a two-car garage facing north, with a narrower prow roof line. Vertical board siding extends from the top of the garage doors to the roof line. (See Continuation Sheet.)

***P3b. Resource Attributes:** (List attributes and codes) HP2- Single Family Property

***P4. Resources Present:** ☒ Building ☐ Structure ☐ Object ☐ Site ☐ District ☐ Element of District ☐ Other (Isolates, etc.)

P5a. Photo or Drawing (Photo required for buildings, structures, and objects.)



P5b. Description of Photo: (View, date, accession #) **Photograph 1**: residence (right) and prefabricated building (left background), camera facing southwest, July 18, 2022.

***P6. Date Constructed/Age and Sources:**
☒ Historic ☐ Prehistoric ☐ Both
1972, San Joaquin County Assessor

***P7. Owner and Address:**
Peter A. and Beth M. Swanson
27655 South Lammers Road
Tracy, CA 95377

***P8. Recorded by:** (Name, affiliation, address)
Cheryl Brookshear and D. Baza
JRP Historical Consulting, LLC
2850 Spafford St.
Davis, CA 95618

***P9. Date Recorded:** July 18, 2022

***P10. Survey Type:** (Describe) Intensive

***P11. Report Citation:** (Cite survey report and other sources, or enter "none.") JRP Historical Consulting, LLC, "Finding of Eligibility Delta-Mendota Canal Subsidence Correction Project," 2022, prepared for US Bureau of Reclamation and San Luis & Delta-Mendota Water Authority.

***Attachments:** ☐ None ☐ Location Map ☐ Sketch Map ☒ Continuation Sheet ☒ Building, Structure, and Object Record ☐ Archaeological Record ☐ District Record ☐ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐ Other (list) _____

***NRHP Status Code** 6Z

***Resource Name or #** (Assigned by recorder) [underline TR11]

B1. Historic Name: _____
B2. Common Name: _____
B3. Original Use: Residence B4. Present Use: Residence
***B5. Architectural Style:** Ranch
***B6. Construction History:** (Construction date, alteration, and date of alterations) Residence constructed 1972, animal shelter added 1972-1987; secondary residence added 1987-1993 and replaced 1993-2004

***B7. Moved?** ☒ **No** ☐ **Yes** ☐ **Unknown** **Date:** _____ **Original Location:** _____
***B8. Related Features:** _____

B9. Architect: Unknown b. Builder: Unknown
***B10. Significance: Theme** n/a **Area** n/a
Period of Significance n/a **Property Type** n/a **Applicable Criteria** n/a
(Discuss importance in terms of historical or architectural context as defined by theme, period, and geographic scope. Also address integrity.)

The residence and outbuildings at 27655 South Lammers Road do not meet the criteria for listing in the National Register of Historic Places (NRHP) or the California Register of Historical Resources (CRHR), nor do they appear to be a historical resource for the purposes of California Environmental Quality Act (CEQA). These buildings have been evaluated in accordance with Section 106 of the National Historic Preservation Act of 1966 as amended and Section 15064.5(a)(2)-(3) of the CEQA Guidelines, using the criteria outlined in Section 5024.1 of the California Public Resources Code.

Historic Context

This property is located southwest of Tracy, on the dryer west side of the San Joaquin Valley, south of the fertile Sacramento-San Joaquin Delta lands. This area developed small scale agriculture later than other portions of the county and this property was not constructed until the second half of the twentieth century. (See Continuation Sheet.)

B11. Additional Resource Attributes: (List attributes and codes) _____

***B12. References:** Thompson and West, *History of San Joaquin County California with Illustrations*, Berkeley, California: Howell-North Books. 1968 reprint; Tinkham, George H. *History of San Joaquin County.* Los Angeles: Historic Record Company, 1923. Jelinek, Lawrence. *Harvest Empire: A History of California Agriculture.* San Francisco, CA: Boyd & Fraser, 1979. *Tracy Press* (See also footnotes.)

B13. Remarks:

***B14. Evaluator:** Cheryl Brookshear

***Date of Evaluation:** July 2022

(This space reserved for official comments.)

(Sketch Map with north arrow required.)



P3a. Description (continued):

The animal shelter on the property is an enclosed structure of one central square, and two roofs extending from the north and east sides (**Photograph 2).** All roofs are of corrugated metal with exposed eaves and projecting rafter tails. The main portion is wood framed with vertical wood siding. There are two doors on the west side. Off to the north, the structure features a long shed roof on two-by-two wood supports. Here there are open rafters and diagonal bracing between the posts and roof. The western side has a shorter roof and two bays, situated on two-by-one supports. There is a four-by-four enclosure composed of salvage such as a left-over utility pole and miscellaneous posts. Salvage is also used for fencing to create corrals.

South of the main house is a double-wide one-story side-gabled prefabricated home on a raised foundation with vents. The roof is composition shingle, and the walls are covered in grooved plywood. A prominent metal chimney extends from the northeastern side of the roof. There are deep overhangs on the gabled ends, but no overhang on the sides. The door is centered, with its own wooden stoop. It appears that there was previously an overhang above the door, for the gutters stop on either side. Fenestration is asymmetrical; the sliding windows are irregularly placed anodized aluminum. They include a flat trim and decorative panels below each window **(Photograph 3).**

In the southwestern corner of the property, there is a prefabricated end-gabled shed.

B10. Significance (continued):

The land southwest of Tracy was considered of little value through the 1850s as miners traveled through the area to and from the mines to cities around the San Francisco Bay. As the area is in the rain shadow of the Coast Range, dry farming of grain began in the area slightly later than other areas of the valley with grain cultivation starting around 1867. Wheat production through the county grew through the 1850s and 1860s and became a major economic force in the 1870s with most processing occurring in Stockton. While other areas of the county diversified with alfalfa, fruits, vines and orchards, the western portion of the valley remained dominated by grains and cattle grazing.[1]

Arrival of the Central Pacific Railroad in the area in 1869 stabilized settlement in the western part of the San Joaquin County. The railroad initially established Ellis as a coaling station on the route across the Altamont Pass, and in 1878 the Central Pacific Railroad created a second route connecting the San Joaquin line with West Oakland and Martinez. The two routes crossed east of Ellis, and the new location was named Tracy. The community became a railroad hub with additional lines meeting at the junction.[2]

Increased diversification of crops developed in the early twentieth century with irrigation. For the last half of the nineteenth century, hopes for irrigating the western side of the San Joaquin valley rested upon construction of canals from Tulare Lake. While companies were formed, no one succeeded in developing such a project. Instead, in 1910 the Patterson Ranch Company, attempting to profit from extensive land holdings, created the Patterson Water Company to operate an irrigation system on the west side of the San Joaquin Valley. Unlike the east side irrigation districts which were gravitationally fed districts, Patterson developed a pumped system that became a model for the west side of the valley. The area surrounding Tracy formed into the West Side Irrigation District in 1915. Irrigation led to diversified crops with additional fruits and

[1] Thompson and West, *History of San Joaquin County California with Illustrations* (Berkeley, California: Howell-North Books. 1968 reprint) 128-131; George H. Tinkham, *History of San Joaquin County* (Los Angeles: Historic Record Company, 1923) 105-106, 117-118, 120.

[2] Thompson and West, *History of San Joaquin County California*, 130; Raymond W. Hillman and Leonard A. Covello, *Cities & Towns of San Joaquin County Since 1847* (Fresno, CA: Panorama West Books, 1985); "The Important Cities of San Joaquin County," *The Lodi Sentinel*, Sept. 25, 1913; Ralph Lee and Christi Kennedy, "Tracy traces its roots back to railroad company," *Lodi News-Sentinel*, May 20, 2005; *Tracy Diamond Jubilee: 1878 to 1953* (Tracy, CA: Tracy Diamond Jubilee, Inc., 1953); Tracy Historical Society, *Images of America: Tracy* (San Francisco: Arcadia Publishing, 2004); *Tracy Press Centennial Edition*, Sept. 6, 1978.

vegetables. Three crops became dominant: alfalfa cultivation and ensuing dairy operations, sugar beet production, and beans.[3]

The area southwest of Tracy started changing after World War II. Until that time, the area was dominated by field-crops. The war expanded the agricultural economy throughout the state, and during the latter half of the twentieth century various shifts occurred that placed development pressures on farmland near urban areas across California. Agricultural pressures were both internal to the industry and external. Relocation of agricultural production from southern California and the coastal valleys increased farmland values in the San Joaquin Valley. Farming also became more industrialized in the latter half of the twentieth century. In general, this resulted in increasing farm sizes not only in land ownership, but in operational units, which for some farms included leased land from multiple owners to reach efficiencies in size.[4]

Under these pressures two trends developed. The state legislature passed the California Land Conservation Act of 1965 (Williamson Act), which allowed landowners to reduce their property tax by committing to retain their land as open space. The increased size of agricultural operational units caused some owners to lease the farmland and separate it from existing farmsteads and other structures. These trends continued through the late twentieth century and continue today. Combined with the many legal permutations for transferring farm ownership and operation to the next generation, agricultural land was and continues to be, increasingly separated from the historically associated farmsteads.[5]

Land in the vicinity of the Delta-Mendota Canal southwest of Tracy did not begin to divide into smaller parcels until the mid-twentieth century. At that time, the area that includes the subject parcel was owned by Roy F. Tuso and his wife Margaret. The family had purchased a ranch along Lammers Road around 1954 and constructed a home at 27545 South Lammers Road north of the subject property. Roy and his brothers Charles and Sal owned multiple properties around Tracy that they operated together.[6] Margaret Tuso, the administrix of Roy Tuso's estate, split a portion of the former Tuso ranch forming the subject parcel in 1972, four years after his death. Mary Foster, a teacher in the Tracy public schools purchased it and had the house built. The Ranch style house had a construction cost of $22,675. Foster continued teaching, possibly leasing the agricultural land. She sold the house in 1986 and within the next two years it was sold three times in rapid succession until it was purchased by current owners Carolyn and Peter Swanson, and Herbert Swanson. While the animal pen had been constructed prior to their purchase they added a secondary residence to the south between 1987 and 1993. It was replaced by the current prefabricated home between 1993 and 2004.[7]

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[3] History (pattersonid.org) accessed July 2022; Harmon S. Bonte, *Division of Water Resources Bulletin 37 Financial and General Data Irrigation, Reclamation and Other Public Districts in California* (Sacramento: California Division of Water Resources, 1930) 104; Tinkham, *History of San Joaquin County*, 115-116; Works Progress Administration, "History of Stockton and San Joaquin County," Works Progress Administration, 1938, Tracy 3.

[4] Lawrence Jelinek, *Harvest Empire: A History of California Agriculture* (San Francisco, CA: Boyd & Fraser, 1979),89,94; Philip M. Raup, "Disaggregating Farmland Markets," *Government Policy and Farmland Markets: The Maintenance of Farmer Wealth* (Ames, Iowa: Iowa State Press, 2003) 19; John E. Reynolds and Warren Johnston, "Micro-markets for Farmland: The Case of Florida and California," *Government Policy and Farmland Markets: The Maintenance of Farmer Wealth* (Ames, Iowa: Iowa State Press, 2003) 367-390;

[5] Lawrence Jelinek, *Harvest Empire: A History of California Agriculture* (San Francisco, CA: Boyd & Fraser, 1979),89,94; California Department of Conservation, The Land Conservation Act, www.conservation.ca.gov/dlrp/lca/Pages/Index.aspx, accessed June, 2017; Philip M. Raup, "Disaggregating Farmland Markets," *Government Policy and Farmland Markets: The Maintenance of Farmer Wealth* (Ames, Iowa: Iowa State Press, 2003) 19; John E. Reynolds and Warren Johnston, "Micro-markets for Farmland: The Case of Florida and California," *Government Policy and Farmland Markets: The Maintenance of Farmer Wealth* (Ames, Iowa: Iowa State Press, 2003) 367-390;

[6] "John Tuso First Tracy Baby of '59." *Tracy Press*, January 5, 1959, 1; "Roy Tuso," *Stockton Evening and Sunday Record*, March 26, 1968; "Funeral Service for Roy F. Tuso Set for Friday," *Tracy Press*, March 27, 1968; San Joaquin County Recorder, Deed Margaret Tuso and Estate of Roy Francis Tuso to Mary L. Foster, Book 3618, 215, February 9, 1972; San Joaquin County Assessor, Parcel Record for 251-050-240, accessed via parcelquest.com July 2022.

[7] R.L. Polk & Co., *Polk's Tracy City Directory* (Monterey Park, California: R.L. Polk & Co., 1972) 52; San Joaquin County Recorder, Deed Margaret Tuso and Roy Tuso estate to Mary Foster, Book 3618, 215, February 9, 1972; "Permits Issued for Two Homes in Rural Area," *Tracy Press*, March 8, 1972, 15; San Joaquin County Recorder, Deed Mary Foster to James D and Clare Atkins, Document

Evaluation

This property was developed during the post war reorganization of agriculture into a more industrial and corporate model and large lot residential construction began to meld urban and rural development (NRHP Criterion A / CRHR Criterion 1). The residence and associated acreage do not fit well within either trend. Mary Foster's use of the land is not documented. This parcel is larger than most used for rural residential development, but it is not large enough to represent industrial and corporate agriculture. Nor does her development of the property represent any other noted trend of the period.

This property does not have an association with the life of an individual important to history (NRHP Criterion B / CRHR Criterion 2). It does not appear that any specific person associated with this property made demonstrably important contributions to history at the local, state, or national level. This residence and associated buildings were constructed after the Tuso family began to pool their lands to create a more corporate farming system, and the buildings are not associated with the family. Mary Foster was a schoolteacher, and the residence and agricultural land does not represent her productive life. Later occupants have used the property for small scale agriculture and research did not reveal any significant activities.

Under NRHP Criterion C / CRHR Criterion 3 this property is not significant as an important example of a type, period, or method of construction. The main residence has a low long plan typical of the Ranch style developed in the 1930s and 1940s which tried to adopt the affect of early western residences. The houses typically had a long low profile including long porches and mixed materials. The Ranch style became popular in the 1950s and 1960s. By the 1970s new influences were introduced. This example shows the increasing influence of Contemporary style with a more minimalistic façade and the pointed ship-like prow projection of the roof ridge. The residence does not appear to include new materials such as glue laminated beams that came to define the Contemporary style. While a transitional example, this residence does not embody significant innovations to either style. The animal shelter is utilitarian and is a common example of the type of building. The prefabricated secondary residence is a newer addition but shows wear. This example is a double-wide mobile home type developed during the 1970s and has become common place in rural and isolated areas. Easily relocated based upon need, and inexpensive they are frequently largely utilitarian with little stylistic elements. The inclusion of faux panels below the windows does not represent any specific architectural style and does not elevate this building to a level of aesthetic interest. As such, these buildings are not important architectural examples and do not meet these significance criteria.

Under NRHP Criterion D / CRHR Criterion 4, this property is not a significant or likely source of important historical information. The ranch residence, animal shelter, and prefabricated residence on this parcel do not appear to have any likelihood of yielding important information about historic construction materials or technologies. Also, the property's land use and the layout of the extant built environment resources, and the relationship the building with the surrounding parcels is typical of the period and does not provide important information within the broader economic, social, and cultural setting of the area since its construction in 1972. This evaluation does not address non-built environment resources or pre-historic resources.

Visual inspection of the residences does not indicate any significant modifications to the buildings. The animal shelter appears to have been partially accretive, but lacks any indications of particular building campaigns. The property retains integrity of location, materials, design, workmanship, setting, feeling, and association. The expansion of Tracy and the construction, currently in progress, of a new housing development to the east will result in a decline to the integrity of the setting. Despite general integrity, the property does not meet any of the criteria necessary for eligibility for listing in either the NRHP or CRHR.

86037339, May 27, 1986; San Joaquin County Recorder, Deed James D and Clare Atkins to Elizabeth C Fee, Document 87115448, December 23, 1987; San Joaquin County Recorder, Deed Elizabeth C Fee to Carolyn S, Herbert T and Peter A Swanson, Document 87115449, December 23, 1987; USGS, Aerial Photographs San Joaquin County Flight NAPP 515-59, June 29, 1987, Earth Explorer Accessed July 2022; Google, Google Earth Historic imagery 1993 and 2004, accessed July 2022.

Photographs (continued):



Photograph 2. Animal shelter north of residence, camera facing northwest, July 18, 2022.



Photograph 3. Prefabricated secondary residence (center) and prefabricated shed (left) camera facing northwest, July 18, 2022.

Site Map:


APN: 251-050-120
Animal Shelter
Residence
Prefab
Secondary
Residence
S Lammers Rd
Delta-Mendota Canal
NORTH
0
50
Feet

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary # _____
HRI # _____
Trinomial _____
NRHP Status Code 6Z
Other Listings _____
Review Code _____ Reviewer _____ Date _____

***Resource Name or #** (Assigned by recorder) APN: 240-140-260

P1. Other Identifier: _____

***P2. Location:** ☐ **Not for Publication** ☒ **Unrestricted** ***a. County** San Joaquin
and (P2b and P2c or P2d. Attach a Location Map as necessary.)
***b. USGS 7.5' Quad** Tracy, California **Date** 1980 **T** 3S; **R** 5E; SW ¼ **of Sec** 6; M.D. **B.M.**
c. Address 4500 South Lammers Road City Tracy Zip 95377
d. UTM: (give more than one for large and/or linear resources) Zone _____; _____mE/ _____mN
e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate)
Assessor Parcel Number (APN) 240-140-260

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries)

The property at 4500 South Lammers Road sits on a one-acre lot just outside Tracy on the south side of the Delta-Mendota Canal right of way. The property contains a 2,335 square-foot residence, and a 1,500 square-foot out building. The main house is a wood-framed single-family residence that has a generally rectangular footprint with a square addition off the northeast corner (**Photograph 1**). Constructed in 1956 on a concrete slab, this single-story house has a composition shingle complex hip roof that sits atop the stucco and brick veneer walls. The residence has an off-center entry projection north of the attached two bay garage. The projection is clad in brick veneer. Large, anodized metal or vinyl sliding windows are on the façade. A large textured window is on the north side of the entrance projection. The square rear addition has smaller sliding windows with little or no trim. The roof has deep eaves with a narrow fascia trim. Solar panels are a recent addition on the roof. A large brick chimney projects from the east slope of the roof. (See Continuation Sheet.)

***P3b. Resource Attributes:** (List attributes and codes) HP2- Single Family Property
***P4. Resources Present:** ☒ Building ☐ Structure ☐ Object ☐ Site ☐ District ☐ Element of District ☐ Other (Isolates, etc.)

P5a. Photo or Drawing (Photo required for buildings, structures, and objects.)



P5b. Description of Photo: (View, date, accession #) **Photograph 1.** Residence camera facing southeast, July 18, 2022

***P6. Date Constructed/Age and Sources:**
☒ Historic ☐ Prehistoric ☐ Both
1956, San Joaquin County Assessor

***P7. Owner and Address:**
Joseph Cardenas et al
4500 South Lammers Road
Tracy, CA 95377

***P8. Recorded by:** (Name, affiliation, address)
Cheryl Brookshear and D. Baza
JRP Historical Consulting, LLC
2850 Spafford St.
Davis, CA 95618

***P9. Date Recorded:** July 18, 2022

***P10. Survey Type:** (Describe) Intensive

***P11. Report Citation:** (Cite survey report and other sources, or enter "none.") JRP Historical Consulting, LLC, "Finding of Eligibility Delta-Mendota Canal Subsidence Correction Project," 2022, prepared for US Bureau of Reclamation and San Luis & Delta-Mendota Water Authority.

***Attachments:** ☐ None ☐ Location Map ☐ Sketch Map ☒ Continuation Sheet ☒ Building, Structure, and Object Record ☐ Archaeological Record ☐ District Record ☐ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐ Other (list) _____

B1. Historic Name: _____
B2. Common Name: _____
B3. Original Use: Residence B4. Present Use: Residence
***B5. Architectural Style:** Minimal Traditional/ Ranch
***B6. Construction History:** (Construction date, alteration, and date of alterations) Residence constructed 1956; updated 1967, divided from surrounding agricultural land 1997; solar panels added 2020; secondary rear building added 1993-2003

***B7. Moved?** ☒ **No** ☐ **Yes** ☐ **Unknown Date:** _____ **Original Location:** _____
***B8. Related Features:** _____

B9. Architect: Unknown b. Builder: Perry Associates, Builders of Homes, Inc.
***B10. Significance: Theme** n/a **Area** n/a
Period of Significance n/a **Property Type** n/a **Applicable Criteria** n/a
(Discuss importance in terms of historical or architectural context as defined by theme, period, and geographic scope. Also address integrity.)

The residence and outbuilding at 4500 South Lammers Road do not meet the criteria for listing in the National Register of Historic Places (NRHP) or the California Register of Historical Resources (CRHR), nor do they appear to be historical resources for the purposes of California Environmental Quality Act (CEQA). These buildings have been evaluated in accordance with Section 106 of the National Historic Preservation Act of 1966 as amended and Section 15064.5(a)(2)-(3) of the CEQA Guidelines, using the criteria outlined in Section 5024.1 of the California Public Resources Code.

Historic Context

This property is located southwest of Tracy, on the dryer west side of the San Joaquin Valley, south of the fertile Sacramento-San Joaquin Delta lands. This area developed small scale agriculture later than other portions of the county and this property was not constructed until the second half of the twentieth century. (See Continuation Sheet.)

B11. Additional Resource Attributes: (List attributes and codes) _____

***B12. References:** Thompson and West, *History of San Joaquin County California with Illustrations*, Berkeley, California: Howell-North Books. 1968 reprint; Tinkham, George H. *History of San Joaquin County*. Los Angeles: Historic Record Company, 1923. Jelinek, Lawrence. *Harvest Empire: A History of California Agriculture*. San Francisco, CA: Boyd & Fraser, 1979. *Tracy Press* (See also footnotes.)

B13. Remarks:

***B14. Evaluator:** Cheryl Brookshear

***Date of Evaluation:** July 2022

(This space reserved for official comments.)

(Sketch Map with north arrow required.)



P3a. Description (continued):

A large secondary building sits behind the residence mostly obscured by vegetation and the main house (**Photograph 2).** The nearly square building has a side gable roof and is clad in stucco. The western façade is recessed under the roof creating a full-length porch supported on simple, square, wood posts. A pair of French doors on the west façade were the only other discernable features.

B10. Significance (continued):

The land southwest of Tracy was considered of little value through the 1850s as miners traveled through the area to and from the mines to cities around the San Francisco Bay. As the area is in the rain shadow of the Coast Range, dry farming of grain began in the area slightly later than other areas of the valley with grain cultivation starting around 1867. Wheat production through the county grew through the 1850s and 1860s and became a major economic force in the 1870s with most processing occurring in Stockton. While other areas of the county diversified with alfalfa, fruits, vines and orchards, the western portion of the valley remained dominated by grains and cattle grazing.[1]

Arrival of the Central Pacific Railroad (CPRR) in the area in 1869 stabilized settlement in the western part of the San Joaquin County. The railroad initially established Ellis as a coaling station on the route across the Altamont Pass, and in 1878 the CPRR created a second route connecting the San Joaquin line with West Oakland and Martinez. The two routes crossed east of Ellis, and the new location was named Tracy. The community became a railroad hub with additional lines meeting at the junction. When the Western Pacific Railroad (WPRR) sought to challenge CPRR in the early twentieth century it ran tracks largely parallel to the earlier Central Pacific route through the pass. But since Tracy was formed and controlled by CPRR and its successor Southern Pacific Railroad, the WPRR tracks passed south of the city with its own junction at Carbona by 1909.[2]

Increased diversification of crops developed in the early twentieth century with irrigation. For the last half of the nineteenth century, hopes for irrigating the western side of the San Joaquin valley rested upon construction of canals from Tulare Lake. While companies were formed, no one succeeded in developing such a project. Instead, in 1910 the Patterson Ranch Company, attempting to profit from extensive land holdings, created the Patterson Water Company to operate an irrigation system on the west side of the San Joaquin Valley. Unlike the east side irrigation districts which were gravitationally fed districts, Patterson developed a pumped system that became a model for the west side of the valley. The area surrounding Tracy formed into the West Side Irrigation District in 1915. Irrigation led to diversified crops with additional fruits and vegetables. Three crops became dominant: alfalfa cultivation and ensuing dairy operations, sugar beet production, and beans.[3]

The area southwest of Tracy started changing after World War II. Until that time, the area was dominated by field-crops. The war expanded the agricultural economy throughout the state, and during the latter half of the twentieth century various shifts occurred that placed development pressures on farmland near urban areas across California. Agricultural pressures

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[1] Thompson and West, *History of San Joaquin County California with Illustrations* (Berkeley, California: Howell-North Books. 1968 reprint) 128-131; George H. Tinkham, *History of San Joaquin County* (Los Angeles: Historic Record Company, 1923) 105-106, 117-118, 120.

[2] Thompson and West, *History of San Joaquin County California,* 130; Raymond W. Hillman and Leonard A. Covello, *Cities & Towns of San Joaquin County Since 1847* (Fresno, CA: Panorama West Books, 1985); "The Important Cities of San Joaquin County," *The Lodi Sentinel*, Sept. 25, 1913; Ralph Lee and Christi Kennedy, "Tracy traces its roots back to railroad company," *Lodi News-Sentinel*, May 20, 2005; *Tracy Diamond Jubilee: 1878 to 1953* (Tracy, CA: Tracy Diamond Jubilee, Inc., 1953); Tracy Historical Society, *Images of America: Tracy* (San Francisco: Arcadia Publishing, 2004); *Tracy Press Centennial Edition*, Sept. 6, 1978; Arthur L. Lloyd, "Western Pacific Railroad: A Railroader's History," *Classic Trains*, August 2021, Western Pacific Railroad: A railroader's history - Trains; USGS, *Tracy, California Topographic Map* (Washington, D.C.: USGS, 1916).

[3] History (pattersonid.org) accessed July 2022; Harmon S. Bonte, *Division of Water Resources Bulletin 37 Financial and General Data Irrigation, Reclamation and Other Public Districts in California* (Sacramento: California Division of Water Resources, 1930) 104; Tinkham, *History of San Joaquin County*, 115-116; Works Progress Administration, "History of Stockton and San Joaquin County," Works Progress Administration, 1938, Tracy 3.

were both internal to the industry and external. Relocation of agricultural production from southern California and the coastal valleys increased farmland values in the San Joaquin Valley. In the latter half of the twentieth century farming also became more industrialized. In general, this resulted in increasing farm sizes not only in land ownership, but in operational units, which for some farms included leased land from multiple owners to reach efficiencies in size.[4]

Under these pressures two trends developed. The state legislature passed the California Land Conservation Act of 1965 (Williamson Act), which allowed landowners to reduce their property tax by committing to retain their land as open space. The increased size of agricultural operational units caused some owners to lease the farmland and separate it from existing farmsteads and other structures. These trends continued through the late twentieth century and continue today. Combined with the many legal permutations for transferring farm ownership and operation to the next generation, agricultural land was and continues to be increasingly separated from the historically associated farmsteads.[5]

The property in the vicinity of the Delta-Mendota Canal southwest of Tracy did not begin to divide into smaller parcels until the mid-twentieth century. Charles and Josephine Spatafore purchased 22 acres (from which the subject parcel would later be separated) between the WPRR tracks, the Delta-Mendota Canal, and Lammers Road in 1956. The property was for their son Charles Jr. who had just married Margaret McDaniel. The elder Spatafores were apricot farmers on the east side of Tracy along Chrisman Road. Charles Jr. and his wife took up apricot farming on the new land. The elder Spatafores had the home built at 4500 South Lammers Road for the couple by Perry Associates Builders that same year. The house was a simple rectangular building with the slight projecting entryway near the south end. While Charles developed the farm, Margaret was active promoting apricots, literacy, and community social events. In 1960, the younger Spatafores were able to purchase their land from the elder couple. By 1967 the ranch was productive and participated in a field test for mechanical apricot harvesting equipment developed by the University of California, Davis. The financial success resulted in a renovation of the home including the construction of the two garage bays on the south end and the square addition off the northeast corner. As farming continued to industrialize in the San Joaquin Valley, Spatafore joined with his parents and other farmers to create Bella Vista Farms as a joint business venture. The couple also created a pick your own farm, farmstand, bakery, and fishing pond along Patterson Pass Road. As they matured Charles Jr. went on to serve on several water and irrigation district boards. In their later years the couple changed their agricultural pursuits. In 1997, they sold the residence recorded on this form and a single acre to Ronald and Margaret Wiley who are the likely builders of the second building. The residence at 4500 South Lammers Road has sold two additional times and serves as a large parcel rural residence and is no longer associated with the Spatafore family, nor is it associated with agriculture.[6]

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[4] Lawrence Jelinek, *Harvest Empire: A History of California Agriculture* (San Francisco, CA: Boyd & Fraser, 1979),89,94; Philip M. Raup, "Disaggregating Farmland Markets," *Government Policy and Farmland Markets: The Maintenance of Farmer Wealth* (Ames, Iowa: Iowa State Press, 2003) 19; John E. Reynolds and Warren Johnston, "Micro-markets for Farmland: The Case of Florida and California," *Government Policy and Farmland Markets: The Maintenance of Farmer Wealth* (Ames, Iowa: Iowa State Press, 2003) 367-390;

[5] Lawrence Jelinek, *Harvest Empire: A History of California Agriculture* (San Francisco, CA: Boyd & Fraser, 1979),89,94; California Department of Conservation, The Land Conservation Act, www.conservation.ca.gov/dlrp/lca/Pages/Index.aspx, accessed June, 2017; Philip M. Raup, "Disaggregating Farmland Markets," *Government Policy and Farmland Markets: The Maintenance of Farmer Wealth* (Ames, Iowa: Iowa State Press, 2003) 19; John E. Reynolds and Warren Johnston, "Micro-markets for Farmland: The Case of Florida and California," *Government Policy and Farmland Markets: The Maintenance of Farmer Wealth* (Ames, Iowa: Iowa State Press, 2003) 367-390;

[6] San Joaquin County Recorder, Deed Salvatore and Anna Magnasco to Charles and Josephine Spatafore, Book 1841, 391, February 26, 1956; "Margaret McDaniel Becomes Bride of Charles Spatafore," *Stockton Evening Record*, June 20, 1956, 25; San Joaquin County Recorder, Notice of Completion, Book 1906, 247, September 24, 1956; "Mrs. Charles Spatafore Offers Recipes for Elegant 'Do-Ahead' Buffet Dinner," *Tracy Press*, May 27, 1964, 10; "Jo and Marge Spatafore Share Apricot Recipes," *Tracy Press*, July 6, 1966, 12; San Joaquin County Recorder, Deed Charles and Josephine Spatafore to Charles Jr. and Margaret Spatafore, Book 2266, 491, January 21, 1960; "Machine Harvest of Apricots Tested in Central California," *Stockton Evening Record*, July 22, 1967, 21; "Legal Notice," *Tracy Press*, October 18, 1967, 16; "Apricot Growers' Wives Form Auxiliary," *Tracy Press*, June 7, 1972, 13; "Public Notice," *Tracy Press*, June 4, 1976, 21; San Joaquin County Recorder, Deed Charles Jr. and Margaret Spatafore to Ronald and Margaret Wiley, Document 9705747, May 23, 1997; San Joaquin County Assessor, Assessor Parcel Data Parcel 240-140-270, obtained via ParcelQuest, July 2022; "Obituary Charles Spatafore Jr." *The Record*, November 27, 2008; Cartwright and Company, San Joaquin County Aerial Photography,

Evaluation

Under NRHP Criterion A or CRHR Criterion 1, this property does not have significant associations with important historic events or trends. The residence was constructed as part of a family farm. Although the house's residents appear to have shared some aspects of farm management, the property does not appear to contribute to the trend of industrialization and corporation of agriculture. This property does not illustrate the growing industrialization and corporation of California agriculture in the latter half of the twentieth century. The residence was separated from the associated agricultural land in 1997, which is late in the development of large parcel residential properties in the state. The property did not form a model for this type of growth or initiate growth in the rural area around Tracy.

This property does not have an association with the life of an individual important to history (NRHP Criterion B / CRHR Criterion 2). It does not appear that any specific person associated with this property made demonstrably important contributions to history at the local, state, or national level. Charles Spatafore Jr. and his wife were successful agriculturists and businesspeople active in their community. While active their varied pursuits, those accomplishments did not result in or affect significant trends or developments within the community. Later occupants have used the property as a residence and research did not reveal any significant activities.

Under NRHP Criterion C / CRHR Criterion 3 this property is not significant as an important example of a type, period, or method of construction. Based upon floor plan and the general simplicity of the north end (oldest portion) of the house it was likely constructed as a Minimal Traditional residence. The Minimal Traditional style was an attempt to modernize architecture, leaving behind all the stylistic embellishments of the past beginning in the 1930s. Simple clean lines were used with minimal trim and no ornament. The style reached the height of popularity immediately after World War II, by the later 1950s and 1960s the style was replaced with the Ranch style which had developed around the same time as Minimal Traditional. The style attempted to evoke the ranches of mid-nineteenth century western settlement. The long low profile expressed the expanse of the outdoors, and a mix of materials the accretive nature of early development. They often had long porches and deep roofs. Elements of this transition are commonly found in homes of this period. The Minimal Traditional them offered compact, economical floor plans, and the Ranch a bit of stylistic flair. This residence with very plain northern and southern ends and a more elaborate entry is typical. The entry with the brick veneer attempts to evoke a more Ranch like theme. Extending the garage to the south also enhanced the Ranch like appearance. The Minimal Traditional lines are still visible, and the projecting entry rather than a recessed or porch covered entry prevent a full transition to the later style. This example is common and typical to both urban and rural areas throughout California. Perry Associates was not a significant builder of the period, and the residence is not the work of a master or has high artistic merit.

Under NRHP Criterion D / CRHR Criterion 4, this property is not a significant or likely source of important historical information. The residence and secondary building on this parcel do not appear to have any likelihood of yielding important information about historic construction materials or technologies. Also, the property's land use and the layout of the extant built environment resources, and the relationship the buildings have with the surrounding parcels is typical of the period and does not provide important information within the broader economic, social, and cultural setting of the area since its construction in 1956. This evaluation does not address non-built environment resources or pre-historic resources.

The main residence was significantly altered in 1967 adding the two-bay garage and northeastern addition. The façade windows appear to be double glazed replacements likely during the construction of the secondary residence between 1997-2003. The property's integrity of design, materials, workmanship, setting, feeling, and association to the date of original construction, 1956, is thus diminished. The property has more integrity to the 1967 renovation retaining design and most materials and workmanship. The separation of the property from the associated agricultural land however affects the feeling and association of the property. Rapid development of Tracy resulting in construction of a housing development directly north of the residence is beginning to affect the property's integrity of the setting.

Flight ABD-1957, frame 39T-42, July 15, 1957, for USDA, accessed UC Santa Barbara Frame Finder, July 2022; San Joaquin County Recorder, Deed Ronald and Margaret Wiley to Samantha and Alexander O'Connor, Document 2020069346, June 12, 2020; San Joaquin County Recorder, Deed Alexander O'Connor to Joseph Cardenas et al, Document 2021208477, December 14, 2021; Google Earth Historic Imagery, accessed July 2022.

Photographs (continued):



Photograph 2. Second building behind the main residence, camera facing southeast, July 18, 2022.

Appendix C: Tables

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Misc	0.09	4+69.4	Non-Contributing	No Adverse Effect	No Adverse Effect
O&M Road, Left Bank	0.19-116.61		Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	0.19-0.85		Contributing	No Adverse Effect	No Adverse Effect
O&M Road, Right Bank	0.19-116.61		Contributing	No Adverse Effect	No Adverse Effect
Bridge	0.33	17+32	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	0.38	19+95	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	0.38	19+95	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	0.74	19+95	Non-Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	0.87-2.52		Contributing	No Adverse Effect	No Adverse Effect
Drainlet	0.95	50+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	1.05		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	1.33	70.20	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	1.36	72+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Siphon	1.36-3.50	72+37	Contributing	No Adverse Effect	No Adverse Effect
Sign	1.41	74+32	Contributing	No Adverse Effect	No Adverse Effect
Drainlet	1.44	75+67	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	1.63	86+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	1.89	100+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	1.94	102+81	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	1.95	103+37	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	1.96	103+93	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	1.97	104.49	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	1.99	105+61	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Shoulder Drain	2.07	110+09	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	2.08	110+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	2.37	125+20	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	2.47	130+14	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	2.53	133+75	Contributing	No Adverse Effect	No Adverse Effect
Culvert	2.68		Non-Contributing	No Adverse Effect	No Adverse Effect
Misc	3.12	164+64	Contributing	No Adverse Effect	No Adverse Effect
Culvert	3.33		Non-Contributing	No Adverse Effect	No Adverse Effect
Building	3.49	184+01	Contributing	No Adverse Effect	No Adverse Effect
Inlet	3.50		Non-Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	3.50-13.66		Contributing	Adverse Effect	Adverse Effect
Pipe	3.53		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	3.53		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	3.53		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	3.54-4		Non-Contributing	No Adverse Effect	No Adverse Effect
Building	3.65	193+34	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	3.78	199+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	3.96	209+15	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	3.96	209+11	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	4.16	218+02	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	4.17	218+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	4.22		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	4.29	225+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Siphon	4.41-4.63	231+80	Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Shoulder Drain	4.76	250+20	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	4.77	250+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	4.97	260+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	4.98	261+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	4.99	261+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	5.15	270+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	5.30	278+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	5.45		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	5.67	297+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	5.77		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	6.01	316+10	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	6.01	315+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	6.27		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	6.36	334+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	6.59	346+72	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	6.60	347+42	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	6.60	347+07	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	6.74	354.90	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	6.75	355+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	6.95	366+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	7.00		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	7.10		Non-Contributing	No Adverse Effect	No Adverse Effect
Building	7.23		Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	7.25	381+50	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Shoulder Drain	7.29	383+61	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	7.50	395+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	7.66	403+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	7.67	403+92	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	7.67	404+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	7.67		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	7.69	404+98	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	7.81		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	8.01	422+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	8.21	433+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	8.37	441+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	8.49		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	8.51		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	8.52		Contributing	Adverse Effect	Adverse Effect
Turnout	8.71		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	8.80		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	8.91	469+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	8.92	470+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	9.04	476+34	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	9.07	477+95	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	9.26	487+42	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	9.27-9.29	487+94	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	9.27	487+94	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	9.29	489+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	9.29	489+40	Non-	No Adverse	No Adverse

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
			Contributing	Effect	Effect
Turnout	9.29		Contributing	No Adverse Effect	No Adverse Effect
Turnout	9.40		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	9.43	497+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	9.82		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	9.85		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	9.87	574+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	10.09		Contributing	Adverse Effect	Adverse Effect
Bridge	10.28	585+41	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	10.53		Contributing	Adverse Effect	Adverse Effect
Drainlet	10.55	610+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	10.61		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	10.62	613+29	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	10.78	622+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	10.86	626+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	10.87	626+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	11.04	635+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	11.28		Contributing	Adverse Effect	Adverse Effect
Stillwell	11.32	650+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	11.35	652+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 1	11.35	652+65	Contributing	Adverse Effect	Adverse Effect
Drainlet	11.38	635+95	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	11.41	655+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	11.45		Contributing	Adverse Effect	Adverse Effect
Shoulder Drain	11.49	659+40	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Siphon	11.49-11.51	659+72	Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	11.51	660+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	11.53	661+47	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	11.74	673+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	11.77	674+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	11.88	680+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	12.07		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	12.09	691+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	12.31	702+95	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	12.33	704+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	12.37		Contributing	Adverse Effect	Adverse Effect
Inlet	12.37	706+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	12.71		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	12.75	723+80	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	13.00		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	13.25		Contributing	No Adverse Effect	No Adverse Effect
Bridge	13.25	752+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	13.25	752+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	13.25	752+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	13.26		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	13.27		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	13.31		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	13.45	763+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	13.57		Contributing	Adverse Effect	Adverse Effect
Siphon	13.66-13.69	774+66	Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Shoulder Drain	13.69	775+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	13.70-20.62		Contributing	Adverse Effect	Adverse Effect
Shoulder Drain	13.96	789+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	13.96	790+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	13.97		Contributing	No Adverse Effect	No Adverse Effect
Turnout	14.12		Contributing	Adverse Effect	Adverse Effect
Drainlet	14.19	802+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	14.26		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	14.26		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	14.49		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	14.49		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	14.49		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	14.79	833+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	14.79		Contributing	Adverse Effect	Adverse Effect
Bridge	14.80	833+87	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	14.80		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	14.81		Contributing	Adverse Effect	Adverse Effect
Culvert	14.82		Non-Contributing	No Adverse Effect	No Adverse Effect
Misc	15.08		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	15.09	850+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	15.10	850+74	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	15.10		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	15.10		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	15.85	872+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	15.95		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	16.14		Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	16.15	899+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	16.16	899+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 2	16.19	901+05	Contributing	Adverse Effect	Adverse Effect
Building	16.19	901+05	Non-Contributing	No Adverse Effect	No Adverse Effect
Siphon	16.20-16.25	901+65	Contributing	No Adverse Effect	No Adverse Effect
Siphon	16.31-16.34	907+15	Contributing	No Adverse Effect	No Adverse Effect
Stillwell	16.39	911+05	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	16.64		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	16.65	925+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	16.78		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	16.78		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	16.80		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	17.10	949+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	17.22		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	17.23	954+14	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	17.59		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	17.77		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	18.05	996+94	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	18.05		Contributing	Adverse Effect	Adverse Effect
Turnout	18.06		Contributing	Adverse Effect	Adverse Effect
Pipe	18.47		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	18.47		Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	18.59	1025+68	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	18.60		Contributing	Adverse Effect	Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	18.90		Contributing	Adverse Effect	Adverse Effect
Turnout	19.15		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	19.17	1052+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	19.18		Contributing	Adverse Effect	Adverse Effect
Turnout	19.39		Contributing	Adverse Effect	Adverse Effect
Turnout	19.40		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	19.59		Contributing	No Adverse Effect	No Adverse Effect
Drainlet	19.59	10.74+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	19.85	1088+20	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	20.00		Contributing	Adverse Effect	Adverse Effect
Drainlet	20.20	1096+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	20.37	1115.50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	20.42		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	20.43		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	20.59		Contributing	Adverse Effect	Adverse Effect
Stillwell	20.60	1127+55	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	20.63	1128+70	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 3	20.63	1129+35	Contributing	Adverse Effect	Adverse Effect
Canal Lining Section	20.66-34.41		Contributing	Adverse Effect	Adverse Effect
Stillwell	20.69	1132+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	20.70	1133+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	20.71	1133+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	20.85	1141+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	20.96	1146+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	20.97		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	20.97		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	21.00	1154+99	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	21.12		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	21.13		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	21.22	1160+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	21.25		Contributing	Adverse Effect	Adverse Effect
Bridge	21.49	1174+52	Non-Contributing	No Adverse Effect	No Adverse Effect
Sign	21.49	1174+52	Contributing	No Adverse Effect	No Adverse Effect
Turnout	21.65		Contributing	Adverse Effect	Adverse Effect
Inlet	21.86		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	21.87	1195+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	21.91	1197+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	21.95	1199+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	22.20		Contributing	Adverse Effect	Adverse Effect
Drainlet	22.26	1215+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	22.37	1220+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	22.39	1220+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	22.45	1225+12	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	22.48	1226+80	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	22.50		Contributing	No Adverse Effect	No Adverse Effect
Drainlet	22.51	1227+80	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	22.54	1229+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	22.57	1231+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	22.60	1233+15	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	22.67	1237+00	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Shoulder Drain	22.67	1237+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	22.70	1239+37	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	22.72	1240+57	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	22.73	1240+80	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	22.73	1240+57	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	22.75		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	22.77	1242+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	22.78		Contributing	Adverse Effect	Adverse Effect
Shoulder Drain	22.80	1252+80	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	23.09	1259+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	23.26	489+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	23.36	494+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	23.41	497+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	23.41		Contributing	Adverse Effect	Adverse Effect
Drainlet	23.72	513+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	23.76		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	23.81		Contributing	Adverse Effect	Adverse Effect
Turnout	23.94		Contributing	No Adverse Effect	No Adverse Effect
Siphon	23.95-24.01	525+70	Contributing	No Adverse Effect	No Adverse Effect
Inlet	24.38		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	24.38		Contributing	Adverse Effect	Adverse Effect
Drainlet	24.39	548+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	24.40	549+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	24.40	548+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 4	24.42	550+00	Contributing	Adverse Effect	Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Building	24.43	550+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	24.48	553+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	24.48	553+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	24.67	563+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	24.89	575+45	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	25.02		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	25.02		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	25.03		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	25.07	584+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	25.10	585+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	25.18		Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	25.20	591+20	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	25.27	594+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	25.37	600+20	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	25.59	611+80	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	25.61		Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	25.62	613+36	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	25.63		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	25.63		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	25.65		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	25.67	615+70	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	25.75	619+70	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	26.13	640+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	26.18	643+00	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	26.21		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	26.21	644+57	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	26.69	670+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	26.89		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	26.93	682+58	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	26.95		Contributing	Adverse Effect	Adverse Effect
Drainlet	27.21	698+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	27.42		Contributing	Adverse Effect	Adverse Effect
Drainlet	27.59	718+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	27.80		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	27.80	729+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	27.84		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	28.04	742+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	28.19		Contributing	Adverse Effect	Adverse Effect
Shoulder Drain	28.27	754+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	28.27	754+19	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	28.53	768+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	28.78	781+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	28.89		Contributing	Adverse Effect	Adverse Effect
Drainlet	28.96	790+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	29.19	802+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	29.19		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	29.19	802+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	29.19	802+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	29.19	802+55	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	29.19		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	29.56		Contributing	Adverse Effect	Adverse Effect
Drainlet	29.69	828+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	29.79	833+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 5	29.81	835+65	Contributing	Adverse Effect	Adverse Effect
Building	29.82	835+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	29.88	838+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	29.91	840+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	29.93	841+23	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	29.95		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	30.33		Contributing	Adverse Effect	Adverse Effect
Drainlet	30.34	862+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	30.43		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	30.43	867+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	30.43	867+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	30.63		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	30.96		Contributing	Adverse Effect	Adverse Effect
Bridge	31.12	903+91	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	31.31	913+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	31.31		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	31.32	914+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	31.59	928+38	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	31.60	929+20	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	31.60		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	31.60		Contributing	Adverse Effect	Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Drainlet	31.61	929+70	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	31.81	940+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	32.10	955+51	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	32.29	965+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	32.36		Contributing	Adverse Effect	Adverse Effect
Turnout	32.38		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	32.61	982+32	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	32.61		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	32.62		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	32.83	994+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	32.94		Contributing	Adverse Effect	Adverse Effect
Turnout	33.07		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	33.29	1018+27	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	33.53	1031+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	33.71	1040+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	33.71		Contributing	Adverse Effect	Adverse Effect
Drainlet	33.89	1050+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	33.90		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	33.98	1054+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	34.08		Contributing	Adverse Effect	Adverse Effect
Drainlet	34.30	1071+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Westley Wasteway	34.32	1072+55	Contributing	No Adverse Effect	No Adverse Effect
Drainlet	34.35	1074+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	34.39	1076+58	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	34.39	1076+33	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Building	34.42	1078+15	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 6	34.42	1078+15	Contributing	Adverse Effect	Adverse Effect
Canal Lining Section	34.45-54.40		Contributing	Adverse Effect	Adverse Effect
Stillwell	34.47	1081+15	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	34.50	1082+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	34.55		Contributing	Adverse Effect	Adverse Effect
Inlet	34.63	1089+42	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	34.63		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	34.76	1096+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	34.89	1102+78	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	35.04		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	35.05	1111+46	Non-Contributing	No Adverse Effect	No Adverse Effect
Siphon	35.05	1111+46	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	35.10	1114+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	35.18		Contributing	Adverse Effect	Adverse Effect
Drainlet	35.38	1128+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	35.39	1129+24	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	35.71	1146+49	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	35.72	1146+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	35.72	1146+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	35.73	1146+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	35.73	1146+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	35.73		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	35.74	1146+96	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	36.01		Contributing	Adverse Effect	Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Inlet	36.01	1162+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	36.09	1166+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	36.39		Contributing	Adverse Effect	Adverse Effect
Turnout	36.45		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	36.52	1189+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	36.55	1190+20	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	36.68		Contributing	Adverse Effect	Adverse Effect
Inlet	36.80	1200+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	36.81	1204+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	37.10	1204+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Siphon	37.24-37.31	1227+85	Contributing	No Adverse Effect	No Adverse Effect
Bridge	37.28	1229+28	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	37.32	1231+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	37.32		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	37.33		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	37.34	1231+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	37.58	1245+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	37.58		Contributing	Adverse Effect	Adverse Effect
Drainlet	37.70	1251+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	38.11	1273+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Misc	38.11	1273+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Misc	38.11	1273+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	38.14	1274+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	38.14		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	38.15		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	38.15		Contributing	Adverse Effect	Adverse Effect
Drainlet	38.39	1287+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	38.59	1298+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	38.64	1300+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	38.68	1302+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 7	38.68	1302+65	Contributing	Adverse Effect	Adverse Effect
Stillwell	38.74	1305+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Misc	38.76		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	38.80		Contributing	Adverse Effect	Adverse Effect
Drainlet	38.99	1319+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	39.20		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	39.21	1330+56	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	39.22		Contributing	Adverse Effect	Adverse Effect
Wasteway	39.32-39.42	1331-01	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	39.46		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	39.78		Contributing	Adverse Effect	Adverse Effect
Bridge	39.81	1362+42	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	39.86	1365+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	40.00	1365+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	40.37	1391+74	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	40.39		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	40.45		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	40.62	1405+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	40.77	1413+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	41.01	1425+70	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	41.03		Contributing	Adverse Effect	Adverse Effect
Drainlet	41.35	1433+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	41.49	1451+03	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	41.53		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	41.53		Contributing	Adverse Effect	Adverse Effect
Overchute	41.93	1474+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	41.94		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	41.99	1477+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	42.08		Contributing	Adverse Effect	Adverse Effect
Turnout	42.10		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	42.50	1504+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	42.50		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	42.51		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	42.52	1505+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	42.53	1505+86	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	42.53	1505+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	42.68		Contributing	Adverse Effect	Adverse Effect
Misc	42.90	1525+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	43.08	1535+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	43.22		Contributing	Adverse Effect	Adverse Effect
Inlet	43.22	1540+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	43.24	1542+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	43.24	1541+41	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	43.26	1542+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	43.73		Contributing	Adverse Effect	Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Inlet	43.73	1569+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	44.19	1593+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	44.20	1593+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	44.22		Contributing	Adverse Effect	Adverse Effect
Turnout	44.24		Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	44.24	1596+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	44.26	1597+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 8	44.26	1597+65	Contributing	Adverse Effect	Adverse Effect
Stillwell	44.32	1600+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	44.53	1610+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	44.56	1613+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	44.73	1622+01	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	45.20		Contributing	Adverse Effect	Adverse Effect
Drainlet	45.25	1647+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	45.26	1648+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	45.35		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	45.38		Contributing	Adverse Effect	Adverse Effect
Drainlet	45.43	1657+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	45.75		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	45.77	1675+17	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	45.78		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	45.79		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	45.92	1683+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	46.02		Contributing	Adverse Effect	Adverse Effect
Pipe	46.17		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	46.19		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	46.35	1705+80	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	46.36		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	46.36	1706+06	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	46.62	1720+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	46.83		Contributing	Adverse Effect	Adverse Effect
Bridge	46.84	1731+79	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	47.09	1745+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	47.37		Contributing	No Adverse Effect	No Adverse Effect
Turnout	47.37		Contributing	Adverse Effect	Adverse Effect
Bridge	47.38	1759+88	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	47.53	1768+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	47.87		Contributing	Adverse Effect	Adverse Effect
Bridge	47.88	1786+38	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	47.88	1786+15	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	47.88	1786+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	47.89		Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	48.13	1799+62	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	48.14		Contributing	Adverse Effect	Adverse Effect
Drainlet	48.37	1812+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	48.38	1812+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	48.59	1824+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	48.60		Contributing	Adverse Effect	Adverse Effect
Building	48.62	1825+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 9	48.62	1825+65	Contributing	Adverse Effect	Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Stillwell	48.69	1829+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	48.70	1829+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	48.80		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	48.96		Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	48.97	1843+48	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	48.97	1843+48	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	49.20	1856+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	49.43	1868+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	49.43		Contributing	Adverse Effect	Adverse Effect
Inlet	49.54	1874+20	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	49.55	1874+64	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	49.56		Contributing	No Adverse Effect	No Adverse Effect
Drainlet	49.58	1876+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	49.71	1883+32	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	49.82	1889+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	49.84		Contributing	Adverse Effect	Adverse Effect
Shoulder Drain	50.00		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	50.20	1911+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	50.46		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	50.49	1927+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	50.49		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	50.53	1929+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	50.53	1929+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	50.66		Contributing	Adverse Effect	Adverse Effect
Turnout	50.70		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Siphon	51.18-51.27	1964+55	Contributing	No Adverse Effect	No Adverse Effect
Culvert	51.31		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	51.40	1975+64	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	51.41		Contributing	Adverse Effect	Adverse Effect
Turnout	51.65		Contributing	Adverse Effect	Adverse Effect
Inlet	51.66	1988+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	52.01	2007+68	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	52.02		Non-Contributing	No Adverse Effect	No Adverse Effect
Shoulder Drain	52.18	2016+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Inlet	52.40	2028+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	52.40		Contributing	Adverse Effect	Adverse Effect
Drainlet	52.72	2057+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	52.85	2073+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	53.15	2083+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	53.39	2094+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	53.41		Contributing	Adverse Effect	Adverse Effect
Bridge	53.43	2096+86	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	53.63	2107+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	53.63	2107+75	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	53.64		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	53.98	2126+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	53.98	2126+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	54.01	2127+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	54.01		Contributing	Adverse Effect	Adverse Effect
Drainlet	54.36	2146+00	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Newman Wasteway	54.38	2147+00	Contributing	No Adverse Effect	No Adverse Effect
Stillwell	54.39	2147+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	54.41	2148+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 10	54.41	2148+65	Contributing	Adverse Effect	Adverse Effect
Canal Lining Section	54.44-69.00		Contributing	No Adverse Effect	No Adverse Effect
Stillwell	54.49	2152+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	54.67	2162+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	54.70		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	55.07	2183+85	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	55.19		Contributing	Adverse Effect	Adverse Effect
Culvert	55.23		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	55.34		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	55.85		Contributing	Adverse Effect	Adverse Effect
Drainlet	55.92	2247+65	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	55.95		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	56.02	2253+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	56.18		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	56.18	2261+55	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	56.60	2283+62	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	56.78		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	56.80		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	56.82		Contributing	Adverse Effect	Adverse Effect
Turnout	56.83		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	56.85		Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	57.46	2340+00	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	57.46		Contributing	Adverse Effect	Adverse Effect
Drainlet	57.73	2354+18	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	57.95		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	57.95	2366+10	Non-Contributing	No Adverse Effect	No Adverse Effect
Drainlet	57.95	2366+10	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	58.25	2381+32	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	58.26		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	58.27		Contributing	Adverse Effect	Adverse Effect
Check No. 11	58.28	2382+00	Contributing	Adverse Effect	Adverse Effect
Building	58.28	2382+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Siphon	58.29-58.35	2384+25	Contributing	No Adverse Effect	No Adverse Effect
Stillwell	58.40	2389+70	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	58.46	2392+79	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	58.73	2392+79	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	58.90		Contributing	Adverse Effect	Adverse Effect
Turnout	59.50		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	59.50		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	59.53		Contributing	Adverse Effect	Adverse Effect
Bridge	60.06	2477+17	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	60.54		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	60.65		Contributing	Adverse Effect	Adverse Effect
Turnout	61.05		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	61.06	2530+22	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	61.37		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	61.84		Contributing	Adverse Effect	Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	62.08		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	62.09	2588+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	62.67		Contributing	Adverse Effect	Adverse Effect
Stillwell	63.95	2691+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	63.96		Contributing	Adverse Effect	Adverse Effect
Check No. 12	63.99	2693+00	Contributing	No Adverse Effect	No Adverse Effect
Building	63.99	2693+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	64.06	2697+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	64.28	2709+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	64.30	2710+33	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	64.32		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	64.32		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	64.85		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	65.35		Contributing	Adverse Effect	Adverse Effect
Turnout	65.37		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	65.38		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	65.52		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	65.89	2802+98	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	65.91	2802+98	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	66.06		Contributing	Adverse Effect	Adverse Effect
Turnout	66.20		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	66.68		Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	66.70	2844+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	66.73		Contributing	Adverse Effect	Adverse Effect
Turnout	67.16		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	67.16		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	67.16	2869+53	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	67.55		Contributing	No Adverse Effect	No Adverse Effect
Bridge	68.03	2922+13	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	68.03		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	68.03		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	68.58		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	68.58		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	68.59		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	68.83		Non-Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	69.00-69.25		Contributing	No Adverse Effect	No Adverse Effect
Turnout	69.21		Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	69.25-69.99		Contributing	No Adverse Effect	No Adverse Effect
O'Neill Forebay Inlet Canal	69.30	2985+99	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	69.62		Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	69.85		Non-Contributing	No Adverse Effect	No Adverse Effect
Volta Wasteway	69.98	3022+00	Contributing	No Adverse Effect	No Adverse Effect
Stillwell	69.99	3022+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 13	70.01	3023+65	Contributing	No Adverse Effect	No Adverse Effect
Building	70.01	3023+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	70.01	3023+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	70.04-85.08		Contributing	No Adverse Effect	No Adverse Effect
Stillwell	70.09	3027+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	70.13		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	70.62		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	71.31		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	71.31	3091+44	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	71.32		Contributing	Adverse Effect	Adverse Effect
Turnout	71.34		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	71.59		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	71.66		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	71.69		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	72.25		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	72.33	3145+53	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	72.33		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	72.34		Contributing	Adverse Effect	Adverse Effect
Bridge	72.80	3167+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	72.80		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	72.82	3167+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	73.06		Contributing	No Adverse Effect	No Adverse Effect
Turnout	73.38		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	73.43		Contributing	Adverse Effect	Adverse Effect
Culvert	73.81		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	73.87		Contributing	Adverse Effect	Adverse Effect
Turnout	74.35		Contributing	Adverse Effect	Adverse Effect
Stillwell	74.36	3253+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 14	74.40	3256+50	Contributing	Adverse Effect	Adverse Effect
Building	74.40	3256+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	74.45	3257+37	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Bridge	74.77	3275+58	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	74.84		Non-Contributing	No Adverse Effect	No Adverse Effect
Overchute	75.38	3307+80	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	75.43		Contributing	Adverse Effect	Adverse Effect
Bridge	75.84	3332+41	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	75.86	3256+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	76.03		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	76.03		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	76.05		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	76.77		Contributing	Adverse Effect	Adverse Effect
Turnout	77.19		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	77.20	3403+89	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	77.20		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	77.24		Contributing	Adverse Effect	Adverse Effect
Bridge	77.63	3426+93	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	77.98		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	78.56		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	78.57		Contributing	Adverse Effect	Adverse Effect
Overchute	78.59	3477+40	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	79.12	3506+26	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	79.12		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	79.13		Contributing	Adverse Effect	Adverse Effect
Stillwell	79.63	3533+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 15	79.64	3533+90	Contributing	Adverse Effect	Adverse Effect
Siphon	79.64-79.72	3534+50	Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Building	79.64	3534+58	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	80.00	3537+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	80.01	3537+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	80.03		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	80.34		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	80.34	3570+19	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	80.93		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	80.99		Contributing	No Adverse Effect	No Adverse Effect
Turnout	81.08		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	81.69	3641+23	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	81.79	3646+89	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	81.80		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	82.31		Contributing	No Adverse Effect	No Adverse Effect
Pipe	82.52		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	82.52	3685+64	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	82.79		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	82.79		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	83.07	3714+64	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	83.08		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	83.08		Contributing	No Adverse Effect	No Adverse Effect
Pipe	83.36		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	83.57		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	83.62		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	83.63		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Pipe	83.88		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	83.88	3757+30	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	84.38	3783+58	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	84.39		Contributing	Adverse Effect	Adverse Effect
Pipe	84.65		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	84.65		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	84.82	3806+72	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	84.82		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	85.04		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	85.05		Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	85.07	3819+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	85.08		Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 16	85.09	3821+50	Contributing	Adverse Effect	Adverse Effect
Building	85.09	3821+50	Non-Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	85.10-98.62		Contributing	No Adverse Effect	No Adverse Effect
Stillwell	85.14	3825+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	85.47		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	85.47	3841+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	85.68		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	86.17		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	86.17		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	86.19		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	86.19	3879+11	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	86.70		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	86.71		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Turnout	86.72		Contributing	Adverse Effect	Adverse Effect
Turnout	87.35		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	87.48		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	87.97		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	88.13	3981+67	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	88.24		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	88.62	4007+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	88.65		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	88.91		Contributing	No Adverse Effect	No Adverse Effect
Pipe	89.23		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	89.56		Contributing	No Adverse Effect	No Adverse Effect
Turnout	90.27		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	90.53		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	90.53		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	90.53		Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	90.53	4108+18	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	90.54	4108+70	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 17	90.54	4108+70	Contributing	Adverse Effect	Adverse Effect
Bridge	90.56	4110+17	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	90.56		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	90.57		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	90.57		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	90.57		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	90.57		Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	90.61	4110+64	Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Bridge	90.91	4128+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Pip	90.91		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	91.71		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	92.23		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	92.73	4224+36	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	92.73		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	93.23		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	93.24	4251+55	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	93.25		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	93.27		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	94.26		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	94.27	4305+93	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	94.57		Contributing	Adverse Effect	Adverse Effect
Pipe	95.45		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	95.45	4368+05	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	95.45		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	95.50		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	95.50		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	95.95		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	96.61		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	96.61	4429+57	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	96.62		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	96.70		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	96.70		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	96.70		Non-	No Adverse	No Adverse

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
			Contributing	Effect	Effect
Turnout	96.70		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	96.70		Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	96.79	4432+60	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	96.81	4440+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 18	96.82	4440+00	Contributing	No Adverse Effect	No Adverse Effect
Stillwell	96.88	4441+37	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	97.68	4482+25	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	97.69		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	97.70		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	97.70		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	97.70		Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	98.64-111.55		Contributing	Adverse Effect	Adverse Effect
Bridge	98.74	4540+12	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	98.74		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	98.74		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	99.82	4597+05	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	99.82		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	100.23		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	100.80		Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	100.85		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	100.85	4652+15	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	100.85		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	101.27		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	102.03	4713+89	Non-	No Adverse	No Adverse

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
			Contributing	Effect	Effect
Turnout	102.04		Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	102.38		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	102.54		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	102.93		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	102.93		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	102.93	4761+81	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	102.95		Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	103.56		Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	104.74		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	105.03		Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	105.03		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	105.03	4873+29	Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	105.04		Non-Contributing	No Adverse Effect	No Adverse Effect
Stillwell	105.05	4875+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	105.05		Non-Contributing	No Adverse Effect	No Adverse Effect
Building	105.06	4875+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 19	105.06	4875+00	Contributing	Adverse Effect	Adverse Effect
Stillwell	105.09	4876+17	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	105.55	4901+06	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	105.55		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	105.56		Non-Contributing	No Adverse Effect	No Adverse Effect
Pipe	106.48		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	106.58	4955+00	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	106.59		Non-Contributing	No Adverse Effect	No Adverse Effect

Structure	Mile Post	Station	Contributing?	Alt1	Alt2
Bridge	107.42	5000+14	Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	107.85		Non-Contributing	No Adverse Effect	No Adverse Effect
Turnout	109.45		Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	110.12	5142+79	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	110.27		Non-Contributing	No Adverse Effect	No Adverse Effect
Siphon	110.96-111.02	5186+97	Contributing	No Adverse Effect	No Adverse Effect
Culvert	111.07		Non-Contributing	No Adverse Effect	No Adverse Effect
Firebaugh Wasteway	111.22	5190+03	Contributing	No Adverse Effect	No Adverse Effect
Stillwell	111.24	5201+70	Non-Contributing	No Adverse Effect	No Adverse Effect
Culvert	111.24		Non-Contributing	No Adverse Effect	No Adverse Effect
Building	111.26	5201+90	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 20	111.26	5202+30	Contributing	Adverse Effect	Adverse Effect
Stillwell	111.28	5203+07	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	111.51	5216+16	Non-Contributing	No Adverse Effect	No Adverse Effect
Canal Lining Section	111.55-114.05		Contributing	Adverse Effect	Adverse Effect
Canal Lining Section	114.05-116.61		Contributing	Adverse Effect	Adverse Effect
Siphon	115.57-115.59	5430+15	Contributing	No Adverse Effect	No Adverse Effect
Stillwell	116.45	5476+35	Non-Contributing	No Adverse Effect	No Adverse Effect
Building	116.48	5477+10	Non-Contributing	No Adverse Effect	No Adverse Effect
Bridge	116.48	5477+22	Non-Contributing	No Adverse Effect	No Adverse Effect
Check No. 21	116.48	5477+37	Contributing	No Adverse Effect	No Adverse Effect
Building	116.50	5478+54	Non-Contributing	No Adverse Effect	No Adverse Effect

Delta-Mendota Canal Subsidence Correction Project Environmental Assessment/Initial Study

Appendix O: Cumulative Projects

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Appendix O Cumulative Projects

This appendix provides a description of other past, present, and reasonably foreseeable probable future projects (or actions) as required by National Environmental Policy Act (NEPA) implementing regulations (40 CFR 1508.1(g)(3)) and California Environmental Quality Act (CEQA) Guidelines (Title 14, Division 6, Chapter 3 of the California Code of Regulations). The reasonably foreseeable probable future actions considered in this cumulative effects analysis are actions located within the project area that have been identified as potentially having an effect on resources that also may be affected by the Proposed Action. This analysis follows applicable guidance provided by the Council on Environmental Quality in *Considering Cumulative Effects under the National Environmental Policy Act* (1997) and *Guidance on the Consideration of Past Actions in Cumulative Effects Analysis (*2005).

O.1 Cumulative Projects

Reasonably foreseeable probable future actions considered in this cumulative effects analysis are actions located within the study area that have been identified as potentially having an effect on resources that also may be affected by the proposed action. In addition, reasonably foreseeable probable future actions are projects where necessary environmental compliance evaluations have been completed and any associated decisions on the final project identified for implementation has been made. The following sections present brief descriptions for each of the projects and plans considered for the cumulative analysis.

O.1.1 B.F. Sisk Dam Raise and Reservoir Expansion Project

As a connected action to the B.F. Sisk Safety of Dams (SOD) Modification Project, the Bureau of Reclamation (Reclamation) and the San Luis & Delta-Mendota Water Authority (SLDMWA) are proposing to raise the B.F. Sisk Dam embankment by 10 feet above the level proposed for dam safety purposes to increase the storage capacity of the San Luis Reservoir. This 10-foot dam embankment raise could add approximately 130,000 AF of water storage to the San Luis Reservoir. SLDMWA, in coordination with Reclamation, is conducting a feasibility study to evaluate the Proposed Action. The Final Supplemental Environmental Impact Statement (EIS)/Environmental Impact Report (EIR) was published in December 2020 (Reclamation 2020a).

Construction of the additional 10-foot embankment and associated modifications would initiate during the final stages of the construction of the B.F. Sisk Dam SOD Modification Project. Construction of the Proposed Action is scheduled to begin in September 2025 and be completed within eight years. Preconstruction and design activities are planned to begin in 2022 (Reclamation 2020a).

O.1.2 California Aqueduct – San Luis Canal Embankment and Liner Raise Project

Subsidence has caused reduced flow capacity in the California Aqueduct (Aqueduct) throughout the Central Valley, which limits the ability of the aqueduct to deliver water to Southern California. The California Aqueduct – San Luis Canal Embankment and Liner Raise Project aims to raise the embankments, concrete liner, and structures in Pools 17, 18, 20, and 21 to regain lost flow capacity to design levels. The Project is in the design stage, with the California Department of Water Resources (DWR) and Reclamation assessing the environmental impacts of raising 38 miles of the

embankment up to six feet on both sides of the Aqueduct, raising the concrete liner up to three feet on both sides, raising Check 17 up to 15 feet, raising eight bridges, rebuilding turnouts and turn-ins, and installing new irrigation under-crossings. A geotechnical investigation has been proposed by DWR in support of the design phase. The Final Environmental Assessment (EA)/Finding of No Significant Impact (FONSI) for the geotechnical investigation was released in September 2021 (Reclamation 2021a). An EA/Initial Study (IS) is in its beginning stages with a draft expected to be released for public comment in Fall 2022. Construction is tentatively scheduled to begin in 2024 and is expected to last three years (DWR 2022a).

O.1.3 Central Valley Project Improvement Act (CVPIA)

The CVPIA mandates certain management actions related to the protection, restoration, and enhancement of fish and wildlife. Major areas of management actions called for by the CVPIA include: 800,000 acre-feet (AF) of water dedicated to fish and wildlife annually; tiered water pricing applicable to new and renewed contracts; water transfers provision, including sale of water to users outside the Central Valley Project (CVP) service area; special efforts to restore anadromous fish population by 2002; restoration fund financed by water and power users for habitat restoration and enhancement and water and land acquisitions; no new water contracts until fish and wildlife goals achieved; no contract renewals until completion of a Programmatic EIS (which was done in 1999 and a Record of Decision [ROD] issued January 2001); terms of contracts reduced from 40 to 25 years with renewal at the discretion of the Secretary of the Interior; installation of the temperature control device at Shasta Dam; implementation of fish passage measures at Red Bluff Diversion Dam; firm water supplies for Central Valley wildlife refuges; and development of a plan to increase CVP yield (Reclamation 2021b).

O.1.4 Central Valley Salinity Alternatives for Long-term Sustainability

The Central Valley Salinity Alternatives for Long-term Sustainability (CV-SALTS) is a collaborative stakeholder driven and managed program to develop sustainable salinity and nitrate management planning for the Central Valley. CV-SALTS developed a Salt and Nitrate Management Plan (SNMP) for the entirety of the Central Valley Regional Water Quality Control Board's jurisdictional area (also referred to as the "Central Valley" or "Region Five"). The Central Valley SNMP builds on a range of water quality management policies and mechanisms already in existence, proposes additional policies and tools needed to provide the Central Valley Water Board with flexibility in addressing legacy and ongoing loading of salt and nitrate in the diverse region, and presents a comprehensive regulatory and programmatic approach for the sustainable management of salt and nitrate (Central Valley Salinity Coalition 2016).

O.1.5 Del Puerto Canyon Reservoir

Del Puerto Water District (DPWD) and the San Joaquin River Exchange Contractors Water Authority (Exchange Contractors) supply CVP water to highly productive farmlands in Stanislaus, San Joaquin, Merced, Fresno, and Madera counties. CVP water is pumped south from the Sacramento-San Joaquin River Delta (Delta) through the Delta-Mendota Canal (DMC). For more than two decades, droughts and pumping restrictions imposed to protect fish habitat and water quality have caused shortages and volatility in water deliveries exported from the Delta. As a result, regional economic stability has been impacted and the environment compromised.

DPWD and the Exchange Contractors are partnering to construct and operate the Del Puerto Canyon Reservoir. The proposed Del Puerto Canyon Reservoir would be located in Del Puerto

Canyon in the Coast Range foothills west of Patterson and south of the Sacramento-San Joaquin Delta, just west of I-5. The Del Puerto Canyon Reservoir Project would deliver water from the DMC into the new reservoir, where it would be stored and released on a managed basis (Del Puerto Canyon Reservoir Project 2022). The reservoir would allow water to be delivered into storage during wetter periods until it is needed in drier periods for irrigation, groundwater recharge, or wildlife beneficial uses.

DPWD released the Final EIR in October 2020 (DPWD 2020). The Final EIR was challenged in the Stanislaus County Superior Court of California (*Friant Water Supply Protection Association v. Del Puerto Water District et al.*). On October 31, 2022, the court issued a ruling in the case, vacating Del Puerto Water District's decision to approve the Del Puerto Canyon Final EIR. The court found the Final EIR to be deficient as it did not adequately address the planned relocation of Del Puerto Canyon Road

O.1.6 Delta Conveyance Project

The Delta Conveyance Project is currently being analyzed by DWR and several State Water Contractors.

The Delta Conveyance Project planning process began in 2006, when Reclamation and DWR, along with several state and federal water contractors (collectively referred to as Potential Authorized Entities), initially proposed the Bay-Delta Conservation Plan (BDCP). The BDCP envisioned updating the State Water Project (SWP) and CVP by adding new points of diversion in the north Delta and by providing for large-scale species conservation through a 50-year habitat conservation plan (HCP)/natural communities conservation plan (NCCP). The HCP/NCCP was intended to comply with Section 10 of the federal Endangered Species Act and to achieve compliance with the California Endangered Species Act through the California Natural Community Conservation Planning Act. An EIS/EIR was released in December 2013.

Following release of the Draft EIS/EIR, Reclamation and DWR issued a Supplemental Draft EIS/Partially Recirculated Draft EIR that included for consideration three additional alternatives that would update SWP and CVP without the large-scale conservation efforts in an HCP/NCCP. The Lead Agencies proposed that one of these non-HCP alternatives, known as California WaterFix Alternative 4A, be identified as the preferred alternative in replacement of the BDCP alternative (DWR and Reclamation 2015). The preferred WaterFix alternative (4A) consisted of three new diversion points in the north Delta, tunnel conveyance and ancillary facilities, operational elements, restoration measures, and an adaptive management program (DWR and Reclamation 2015). The Supplemental Draft EIS/Partially Recirculated Draft EIR also included updates to the BDCP alternative and other revisions and updates to the 2013 Draft EIR/EIS analyses. In addition, the state proposed as a separate program, California EcoRestore, to provide restoration efforts for species conservation independent of the SWP and CVP facility upgrades. The Final EIS/EIR for the BDCP/California WaterFix that identified the California WaterFix for implementation was released in December 2016. Biological opinions for the California WaterFix were released in June 2017. However, in May 2019, DWR rescinded all permits, permit applications, bond authorizations, and CEQA documentation for California WaterFix and announced that it was working with public water agencies on a new environmental review process for a single tunnel project.

In January 2020, DWR initiated a new CEQA process for the Delta Conveyance Project with a Notice of Preparation of an EIR. DWR released the Draft EIR in July 2022 for public review and

comment. The Draft EIR evaluates eight conveyance alternatives that include constructing (DWR 2022b):

- One, two, or three new intakes in the north Delta
- Four capacity options ranging from 3,000 cubic feet per second (cfs)–7,500 cfs
- One new tunnel following the Central or Eastern Alignment
- New facilities in the south Delta at the Southern Complex near Clifton Court Forebay

DWR expects the NEPA/ CEQA process and other environmental permitting to be complete in mid-2024 (DWR 2020).

The U.S. Army Corps of Engineers (USACE) published their Notice of Intent to prepare an EIS in August of 2020. Their fact sheet dated March 7, 2022, states the Project is sized for the SWP only and that Reclamation does not have a federal action. The USACE Sacramento District is serving as the lead agency and preparing a stand-alone EIS with cooperation of National Marine Fisheries Service, the U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and Reclamation (USACE 2022).

O.1.7 Friant-Kern Canal Middle Reach Capacity Correction Project

The Friant-Kern Canal (FKC) Middle Reach has lost over 50 percent of its original design capacity because of regional land subsidence and a design deficiency, which has resulted in water delivery impacts on Friant Contractors, a reduced ability of the FKC to convey flood waters during wet years, and more impacts. Reclamation and Friant Water Authority proposed to restore the capacity of a 33-mile-long section of the FKC located within Tulare and Kern Counties by widening and/or raising approximately 10 miles of the existing canal and realigning approximately 23 miles of the canal corridor to newly constructed canal segments. An EIS/EIR evaluating two action alternatives was published in September 2020, and a ROD was signed in November 2020 confirming Reclamation's selection of the preferred action alternative (described above). The realigned canal is planned to be constructed immediately east of the existing FKC and will serve as the exclusive water conveyance and delivery mechanism through its length (Reclamation 2020b).

Construction for Phase One of this multi-phased project began in January 2022. Phase One includes constructing 10 miles of new concrete-lined canal to replace one of the worst pinch points of the canal's subsiding middle reach. Phase One is anticipated to take around three years and be completed and fully operational by January 2024 (Reclamation 2022).

O.1.8 Kern Fan Groundwater Storage Project

Rosedale-Rio Bravo Water Storage District and Irvine Ranch Water District (known as the Groundwater Banking Joint Powers Authority [GBJPA]) propose to construct up to 1,300 acres of recharge basin facilities and up to 12 recovery wells on the Kern Fan Project Properties. The Kern Fan Conveyance Facilities include canals and/or pipelines, pump stations, and a new turnout at the Aqueduct to convey water between the Project facilities and the Aqueduct. Water stored by the Kern Fan Groundwater Storage Project would be recovered when needed to provide ecosystem and water supply benefits (GBJPA 2022).

The proposed project would be operated so that surplus surface water from the SWP, CVP, Kern River and other available water sources would be recharged and stored for subsequent recovery. It is

estimated that the Project would be able to recharge and store upward of 100,000 AF per year (GBJPA 2022).

The Groundwater Banking Joint Powers Authority released the Final EIR in December 2020. Construction was scheduled to begin late 2021 (GBJPA 2020).

O.1.9 Los Vaqueros Reservoir Expansion Project

Los Vaqueros Reservoir is an off-stream reservoir in the Kellogg Creek watershed to the west of the Delta. The Los Vaqueros Reservoir initial construction was completed in 1997 as a 100,000 AF off-stream storage reservoir owned and operated by Contra Costa Water District (CCWD) to improve delivered water quality and emergency storage reliability to their customers. In 2012, the Los Vaqueros Reservoir was expanded to a total storage capacity of 160,000 AF (Phase One) to provide additional water quality and supply reliability benefits, and to adjust the timing of its Delta water diversions to accommodate the life cycles of Delta aquatic species, thus reducing species impact and providing a net benefit to the Delta environment. As part of the Storage Investigation Program described in the California and Federal government (CALFED) Bay Delta Program ROD, additional expansion up to 275,000 AF (Phase Two) is being evaluated by CCWD, DWR, and Reclamation. The alternatives considered in the evaluation also consider methods to convey water from Los Vaqueros Reservoir to the South Bay Aqueduct to provide water to Zone Seven Water Agency, Alameda County Water District, and Santa Clara Valley Water District (Valley Water). The Final EIS/EIR was released by Reclamation and CCWD in March 2010. Reclamation approved and released the ROD in March 2011.

Since the Final EIS/EIR was certified, refinements have been made to elements of the previously analyzed facilities, revisions to water sources and destinations have been made, and operational assumptions have been updated, primarily to reflect current and projected drought conditions, updated Delta hydrology models, and water quality monitoring. There is now more information about water supply demand and operational preferences from the local water agencies and south-of-Delta wildlife refuges that have been identified as potential partners in the Phase 2 Expansion Project. In addition, the regulatory and environmental conditions in which the Project would be operated have been modified over the past seven years. Because of these reasons, a Draft Supplement to the EIS/EIR was released in June of 2017 (Reclamation and CCWD 2017). The Final Supplement to the EIS/EIR was released in February of 2020. As of April 2022, construction is planned for 2023 through 2030 (CCWD 2022).

O.1.10 San Joaquin River Restoration Program

The San Joaquin River Restoration Program (SJRRP) is a comprehensive long-term effort to restore flows to the San Joaquin River from Friant Dam to the confluence of Merced River and restore a self-sustaining Chinook salmon fishery in the river while reducing or avoiding adverse water supply impacts from restoration flows. The restoration program is the product of more than 18 years of litigation, which culminated in a Stipulation of Settlement on the lawsuit known as *Natural Resource Defense Council, et al., v. Kirk Rodgers, et al.* The settling parties reached agreement on the terms and conditions of the settlement, which was subsequently approved by Federal Court on October 23, 2006. The settling parties include the Natural Resources Defense Council, Friant Water Users Authority, and the U.S. Departments of the Interior and Commerce. The settlement's two primary goals are to:

- Restore and maintain fish populations in "good condition" in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish, and;

- Reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the settlement.

The settlement requires specific releases of water from Friant Dam to the confluence of the Merced River, which are designed primarily to meet the various life stage needs for spring- and fall-run Chinook salmon. The release schedule assumes continuation of the current average Friant Dam release of 116,741 AF, with additional flow requirements depending on the year type. Interim flows began in October 2009, and full restoration flows began in 2014. There are many physical improvements within and near the San Joaquin River have/will be undertaken to fully achieve the river restoration goal. The improvements will occur in two separate phases that will focus on a combination of water releases from Friant Dam, as well as structural and channel improvements.

The project was authorized and funded with the passage of San Joaquin River Restoration Settlement Act, part of the Omnibus Public Land Management Act of 2009 (Public Law 111-11) (SJRRP 2023).

O.1.11 San Luis Low Point Improvement Project

Reclamation and Valley Water are proposing to address water supply reliability and service interruption issues associated with low water levels in San Luis Reservoir. The Draft EIS/EIR was released in July 2019 and identified four action alternatives: Lower San Felipe Intake Alternative, Treatment Alternative, San Luis Reservoir Expansion Alternative, and Pacheco Reservoir Expansion Alternative. Valley Water identified the Pacheco Reservoir Expansion Alternative as the CEQA Proposed Project. The Pacheco Reservoir Expansion Alternative includes removal of the existing dam, development of a new reservoir (located 0.5 mile upstream of the existing North Fork Dam along Pacheco Creek), a new earthen dam and spillway, new pipelines and tunnels, a new pump station, and associated channel modifications, a new regulating tank at Pacheco Pumping Plant, and access improvements. The pending Final EIS/EIR will identify a NEPA preferred alternative. Construction is planned to start in 2024 (Reclamation and Valley Water 2019).

O.1.12 Pacheco Reservoir Expansion Project

Valley Water, San Benito County Water District, and Pacheco Pass Water District are proposing to increase Pacheco Reservoir's operational capacity from 5,500 AF to up to 140,000 AF, to reduce the frequency and severity of water shortages during droughts (Valley Water 2020). The Project would construct new conveyance infrastructure to segments of the CVP San Felipe Division in Merced and Santa Clara counties and deliver water supply to up to eight south-of-Delta wildlife refuges in Merced County. (California Water Commission 2020). The Draft EIR was released in November 2021 and the public comment period ended February 2022 (Valley Water 2021a; Valley Water 2021b). Construction is planned to begin mid-2027 (California Water Commission 2020). If the Pacheco Expansion Alternative is implemented under the San Luis Low Point Improvement Project (described above in Section O.1.10), then the Pacheco Reservoir Expansion Project will no longer be analyzed or implemented.

O.1.13 Reach 2B and Mendota Pool Bypass

To create a passable San Joaquin River for salmonids between Mendota Dam and the confluence with Merced River, a critical component for the San Joaquin River Restoration Program (SJRRP), Reclamation is proposing to create a river-like channel over a half-mile around Mendota Pool. The Reach 2B and Mendota Pool Bypass Project includes construction, operation, and maintenance of the Mendota Pool Bypass and improvements in the San Joaquin River channel in Reach 2B. In October 2016, Reclamation signed a ROD, which identified Alternative B as the preferred alternative for the Reach 2B Project (Reclamation 2016). Alternative B includes construction of setback levees capable of conveying flows up to 4,500 cfs, restoring floodplain habitat with an average width of approximately 4,200 feet. This alternative would also construct the Compact Bypass bifurcation structure capable of conveying up to 2,500 cfs from Reach 2B to the Mendota Pool (Reclamation 2016).

In September 2021, the SJRRP replaced the Mowry Bridge spanning the Fresno Slough at the upstream end of the Mendota Pool, the first component of the Reach 2B construction Project. This Project serves several purposes including providing a haul route during Project construction and the primary operation and maintenance access point for Reach 2B control structures and the Mendota Pool Bypass (SJRRP 2022).

O.2 Relevant Infrastructure Projects

O.2.1 College Park at Mountain House

The *Mountain House Specific Plan III* (2005, amended 2019) is the detailed plan for the development of approximately 816 acres within the 4,784-acre Mountain House Master Plan community northwest of Tracy, California. The Specific Plan III provides for approximately 2,240 residential units, approximately 1,500,000 square feet of limited industrial uses and 250,000 square feet of commercial uses, two K-8 schools, approximately 42 acres of neighborhood and community parks, and an approximately 107.9-acre community college with a planned capacity of 12,000 students. The plan area is located within the southern third of the Master Plan area. It is generally bounded by Mountain House Parkway to the east, I-205 to the south, the Alameda County line to the west and Grant Line Road to the north, except for a small portion that extends north of Grant Line Road adjacent to Mountain House Parkway. The DMC runs along the southwest corner of the plan area for approximately 0.30 miles (Mile Post [MP] 7.33 to MP 7.63), with the site approximately 1.82 miles from the DMC at its furthest point. Development for Phase II is ongoing with construction scheduled to end in 2025 (San Joaquin County 2005).

O.2.2 Cordes Ranch Specific Plan

The *Cordes Ranch Specific Plan* (2013, amended 2018) established land use, zoning, development standards and regulations for approximately 1,780 acres located in the northwest region of the City of Tracy. The area is bordered by I-205 to the north, Old Schulte Road to the south, a portion of Mountain House Parkway to the west, and then extends northwest, north of the DMC to I-205. The specific plan covers the development of 1,462 net acres of the plan area with commercial, office, manufacturing, warehouse, and distribution uses. The remaining acres fall under park zones and are limited to open space areas, park facilities, detention basins, and flood control improvements (City of Tracy 2013). The DMC is adjacent to the specific plan area for approximately 2.6 miles (MP 7.6 to MP 10.25), with approximately one mile of the DMC running through the southwest corner of the area (MP 9.25 to MP 10.25). The plan area is 1.5 miles from the DMC at its furthest point.

Construction of the plan area is in phase one, with seven approved project sites under construction or soon to start (City of Tracy 2022a). The *Cordes Ranch Specific Plan* (2013a), its development projects, and associated impacts are evaluated in the *Cordes Ranch Specific Plan EIR* (2013b).

The Prologis International Park of Commerce (IPC) Building Two was approved for construction in April 2021 and is currently in progress. The site will host an approximately 375,369 square foot (sq ft) industrial building and associated parking and landscape improvements. The site is bordered on the northern side by approximately 0.24 miles of the DMC (MP 9.54 to MP 9.78), with a drainage easement to the east and Schulte Road to the south (City of Tracy 2021a). The DMC is approximately 0.29 miles away from the site at its furthest point.

The Prologis IPC Building Eight was approved for construction in April 2021. Building Eight will be an electric vehicle and battery facility consisting of a 6,000 sq ft office building, autonomous vehicle research and development, auto and trailer parking and storage, and associated site area improvements on an approximately 56.5-acre site located between the DMC to the south and southwest and Hopkins Road to the northeast. A drainage channel runs along the southeast side (City of Tracy 2021b). The site runs along approximately 0.5 miles of the DMC (MP 9.29 to MP 9.79) and is approximately 0.20 miles from the DMC its furthest point.

Prologis IPC Building 16 was approved for construction in April 2021. The 66.7-acre site will have a 1,120,082 sq ft industrial building along with parking and landscape improvements. The site is approximately one mile away from the DMC at its closest point and 1.5 miles at is furthest point. The site will be bordered by the future Capital Parks Drive to the north, Pavilion Parkway to the west, and Promontory Parkway to the south (City of Tracy 2021c).

The Cordes Ranch Central Green was approved in January 2022 and consists of passive use open space areas, and a joint use park/stormwater detention facility. The Central Green will be approximately 35 acres between the future Capital Parks Drive to the north and Promontory Parkway to the south, the industrial building to its east, and Road F and a future office building to the west. The pending construction site sits at the intersection of PG&E power and gas easements and a drainage easement (City of Tracy 2022a; City of Tracy 2013a). The site is approximately 0.43 miles away from the DMC at its closest point and approximately 0.77 miles away at its furthest point.

A gas station and convenience store with a self-service car wash tunnel was approved by the City of Tracy in June 2021 for construction on the southwest corner of International Parkway and Daylight Road, parcel eight of the planned West Parkway Village. The convenience store will be 4,028 sq ft, the carwash would be 1,449 sq ft, and the fueling canopy of the gas station would be 4,675 sq ft (City of Tracy 2021d). The site is approximately 0.42 miles from the DMC at its closest point and 0.47 miles at its furthest point.

The Tracy Courtyard by Marriott was approved for construction in September 2021. The site is a two-acre lot on the southeast corner of the planned West Parkway Village where a four-story, 60,074 sq ft hotel with an outdoor pool, patio, and parking will be constructed (City of Tracy 2021e). It is approximately 0.51 miles from the DMC at its closest point and 0.57 miles at its furthest point.

The Promontory Station was approved for construction in March 2022. The site sits between Promontory Parkway and International Parkway, bordered by Daylight Road to the north and Capital Parks Drive to the south. The proposal for phase one of Promontory Station is to build two multi-tenant commercial buildings, an outdoor plaza, and 235 parking spaces. The 3,968 sq ft multi-tenant commercial building consists of a 1,500 sq ft. restaurant and two 1,200 sq ft. retail spaces.

The 8,160 sq. ft. multi-tenant commercial building consists of a 2,300 sq ft. and 1,900 sq ft restaurant and three 1,300 sq ft. retail spaces. In between the two multi-tenant commercial buildings is a plaza with public outdoor seating (City of Tracy 2022b). The site is approximately 0.23 miles from the DMC at its closest point, and approximately 0.34 miles at its furthest point.

O.2.3 Costco Wholesale Trailer Storage Facility

The San Joaquin County approved the Costco Wholesale Trailer Storage Facility site plan on August 30, 2022 (San Joaquin County 2022a). The site is approximately 7.9 acres, bordered by the Aqueduct to the north, I-508 to the southeast, and Hansen Road to the east. Construction will expand an existing unmanned trailer parking and storage facility from 200 trailers to a total of 439 trailers. The Project proposes utilizing an existing onsite well and a new onsite stormwater retention pond and bioswale (San Joaquin County 2022b). A mitigated negative declaration was approved July 8, 2022; the conditions of approval for the site expire in March of 2024 (San Joaquin County 2022b; San Joaquin County 2022a).

O.2.4 Crows Landing Industrial Business Park & Airfield

Stanislaus County is proposing to transform 1,528 acres of the former Crows Landing Naval Air facility into a regional employment and business center, called Crows Landing Industrial Business Park and Airfield (CLIBP), that capitalizes on existing transportation infrastructure. CLIBP is planned to be located on Fink Road in western Stanislaus County, two miles east of the Fink Road/Interstate-5 (I-5) interchange, at the current Naval Auxiliary Landing Field (Stanislaus County 2020a). The site is around 0.02 mile from the DMC at its closest point and around 1.3 miles from the DMC at its furthest point. The Stanislaus County Board of Supervisors certified an EIR in 2018 and adopted a Specific Plan to support CLIBP development for a variety of uses including light industrial, office, public facilities, open space, airport, and aviation-compatible uses. Stanislaus County is pursuing the development of the initial site infrastructure (roads, water supply, and drainage).

Construction on the multiphase Project was anticipated to begin in 2021, with completion of the first phase anticipated in 2028. The last phase of the Project is anticipated to be completed by 2048, if not sooner (Stanislaus County 2020b).

O.2.5 Edgewood Commercial Center

The Edgewood Commercial Center is under construction on the 10.92-acre southeast corner lot of Corral Hollow Road and Middlefield Drive in Tracy, California. The commercial center is approximately 0.3 acres from the DMC at its closest point, and 0.4 acres at its furthest point. The center will have a 3,884 square foot (sf) convenience store building, an automotive service station with six dispensers and a 2,880-sf canopy, an electric vehicle charging station containing 7 chargers, and associated parking area and landscaping improvements on the 2.44-acre northwestern portion of the site. The commercial center project is consistent with the *Tracy General Plan Environmental Impact Report*, certified by the City of Tracy on February 1, 2011. In accordance with CEQA Guidelines Section 15183, no further environmental assessment was required (Tracy Press 2020; Tracy City Planning Commission 2020).

O.2.6 Ellis and Avenues Specific Plan

The *Ellis Specific Plan* (2013, amended 2021) serves as the land use development plan for 321 acres in Tracy, California. The Ellis neighborhood is located alongside approximately 0.42 miles of the DMC

(MP 13.23 to MP 13.65), bordered by South Lammers Road and Corral Hollow Road and the Union Pacific Railroad Line. The DMC is approximately 0.7 miles from the site at its furthest point. The Ellis neighborhood includes a mix of residential housing types and densities with a maximum of 2,250 units, neighborhood parks, a Village Center, a storage facility, a water park, and an elementary school. The neighborhood is divided into three sub neighborhoods that correspond with the construction phases: phase one- village neighborhood, phase two- garden neighborhood, and phase three- town and country neighborhood (City of Tracy 2013c). Phases two and three (approximately 171 acres) are currently under construction (City of Tracy 2022c).

The *Avenues Specific Plan* was added to the *Ellis Specific Plan* in the May 2021 amendment. The amended Ellis Specific Plan area consists of the 341 acres of the Ellis Neighborhood and the 95 acres of the Avenues Neighborhood. The neighborhood is bordered by Valpico Road to the north, agricultural fields to the east, southeast and west, and will connect to the Ellis Neighborhood to the south (City of Tracy 2013). The DMC is located approximately 0.64 miles southwest of the Avenues Neighborhood at its closest point and 1.13 miles away at its furthest point. The Avenues Neighborhood had a subdivision map for 480 residential lots, a park, and associated roads approved by the City of Tracy in March 2022 and is not yet under construction (City of Tracy 2022d).

O.2.7 Interstate 205 and Interstate 580 - International Parkway Interchange Projects

The City of Tracy and the California Department of Transportation (Caltrans) are working cooperatively to examine and analyze feasible alternatives for two interchange projects within 1 mile of the DMC and within the City of Tracy's limits: I-205 at Mountain House Parkway/International Parkway Interchange and I-580 and International Parkway/Patterson Pass Road Interchange.

Caltrans, the CEQA and NEPA lead agency for the I-205/International Parkway Interchange Project, circulated the Project Draft Environmental Document (DED) for public review in July 2020. Caltrans has received public comments and is now preparing the Final Environmental Document.

In March 2021, the I-580/International Parkway Interchange Project completed the environmental phase during which the proposed build alternative was analyzed for potential environmental impacts as required by the NEPA and CEQA. The I-580/International Parkway Interchange Project is currently in the final design phase which involves detailed design of the proposed improvements, right of way acquisition, utility relocation, and stage construction definition, as defined in the approved Final Environmental Document. The I-580 /International Parkway Interchange Project final design phase is expected to be completed by February 2023 (City of Tracy and Caltrans 2022).

O.2.8 Tracy Hills Specific Plan

The *Tracy Hills Specific Plan* (2016, amended 2019) is the detailed plan and regulatory document for the development of the plan area, encompassing approximately 2,731.6 acres within the southern portion of the City of Tracy surrounding the existing interchange at Corral Hollow Road and the proposed Lammers Road interchange on I-580. Tracy Hills includes 1,117 acres of residential land, 59 acres of parks, 258 acres of commercial, retail, office and industrial land, 42 acres of school sites, 337 acres of greenways and on-site open space incorporated into the land plan, 63 acres of infrastructure and 3,535 acres of open space and conservation land. The plan area can be further divided into three areas: the northern portion, the central portion, and the southern portion (City of Tracy 2016).

The northern portion of the Specific Plan is between the DMC and the Aqueduct and zoned for medium density residential and light industrial uses. The central portion of the Specific Plan, south of the Aqueduct and north of I-580, is planned predominately for single-family homes, open space conservation easements, mixed use business park, and commercial retail areas. Multiuse trails will connect residential neighborhoods, integrated with public park amenities that are within walking distance. Additionally, an elementary school site is planned in this area. The southern portion of the Specific Plan area, with rolling and steeper slopes on the southern side of I-580, will be primarily residential neighborhoods with parks and school sites. Consistent with the General Plan, 180 to 185 acres of open space, will be integrated into the low-density residential areas. A mixed-use business park area will be located southwest of the planned Lammers interchange and a commercial retail area will be located along the southeasterly project boundary at Corral Hollow Road. This area abuts approximately 3,500 acres of open space under a conservation easement (City of Tracy 2016).

According to the September *City of Tracy Residential Development Pipeline Report* (2022), Tracy Hills Phase 1A, 1B, and the Tracy Hills KT Project (Hillview) are currently under construction.

Phase 1A includes the development of the residential neighborhood with three neighborhood parks, open space easements, and an elementary school between I-580 and the Aqueduct, between Corral Hollow Road and Lammers Road. Also planned for development is the Mixed-Use Business Park adjacent to Corral Hollow Road (City of Tracy 2016). The area is approximately 419 acres, bounded by the Aqueduct to the north, I-580 to the south, and Corral Hollow Road to the east. The area is approximately 0.39 miles from the DMC at its closest point and approximately 1.0 miles away at its furthest point.

On August 31st, 2022, Tracy Hills and the Jefferson School District School broke ground at the site of the future Corral Hollow Elementary School. The school is anticipated to open in August 2024 (Tracy Press 2022). The site is approximately 15 acres, bounded by Coriander Street to the south, Fargo Street to the west, Corral Hollow Road to the east, and the Aqueduct to the north. It is approximately 0.55 miles from the DMC at its closest point and 0.70 miles at its furthest point.

Phase 1B is a continuation of residential development in the areas between I-580 and the Aqueduct. Mixed Use Business Park development along the I-580 corridor is planned along with commercial development along Lammers Road. Parks, and open space corridor improvements will also be constructed (City of Tracy 2016). The area is approximately 307 acres, bounded by the Union Pacific Railroad to the north, the Aqueduct to the northeast, and I-580 to the southwest.

The Hillview Project is the construction of approximately 200 homes, a park, and a neighborhood pool (Lennar 2022). The site is approximately 31 acres and is 1.0 miles away from the DMC at its

furthest point, and 0.48 miles away at its closest point. It is bounded by the Aqueduct to the north and northeast, and Corral Hollow Road to the west.

Future development phases will include residential, mixed use business park, and general highway commercial development southwest of I-580 and west of Corral Hollow Road, and industrial park and residential development north of the Aqueduct, as individual landowners submit development applications (City of Tracy 2016).

O.2.9 Tracy Village Specific Plan

The *Tracy Village Specific Plan* (2018a) is the detailed plan for the development of approximately 135 acres into an age-qualified, gated, residential community of 594 homes, organized around a lake and open space system. Located on the southeast of Valpico Road and Corral Hollow Road, the site is bordered by existing residences to the west, south, and east, and Valpico road to the north. The site of Tracy Village is approximately 0.79 miles from the DMC at its closest point and approximately 1.36 miles away at its furthest point. As of the September *City of Tracy Residential Development Pipeline Report* (2022), the site has been approved and is not yet under construction. Construction impacts have been evaluated under the *Tracy Village Specific Plan EIR* (2018b).

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Delta-Mendota Canal Subsidence Correction Project Environmental Assessment/Initial Study

Appendix P: Comments and Responses

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Appendix P Comments and Responses

P.1 Introduction

This appendix contains responses to comments received on the Delta-Mendota Canal Subsidence Correction Project Draft Environmental Assessment/Initial Study (EA/IS). While responding to comments on an IS is not specifically required by CEQA, CEQA Guidelines Section 15074(b) requires that the lead agency consider any comments received on the IS prior to approving the project. This document provides evidence that San Luis & Delta-Mendota Water Authority (SLDMWA) considered all comments received on this EA/IS.

Each commenter, their associated agency/group, and assigned number identification is listed in Section P.2. Section P.3 includes the comments and responses to those comments. The full comment letters are included in Appendix Q.

P.2 List of Commenters

Table P-1 presents commenters and associated agencies or groups that submitted comments on the Delta-Mendota Canal Subsidence Correction Project Draft EA/IS.

Table P-1. List of Commenters

Commenter	Agency/Group	Letter ID
Julie Vance	California Department of Fish and Wildlife	1
Peter Minkel	Central Valley Regional Water Quality Control Board	2
Donald Davis and Ian Buck-Macleod	Friant Water Authority	3
Brian Clements	San Joaquin Valley Air Pollution Control District	4

P.3 Detailed Comments and Responses

Individual responses to comments are presented in the following section.

Comment Letter 1, Julie Vance, California Department of Fish and Wildlife

Comment 1-1

The California Department of Fish and Wildlife (CDFW) received an Initial Study (IS)/ Mitigated Negative Declaration (MND) from the San Luis and Delta Mendota Water Authority for the above-referenced Project pursuant to the California Environmental Quality Act (CEQA) and CEQA Guidelines.

Thank you for the opportunity to provide comments and recommendations regarding those activities involved in the Project that may affect California fish and wildlife. Likewise, CDFW

appreciates the opportunity to provide comments regarding those aspects of the Project that CDFW, by law, may be required to carry out or approve through the exercise of its own regulatory authority under Fish and Game Code. While the comment period may have passed, CDFW would appreciate if the Fresno County Department of Public Works and Planning will still consider our comments.

CDFW ROLE

CDFW is California's **Trustee Agency** for fish and wildlife resources and holds those resources in trust by statute for all the people of the State (Fish & G. Code, §§ 711.7, subd. (a) & 1802; Pub. Resources Code, § 21070; CEQA Guidelines § 15386, subd. (a)). CDFW, in its trustee capacity, has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and habitat necessary for biologically sustainable populations of those species (Id., § 1802). Similarly, for purposes of CEQA, CDFW is charged by law to provide, as available, biological expertise during public agency environmental review efforts, focusing specifically on projects and related activities that have the potential to adversely affect fish and wildlife resources.

CDFW is also submitting comments as a **Responsible Agency** under CEQA (Pub. Resources Code, § 21069; CEQA Guidelines, § 15381). CDFW expects to exercise regulatory authority as provided by the Fish and Game Code. As proposed, for example, the Project will be subject to CDFW's lake and streambed alteration regulatory authority (Fish & G. Code, § 1600 et seq.). Likewise, to the extent implementation of the Project as proposed may result in "take" as defined by State law of any species protected under the California Endangered Species Act (CESA) (Fish & G. Code, § 2050 et seq.), related authorization as provided by the Fish and Game Code will be required.

Nesting Birds: CDFW has jurisdiction over actions with potential to result in the disturbance or destruction of active nest sites or the unauthorized take of birds. Fish and Game Code sections that protect birds, their eggs and nests include sections 3503 (regarding unlawful take, possession or needless destruction of the nest or eggs of any bird), 3503.5 (regarding the take, possession or destruction of any birds-of-prey or their nests or eggs), and 3513 (regarding unlawful take of any migratory nongame bird).

Water Pollution: Pursuant to Fish and Game Code section 5650, it is unlawful to deposit in, permit to pass into, or place where it can pass into "Waters of the State" any substance or material deleterious to fish, plant life, or bird life, including non-native species. It is possible that without mitigation measures, implementation of the Project could result in pollution of Waters of the State from storm water runoff or construction-related erosion. Potential impacts to streams/lakes include the following: increased sediment input from road or structure runoff; and toxic runoff associated with development activities and implementation. The Regional Water Quality Control Board and United States Army Corps of Engineers also have jurisdiction regarding discharge and pollution to "Waters of the State".

Response

The comment acknowledges receipt of the Draft EA/IS and summarizes CDFW's regulatory role; no further response is required.

Comment 1-2

PROJECT DESCRIPTION SUMMARY

Proponent: San Luis and Delta-Mendota Water Authority

Objective: Since its original construction, the Delta-Mendota Canal (DMC) has been affected by land subsidence which has reduced the capacity the DMC can convey while operating in accordance with Reclamation Safety Standards and Guidelines. These limits on conveyance capacity have introduced operational constraints that can affect deliveries to south-of-Delta Central Valley Project (CVP) contractors. The continued, safe, and reliable operation of the DMC is critical to the users that it serves and the economies that it supports. The proposed project would restore the designed conveyance capacity of the DMC (a maximum flow capacity of 4,600 cubic feet per second (cfs) at the origin and a minimum flow capacity of 3,210 cfs at the terminus) by (1) raising deficient concrete lining segments and bank segments to meet the minimum freeboard requirements; (2) installing riprap for erosion protection to stabilize the banks along the earthen-lined segment; (3) replacing bridges and pipeline crossings that do not have enough clearance above water surface elevation to meet minimum required clearings; (4) raising the gates of check structures and wasteways to design level and modify impacted structures; and (5) evaluating existing drainage structures to modify them for safe passage of stormwater.

Location: Per Project information, Project effects would occur within Alameda, San Joaquin, Stanislaus, Merced, Fresno, San Benito and Santa Clara Counties.

Timeframe: None given.

Response

The comment summarizes the project description and objectives, consistent with information presented in the Draft EA/IS. Regarding the portion of the comment indicating that no timeframe was provided for Project implementation, Section 2.2.1 (Construction Equipment and Schedule) of the Final EA/IS details that it is assumed construction would begin in March 2025 and would be conducted over a period of seven and a half years.

Comment 1-3

COMMENTS AND RECOMMENDATIONS

CDFW offers the following comments and recommendations to assist the San Luis and Delta-Mendota Water Authority in adequately identifying and/or mitigating the Project's significant, or potentially significant, direct and indirect impacts on fish and wildlife (biological) resources. Editorial comments or other suggestions may also be included to improve the environmental document for this Project.

Per California Natural Diversity Database (CNDDB) 2023 records, the Project site is within the geographic range of the Federal endangered (FE)/State threatened (ST) San Joaquin kit fox (*Vulpes macrotis mutica*), the State candidate-listed as endangered Crotch bumble bee (*Bombus crotchii*), the ST Swainson's hawk (*Buteo swainsoni*), the ST tricolored blackbird (*Agelaius tricolor*), and State Species of Special Concern (SSC) burrowing owl (*Athene cunicularia*).

Response

As described in Appendix M (Section M.1.2) of the Draft EA/IS, based on existing habitat conditions, species-specific habitat requirements, CNDDB occurrence records, and/or direct observations recorded during biological surveys conducted in April 2022, the San Joaquin kit fox, Swainson's hawk, tricolored blackbird, and burrowing owl were identified as having moderate to high potential to occur within the Project area.

The Draft EA/IS does not discuss the Crotch bumble bee because at the time that the Draft EA/IS was prepared the species was not a candidate for listing under the California Endangered Species Act (CESA), and as such, was not identified as a special-status species pursuant to CEQA guidelines. Although the species was declared a candidate for listing under CESA in 2019, a subsequent ruling issued by the Sacramento County Superior Court in November 2020 determined that insects were ineligible for listing under CESA. This ruling was in effect when the Draft EA/IS was prepared. However, following preparation of the Draft EA/IS, the November 2020 ruling was reversed, and as of September 30, 2022, the species' candidacy for listing under CESA was reinstated. The status of the Crotch bumble bee as a candidate species under CESA qualifies it as an endangered, rare, or threatened species under CEQA. Therefore, in accordance with CEQA guidelines, an evaluation of the likelihood of the Crotch bumble bee to occur within the Project area and a discussion of the potential impacts of the Proposed Action on the species has been added to Appendix M of the Final EA/IS.

Comment 1-4

SAN JOAQUIN KIT FOX (SJKF)

SJKF occurrences have been documented to the east of the DMC in the Firebaugh area (CDFW 2023). The Project has the potential to temporarily disturb and permanently alter suitable habitat for SJKF and directly impact individuals if present during construction, and other activities.

SJKF den in a variety of areas such as right-of-ways (ROW), agricultural and fallow/ruderal habitat, dry stream channels, and canal levees, and populations can fluctuate over time. SJKF are also capable of occupying urban environments (Cypher and Frost 1999). SJKF may be attracted to Project areas due to the type and level of ground-disturbing activities and the loose, friable soils resulting from intensive ground disturbance. SJKF will forage in fallow and agricultural fields and utilize streams and canals as dispersal corridors. As a result, there is potential for SJKF to occupy all suitable habitat within the proposed Project boundary and surrounding area.

The Project area is within, adjacent to, and crosses through several areas of highly suitable habitat. Therefore, subsequent ground-disturbing activities have the potential to significantly impact local SJKF populations.

For all Project-specific components including construction, CDFW recommends that a qualified biologist conduct a habitat assessment in advance of Project implementation, to determine if the Project area or its immediate vicinity contains suitable habitat for SJKF in support of the CEQA document.

CDFW recommends assessing presence/absence of SJKF by having qualified biologists conducting surveys of Project areas and a 500-foot buffer of Project areas to detect SJKF and their sign. CDFW also recommends following the United States Fish and Wildlife Service (USFWS) "Standardized recommendations for protection of the San Joaquin kit fox prior to or during ground disturbance" (2011).

SJKF detection warrants consultation with CDFW to discuss how to avoid take or, if avoidance is not feasible, to acquire an Incidental Take Permit (ITP) prior to ground-disturbing activities, pursuant to Fish and Game Code section 2081 subdivision (b).

Response

As discussed in Appendix M (Section M.4.2.1) of the Draft EA/IS, SJKF presence in the western San Joaquin Valley is largely limited to a narrow belt of suitable habitat between Interstate 5 and the

Coast Range foothills. As such, known occurrences of the species are largely concentrated west of the Project area. In addition, as noted in the Draft EA/IS, SJKF are known to occupy human-altered habitats, where denning opportunities and suitable prey are available, and the species frequently uses human-made features (e.g., culverts in roadbeds and pipes) in developed landscapes. Therefore, although no SJKFs were observed during surveys of the Project area conducted in April 2022, the Project area and surrounding grassland, where present, are expected to provide SJKFs with suitable foraging habitat, potential prey, and existing ground squirrel burrows for denning.

As discussed in Appendix M (Section M.4.2.1) of the Draft EA/IS, construction activities implemented under the Proposed Action could cause the destruction of potential kit fox dens—potentially resulting in mortality if dens are occupied—and may temporarily displace kit foxes from preferred habitats, thereby increasing intraspecific competition for resources and making displaced individuals more susceptible to predation or vehicle strikes. Construction may also result in reproductive failure by disrupting foraging activities, increasing human disturbance, and precluding the formation of natal dens in the Project area. The loss of potential dens and temporarily reduced habitat access would negatively affect SJKFs if any were to be present in the vicinity during Project implementation, and such impacts would likely be significant.

To avoid or minimize impacts on the SJKF from implementation of the Proposed Action such that they would be less than significant, mitigation measure (MM) BIO-5 would be implemented as described in Section 4.14.4.5 of the Draft EA/IS. This measure includes (1) conducting pre-construction monitoring to identify potential and occupied SJKF dens within the Project area (2) contacting USFWS and CDFW to determine permissible actions to permit resumption of work in situations where an occupied natal is encountered within or near the Project area, and (3) implementing no-disturbance buffers as recommended in the USFWS *Standardized Recommendations for Protection of the SJKF Prior to or During Ground Disturbance* around SJKF dens as appropriate. Additionally, in accordance with MM BIO-2 (as revised), SLDMWA will consult with CDFW to determine whether take authorization is required for expected impacts on the SJKF, and if necessary, will obtain take authorization through acquisition of an ITP from CDFW.

Comment 1-5

CROTCH BUMBLE BEE (CBB)

The proposed Project location is within CBB range (CDFW 2023). Suitable CBB habitat includes areas of grasslands and upland scrub that contain requisite habitat elements, such as small mammal burrows. CBB primarily nest in late February through late October underground in abandoned small mammal burrows but may also nest under perennial bunch grasses or thatched annual grasses, under brush piles, in old bird nests, and in dead trees or hollow logs (Williams et al. 2014; Hatfield et al. 2015). Overwintering sites utilized by CBB mated queens include soft, disturbed soil (Goulson 2010), or under leaf litter or other debris (Williams et al. 2014). Therefore, potential ground disturbance and vegetation removal associated with Project implementation may significantly impact local CBB populations.

CBB was once common throughout most of central and southern California; however, it now appears to be absent from most of it, especially in the central portion of its historic range within California's Central Valley (Hatfield et al. 2014). Analyses by the Xerces Society et al. (2018) suggest there have been sharp declines in relative abundance by 98% and persistence by 80% over the last ten years.

CDFW recommends that a qualified biologist conduct focused surveys for CBB, and their requisite habitat features prior to Project implementation to evaluate impacts resulting from potential ground- and vegetation-disturbing activities that may result from the approval of the IS/MND.

If surveys cannot be completed, CDFW recommends that all small mammal burrows and thatched/bunch grasses be avoided by a minimum of 50 feet to avoid take and potentially significant impacts. If ground-disturbing activities will occur during the overwintering period (October through February), consultation with CDFW is warranted to discuss how to implement Project activities and avoid take. Any detection of CBB prior to or during Project implementation warrants consultation with CDFW to discuss how to avoid take.

If CBB is identified during surveys, consultation with CDFW is warranted to determine if the Project can avoid take. If take cannot be avoided, take authorization prior to any ground-disturbing activities may be warranted. Take authorization would occur through acquisition of an ITP by CDFW, pursuant to Fish and Game Code section 2081 subdivision (b).

Response

As noted in the Response to Comment 1-3, the following evaluation of the likelihood of the Crotch bumble bee to occur within the Project area and discussion of the potential impacts of the Proposed Action on the species has been added to Appendix M of the Final EA/IS.

According to CNDDB records, three occurrences of the Crotch bumble bee have been documented in the vicinity (i.e., within 5 miles) of the Project area. However, these occurrences were all recorded prior to 1960. The nearest recent (documented within the last 20 years) occurrence of the species was recorded approximately 18 miles away from the Project area. Marginally suitable annual grassland habitats occur throughout the Project area. Habitat suitability for the Crotch bumble bee is dependent on the presence of suitable nesting sites, floral resources, and overwintering sites. Crotch bumble bees primarily nest from late February through late October in abandoned small mammal burrows but may also nest under perennial bunch grasses or thatched annual grasses, beneath brush piles, in old bird nests, and in dead trees or hollow logs (Williams et al. 2014). Crotch bumble bees are generalist foragers capable of collecting pollen and nectar from a wide variety of flowering plants (Williams et al. 2014). Little is known about the overwintering sites used by Crotch bumblebees; however, bumble bees generally overwinter in soft disturbed soil or under leaf litter.

Annual grassland habitats within the Project area are considered marginally suitable for the Crotch bumble bee because they are within the DMC ROW, which is subject to regular maintenance to control weedy vegetation (i.e., blading and discing and herbicide use). Blading and discing involves using a grader- or tractor-mounted blade or disc to scrape or shallowly till the soil. These activities disturb the upper soil horizons, which is not conducive to maintaining the types of underground cavities typically used by Crotch bumble bees for nesting. Blading and discing may also result in the removal of flowering plants providing pollen and nectar resources. Similarly, herbicides used to control weeds along the DMC ROW may reduce the availability of floral resources for Crotch bumble bees within the Project area.

Despite the marginal nature of existing annual grassland habitats, Crotch bumble bees have the potential to occur within the Project area where such habitats are present. Therefore, ground disturbance associated with Project implementation has the potential to impact the Crotch bumble bee through direct mortality from being crushed in underground burrows or collisions with vehicles or equipment. Additionally, ground disturbance may result in the loss of foraging plants; changes in foraging behavior; nest abandonment; reduced nest success; and reduced health and vigor of eggs,

young and/or queens. Based on the findings of the 2022 surveys, potential Crotch bumble bee nesting, foraging, and overwintering habitat is ubiquitous throughout the Project area. Therefore, the avoidance of areas that may provide suitable Crotch bumble bee habitat is infeasible. Similarly, avoidance of the Crotch bumble bee overwintering period is infeasible as construction work would be required year-round to achieve Project objectives. For these reasons, the Proposed Action has the potential to result in impacts due to direct disturbance and/or habitat loss. Given however the marginal quality of the habitat present and the multiple decade long period since Crotch bumble bees have been observed within the Project area no substantial adverse effect on this species, either directly or through habitat modifications, is anticipated. Nevertheless, in accordance with MM BIO-2 (as revised), upon any detection of Crotch bumble bees prior to or during Project implementation, SLDMWA would coordinate with CDFW to identify applicable species-specific avoidance and minimization measures, determine whether compensatory mitigation would be required, and obtain take authorization, if necessary. Therefore, with the implementation of MM BIO-2, impacts on the Crotch bumble bee would be less than significant.

Comment 1-6

SWAINSON'S HAWK (SWHA)

SWHA have the potential to nest near the Project site. The CNDDB shows SWHA occurrences throughout the Project vicinity (CDFW 2023).

Without appropriate avoidance and minimization measures for SWHA, potential significant impacts that may result from Project activities include nest abandonment, and/or loss of foraging habitat that would reduce nesting success (loss or reduced health or vigor of eggs or young). Any take of SWHA without appropriate incidental take authorization would be a violation of Fish and Game Code.

SWHA exhibit high nest-site fidelity year after year and lack of suitable nesting habitat in the San Joaquin Valley limits their local distribution and abundance (CDFW 2016). The Project as proposed will involve noise, groundwork, and movement of workers that could affect nests and has the potential to result in nest abandonment, significantly impacting local nesting SWHA.

To evaluate potential impacts, CDFW recommends that a qualified wildlife biologist conduct surveys for nesting SWHA following the survey methods developed by the Swainson's Hawk Technical Advisory Committee (SWHA TAC, 2000) prior to Project implementation. The survey protocol includes early season surveys to assist the project proponent in implementing necessary avoidance and minimization measures, and in identifying active nest sites prior to initiating ground-disturbing activities.

If ground-disturbing Project activities are to take place during the normal bird breeding season (March 1 through September 15), CDFW recommends that additional pre-activity surveys for active nests be conducted by a qualified biologist no more than 10 days prior to the start of Project implementation. CDFW recommends a minimum no-disturbance buffer of ½-mile be delineated around active nests until the breeding season has ended or until a qualified biologist has determined that the birds have fledged and are no longer reliant upon the nest or parental care for survival.

CDFW recommends that in the event an active SWHA nest is detected during surveys and the ½-mile no-disturbance buffer around the nest cannot feasibly be implemented, consultation with CDFW is warranted to discuss how to implement the project and avoid take. If take cannot be avoided, take authorization through the issuance of an ITP, pursuant to Fish and Game Code section 2081 subdivision (b) is necessary to comply with CESA.

Response

As discussed in Appendix M (Section M.4.2.1) of the Draft EA/IS, Swainson's hawks were observed soaring over portions of the Project area during biological surveys that were conducted in April 2022. Implementation of the Proposed Action could result in the temporary and permanent loss of foraging habitat (i.e., annual grassland and agricultural fields) through the staging of equipment, temporary construction access, and other construction activities that may occur along the outer edge of the DMC ROW. Additionally, direct disturbance to nests and/or breeding adults may occur where Project activities occur near or involve the removal of suitable nesting trees for Swainson's hawks. Further, indirect disturbance due to construction activities, such as noise and vibration associated with the operation of vehicles and heavy equipment, could have significant impacts on Swainson's hawks in the form of stress, injury, or mortality to individuals where construction activities occur near active nests.

To minimize potential impacts on Swainson's hawks, MM BIO-8 would be implemented as described in Section 4.14.4.8 of the Draft EA/IS. This measure includes: (1) conducting pre-construction surveys no more than 10 days before ground disturbance in a given area for construction activities that would occur between February 1 and August 31; (2) establishing a 0.5-mile no-disturbance buffer around active Swainson's' hawk nests that will be maintained until a qualified biologist has determined that the young have fledged and are no longer reliant on the nest or parental care for survival; and (3) consulting with CDFW in situations where establishing a 0.5-mile no-disturbance buffer is infeasible to determine whether a reduced minimum no-disturbance buffer could be implemented or to identify alternative measures to minimize the potential for Project-related disturbance to existing Swainson's hawk nest sites. Additionally, if trees suitable for Swainson's hawk nesting are scheduled to be removed during the non-nesting season, a qualified biologist will conduct a pre-construction survey during the nesting season prior to tree removal to determine whether Swainson's hawks are using the trees for nesting. If the trees proposed for removal are being used by nesting Swainson's hawk, consultation with CDFW will take place prior to tree removal. Lastly, if consultation with CDFW results in a determination that take of an active Swainson's hawk nest cannot be avoided, then take authorization pursuant to CESA will be obtained from CDFW prior to initiation of any activities that are likely to result in take.

Comment 1-7

TRICOLORED BLACKBIRD (TRBL)

TRBL occurrences have been documented near certain portions of the Project site (CDFW 2023). TRBL colonies require suitable nesting habitat, nearby freshwater, and nearby foraging habitat including semi-natural grasslands, agricultural croplands or alkali scrub (Beedy et al. 2017). Habitat surrounding the Project area may provide suitable foraging habitat for TRBL.

CDFW recommends that Project activities be timed to avoid the normal bird breeding season (February 1 through September 15). However, if Project activities must take place during that time, CDFW recommends that a qualified wildlife biologist conduct surveys for nesting TRBL no more than 10 days prior to the start of implementation to evaluate presence/absence of TRBL nesting colonies in proximity to Project activities and to evaluate potential Project-related impacts in support of the CEQA document.

If an active TRBL nesting colony is found during preconstruction surveys, CDFW recommends implementation of a minimum 300-foot no-disturbance buffer in accordance with CDFW's "Staff Guidance Regarding Avoidance of Impacts to Tricolored Blackbird Breeding Colonies on

Agriculture Fields in 2015" (CDFW 2015). CDFW advises that this buffer remain in place until the breeding season has ended or until a qualified biologist has determined that nesting has ceased, the birds have fledged, and are no longer reliant upon the colony or parental care for survival. It is important to note that TRBL colonies can expand over time and for this reason, the colony should be reassessed to determine the extent of the breeding colony within 10 days for Project initiation.

In the event that a TRBL nesting colony is detected during surveys, consultation with CDFW is warranted to discuss how to implement the Project and avoid take, or if avoidance is not feasible, to acquire an ITP, pursuant to Fish and Game Code section 2081 subdivision (b), prior to any ground-disturbing activities.

Response

As discussed in Appendix M (Section M.4.2.1) of the Draft EA/IS, tricolored blackbirds breed near fresh water, preferably in emergent wetlands with tall, dense cattails or tules. Preferred foraging habitats for the tricolored blackbird include crops such as rice, alfalfa, irrigated pastures, and ripening or cut grain fields (e.g., oats, wheat, silage), as well as annual grasslands, cattle feedlots, and dairies (Beedy and Hamilton 1999). Although the species was not observed within or near the Project area during biological surveys conducted in April 2022, suitable habitat for the species is present within the Project area including freshwater emergent wetlands, ponds, and maintained agricultural ditches and drainage features with perennial water and sufficient vegetation. Activities associated with the Proposed Action, such as vegetation clearance to facilitate construction access, could result in the loss or alteration of breeding habitat for the tricolored blackbird and/or indirect (noise) disturbance to nest sites, which could result in nest abandonment, loss of young, or reduced health and vigor of eggs and/or nestlings.

To minimize potential impacts on tricolored blackbirds, MM BIO-6 would be implemented as described in Section 4.14.4.6 of the Draft EA/IS. This measure includes (1) conducting appropriately timed pre-construction surveys in portions of the Project area where suitable tricolored blackbird habitat occurs within 0.25 mile of construction areas, (2) avoiding work within 0.25 mile of tricolored blackbird colonies during the nesting season, and (3) consulting with CDFW if colonies cannot be avoided.

Comment 1-8

BURROWING OWL (BUOW)

BUOW have been observed near the DMC Project site (CDFW 2023) throughout the length of the project area. BUOW inhabit open/disturbed grassland and/or adjacent canal banks, ROWs, vacant lots, etc. containing small mammal burrows, a requisite habitat feature used by BUOW for nesting and cover. Review of aerial imagery indicates that some of the Project site is bordered by annual grassland and potentially fallow agricultural fields.

Potentially significant direct impacts associated with subsequent activities include burrow collapse, inadvertent entrapment, nest abandonment, reduced reproductive success, reduction in health and vigor of eggs and/or young, and direct mortality of individuals.

BUOW rely on burrow habitat year-round for their survival and reproduction. Habitat loss and degradation are considered the greatest threats to BUOW in California's Central Valley (Gervais et al. 2008). Therefore, subsequent ground-disturbing activities associated with the Project have the potential to significantly impact local BUOW populations. In addition, and as described in CDFW's

"Staff Report on Burrowing Owl Mitigation" (CDFG 2012), excluding and/or evicting BUOW from their burrows is considered a potentially significant impact under CEQA.

CDFW recommends assessing presence/absence of BUOW by having a qualified biologist conduct surveys following the California Burrowing Owl Consortium's "Burrowing Owl Survey Protocol and Mitigation Guidelines" (CBOC 1993) and CDFW's Staff Report on Burrowing Owl Mitigation" (CDFG 2012) in support of the CEQA document. Specifically, CBOC and CDFW's Staff Report suggest three or more surveillance surveys conducted during daylight with each visit occurring at least three weeks apart during the peak breeding season (April 15 to July 15), when BUOW are most detectable.

CDFW recommends no-disturbance buffers, as outlined in the "Staff Report on Burrowing Owl Mitigation" (CDFG 2012), be implemented prior to and during any ground-disturbing activities. Specifically, CDFW's Staff Report recommends that impacts to occupied burrows be avoided in accordance with the following table unless a qualified biologist approved by CDFW verifies through non-invasive methods that either: 1) the birds have not begun egg laying and incubation; or 2) that juveniles from the occupied burrows are foraging independently and are capable of independent survival.

Location	Time of Year	Level of Disturbance		
		Low	Med	High
Nesting sites	April 1-Aug 15	200 m*	500 m	500 m
Nesting sites	Aug 16-Oct 15	200 m	200 m	500 m
Nesting sites	Oct 16-Mar 31	50 m	100 m	500 m

* meters (m)

If BUOW are found within these recommended buffers and avoidance is not possible, it is important to note that according to the Staff Report (CDFG 2012), exclusion is not a take avoidance, minimization, or mitigation method and is considered a potentially significant impact under CEQA. However, if necessary, CDFW recommends that burrow exclusion be conducted by qualified biologists and only during the non-breeding season, before breeding behavior is exhibited and after the burrow is confirmed empty through non-invasive methods, such as surveillance. CDFW recommends replacement of occupied burrows with artificial burrows at a ratio of 1 burrow collapsed to 1 artificial burrow constructed (1:1) as mitigation for the potentially significant impact of evicting BUOW. BUOW may attempt to colonize or re-colonize an area that will be impacted; thus, CDFW recommends ongoing surveillance, at a rate that is sufficient to detect BUOW if they return.

Response

As discussed in Appendix M (Section M.4.2.1) of the Draft EA/IS, burrowing owls were not observed during biological surveys that were conducted in April 2022. However, suitable habitat featuring friable soils, existing small mammal burrows, and grazed grassland is present within and adjacent to the Project area. Open developed areas, canal embankments, and fallow agricultural fields also have the potential to support burrowing owls. In addition, this species has potential to use canal infrastructure, such as culverts, for nesting. If burrowing owls are present during Project implementation, the Proposed Action could result in a temporary or permanent loss of burrowing owl habitat and displacement of owls where project activities affect potential burrow sites. Direct disturbance from construction activities, such as operation of vehicles and heavy equipment and

earth-moving operations around burrows could result in significant impacts due to stress, injury, or mortality to individual owls and/or destruction of their burrows. Potential impacts on burrowing owl habitat are considered to be largely temporary because small mammal burrows are expected to become reestablished along the modified earthen-lined segments of the DMC once construction is complete.

To minimize potential impacts on burrowing owls, MM BIO-7 would be implemented as described in Section 4.14.4.7 of the Draft EA/IS. As such, a minimum of one pre-construction survey for burrowing owls within a minimum of 500 feet of the Project area (where accessible) will be conducted by a qualified biologist within 15 days prior to the initiation of construction activities in a given area, regardless of the timing of construction. Further, pre-construction surveys each year of construction during the nonbreeding season (September 1 to January 31) will take place in order to determine the presence of burrowing owls before breeding activities begin. If any occupied burrows are identified, appropriate conservation measures (as determined by a qualified biologist) will be implemented. No disturbance will occur within 150 feet of occupied burrows during the nonbreeding season (September 1 to January 31) or within 250 feet during the breeding season (February 1 to August 31). These measures may also include establishing a construction-free buffer zone around the active nest site in coordination with CDFW, biological monitoring of the active nest site, and delaying construction activities in the vicinity of the active nest site until the young have fledged.

If burrowing owls are detected within the Project area during the nonbreeding season and maintaining a 150-foot, no-disturbance buffer is not practicable, a qualified biologist will submit an exclusion and passive relocation plan to CDFW. The exclusion and passive relocation plan will generally follow the guidelines outlined in Appendix E of the *Staff Report on Burrowing Owl Mitigation* (CDFW 2012). The exclusion and passive relocation plan will consist of installing one-way doors in potential burrows, daily monitoring, and collapsing burrows once it is determined that the burrows are unoccupied. Exclusion may only take place during the nonbreeding season (September 1 to January 31) and may be an ongoing effort during this time. This will allow the owls to exit burrows if they are present, but not return. The exclusion and passive relocation plan will also detail plans to replace collapsed burrows with artificial burrows at a minimum 1:1 ratio or describe why artificial burrows are not needed (e.g., numerous available natural burrows are available in nearby areas that will not be disturbed). Monitoring of collapsed burrows will be conducted as needed so that burrowing owls do not recolonize the area prior to construction disturbance.

If occupied burrows are detected during the breeding season and maintaining a 250-foot no-disturbance buffer is not practicable, CDFW will be consulted to determine alternative measures to minimize the potential for disturbance to occupied burrows and nesting activities. Measures may include but are not limited to continuous biological monitoring by a qualified biologist until it has been determined that the young have fledged and are no longer reliant on the nest or parental care for survival or construction is complete. No direct disturbance of burrows with eggs or young will be conducted without written authorization from the CDFW and USFWS.

Comment 1-9

LAKE AND STREAMBED ALTERATION

The Project includes evaluating existing drainage structures and may require modification for safe passage of stormwater. Therefore, the Project may be subject to CDFW's regulatory authority pursuant Fish and Game Code Section 1600 et seq. Fish and Game Code section 1602 requires the Project proponent to notify CDFW prior to commencing any activity that may (a) substantially

divert or obstruct the natural flow of any river, stream, or lake; (b) substantially change or use any material from the bed, bank, or channel of any river, stream, or lake; or (c) deposit debris, waste or other materials that could pass into any river, stream, or lake. "Any river, stream, or lake" includes those that are ephemeral or intermittent as well as those that are perennial in nature. For additional information on notification requirements, please contact our staff in the LSA Program at (559) 243-4593, or by electronic mail at R4LSA@wildlife.gov.

Response

Reclamation and SLDMWA are committed to working with CDFW throughout Project implementation. SLDMWA will secure all necessary permits prior to implementation of the Proposed Action.

Comment 1-10

FEDERALLY LISTED SPECIES

CDFW also recommends consulting with the USFWS on potential impacts to Federal listed species including, but not limited to, SJKF. Take under the Federal Endangered Species Act (FESA) is more broadly defined than CESA; take under FESA also includes significant habitat modification or degradation that could result in death or injury to a listed species by interfering with essential behavioral patterns such as breeding, foraging, or nesting. Consultation with the USFWS in order to comply with FESA is advised well in advance of any ground disturbing activities.

More information on survey and monitoring protocols for sensitive species can be found at CDFW's website (https://www.wildlife.ca.gov/Conservation/Survey-Protocols). If you have any questions, please contact Kelley Nelson, Environmental Scientist, at the address provided on this letterhead, by telephone at (559) 580-3194, or by electronic mail at Kelley.Nelson@wildlife.ca.gov.

Response

Prior to Project implementation, Reclamation will consult with USFWS regarding potential impacts on federally listed with potential to occur within the Project area to ensure that its actions do not jeopardize the continued existence of these species or destroy/adversely modify critical habitat pursuant to Section 7(a)(2) of the ESA. If consultation with USFWS results in the issuance of a biological opinion, the Proposed Action will be conducted in compliance with all reasonable and prudent measures and terms and conditions set forth in the biological opinion.

Comment Letter 2, Peter Minkel, Central Valley Regional Water Quality Control Board

Comment 2-1

Pursuant to the State Clearinghouse's 13 February 2023 request, the Central Valley Regional Water Quality Control Board (Central Valley Water Board) has reviewed the Request for Review for the Mitigated Negative Declaration for the Delta-Mendota Canal Subsidence Correction Project, located in Alameda, Fresno, Merced, San Benito, San Joaquin, Santa Clara, and Stanislaus Counties.

Our agency is delegated with the responsibility of protecting the quality of surface and groundwaters of the state; therefore, our comments will address concerns surrounding those issues.

Response

The comment acknowledges receipt of the EA/IS and summarizes the Central Valley Regional Water Quality Control Board's (Central Valley RWQCB) regulatory role; no further response is required.

Comment 2-2

I. Regulatory Setting

Basin Plan

The Central Valley Water Board is required to formulate and adopt Basin Plans for all areas within the Central Valley region under Section 13240 of the Porter-Cologne Water Quality Control Act. Each Basin Plan must contain water quality objectives to ensure the reasonable protection of beneficial uses, as well as a program of implementation for achieving water quality objectives with the Basin Plans. Federal regulations require each state to adopt water quality standards to protect the public health or welfare, enhance the quality of water and serve the purposes of the Clean Water Act. In California, the beneficial uses, water quality objectives, and the Antidegradation Policy are the State's water quality standards. Water quality standards are also contained in the National Toxics Rule, 40 CFR Section 131.36, and the California Toxics Rule, 40 CFR Section 131.38.

The Basin Plan is subject to modification as necessary, considering applicable laws, policies, technologies, water quality conditions and priorities. The original Basin Plans were adopted in 1975, and have been updated and revised periodically as required, using Basin Plan amendments. Once the Central Valley Water Board has adopted a Basin Plan amendment in noticed public hearings, it must be approved by the State Water Resources Control Board (State Water Board), Office of Administrative Law (OAL) and in some cases, the United States Environmental Protection Agency (USEPA). Basin Plan amendments only become effective after they have been approved by the OAL and in some cases, the USEPA. Every three (3) years, a review of the Basin Plan is completed that assesses the appropriateness of existing standards and evaluates and prioritizes Basin Planning issues. For more information on the Water Quality Control Plan for the Sacramento and San Joaquin River Basins, please visit our website:
http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/

Antidegradation Considerations

All wastewater discharges must comply with the Antidegradation Policy (State Water Board Resolution 68-16) and the Antidegradation Implementation Policy contained in the Basin Plan. The Antidegradation Implementation Policy is available on page 74 at:
https://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/sacsjr_201805.pdf

In part it states:

Any discharge of waste to high quality waters must apply best practicable treatment or control not only to prevent a condition of pollution or nuisance from occurring, but also to maintain the highest water quality possible consistent with the maximum benefit to the people of the State.

This information must be presented as an analysis of the impacts and potential impacts of the discharge on water quality, as measured by background concentrations and applicable water quality objectives.

The antidegradation analysis is a mandatory element in the National Pollutant Discharge Elimination System and land discharge Waste Discharge Requirements (WDRs) permitting processes. The environmental review document should evaluate potential impacts to both surface and groundwater quality.

Response

Information regarding the Basin Plan is included within Appendix E (Section E.2.21) of the EA/IS. The project does not include the discharge of wastewater. Surface water and groundwater quality impacts are evaluated in Section 4.2 of the EA/IS.

Comment 2-3

II. Permitting Requirements

Construction Storm Water General Permit

Dischargers whose project disturb one or more acres of soil or where projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, are required to obtain coverage under the General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (Construction General Permit), Construction General Permit Order No. 2009-0009-DWQ. Construction activity subject to this permit includes clearing, grading, grubbing, disturbances to the ground, such as stockpiling, or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility. The Construction General Permit requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP). For more information on the Construction General Permit, visit the State Water Resources Control Board website at: http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml

Clean Water Act Section 404 Permit

If the project will involve the discharge of dredged or fill material in navigable waters or wetlands, a permit pursuant to Section 404 of the Clean Water Act may be needed from the United States Army Corps of Engineers (USACE). If a Section 404 permit is required by the USACE, the Central Valley Water Board will review the permit application to ensure that discharge will not violate water quality standards. If the project requires surface water drainage realignment, the applicant is advised to contact the Department of Fish and Game for information on Streambed Alteration Permit requirements. If you have any questions regarding the Clean Water Act Section 404 permits, please contact the Regulatory Division of the Sacramento District of USACE at (916) 557-5250.

Clean Water Act Section 401 Permit – Water Quality Certification

If an USACE permit (e.g., Non-Reporting Nationwide Permit, Nationwide Permit, Letter of Permission, Individual Permit, Regional General Permit, Programmatic General Permit), or any other federal permit (e.g., Section 10 of the Rivers and Harbors Act or Section 9 from the United States Coast Guard), is required for this project due to the disturbance of waters of the United States (such as streams and wetlands), then a Water Quality Certification must be obtained from the Central Valley Water Board prior to initiation of project activities. There are no waivers for 401 Water Quality Certifications. For more information on the Water Quality Certification, visit the Central Valley Water Board website at: https://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_certification/

Waste Discharge Requirements – Discharges to Waters of the State

If USACE determines that only non-jurisdictional waters of the State (i.e., "non-federal" waters of the State) are present in the proposed project area, the proposed project may require a Waste Discharge Requirement (WDR) permit to be issued by Central Valley Water Board. Under the California Porter-Cologne Water Quality Control Act, discharges to all waters of the State, including all wetlands and other waters of the State including, but not limited to, isolated wetlands, are subject to State regulation. For more information on the Waste Discharges to Surface Water NPDES Program and WDR processes, visit the Central Valley Water Board website at: https://www.waterboards.ca.gov/centralvalley/water_issues/waste_to_surface_water/

Projects involving excavation or fill activities impacting less than 0.2 acre or 400 linear feet of non-jurisdictional waters of the state and projects involving dredging activities impacting less than 50 cubic yards of non-jurisdictional waters of the state may be eligible for coverage under the State Water Resources Control Board Water Quality Order No. 2004-0004-DWQ (General Order 2004-0004). For more information on the General Order 2004-0004, visit the State Water Resources Control Board website at: https://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2004/wqo/wqo2004-0004.pdf

Dewatering Permit

If the proposed project includes construction or groundwater dewatering to be discharged to land, the proponent may apply for coverage under State Water Board General Water Quality Order (Low Threat General Order) 2003-0003 or the Central Valley Water Board's Waiver of Report of Waste Discharge and Waste Discharge Requirements (Low Threat Waiver) R5-2018-0085. Small temporary construction dewatering projects are projects that discharge groundwater to land from excavation activities or dewatering of underground utility vaults. Dischargers seeking coverage under the General Order or Waiver must file a Notice of Intent with the Central Valley Water Board prior to beginning discharge.

Quality Order No. 2004-0004-DWQ (General Order 2004-0004). For more information on the General Order 2004-0004, visit the State Water Resources Control Board website at: https://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2004/wqo/wqo2004-0004.pdf

Limited Threat General NPDES Permit

If the proposed project includes construction dewatering and it is necessary to discharge the groundwater to waters of the United States, the proposed project will require coverage under a National Pollutant Discharge Elimination System (NPDES) permit. Dewatering discharges are typically considered a low or limited threat to water quality and may be covered under the General Order for Limited Threat Discharges to Surface Water (Limited Threat General Order). A complete Notice of Intent must be submitted to the Central Valley Water Board to obtain coverage under the Limited Threat General Order. For more information regarding the Limited Threat General Order and the application process, visit the Central Valley Water Board website at: https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2016-0076-01.pdf

NPDES Permit

If the proposed project discharges waste that could affect the quality of surface waters of the State, other than into a community sewer system, the proposed project will require coverage under a National Pollutant Discharge Elimination System (NPDES) permit. A complete Report of Waste Discharge must be submitted with the Central Valley Water Board to obtain a NPDES Permit. For more information regarding the NPDES Permit and the application process, visit the Central Valley Water Board website at: https://www.waterboards.ca.gov/centralvalley/help/permit/

Response

Reclamation and SLDMWA will obtain all necessary permits prior to implementation of the Proposed Action.

Comment Letter 3, Donald Davis and Ian Buck-Macleod, Friant Water Authority

Comment 3-1

The Friant Water Authority respectfully submits these comments on the Draft Environmental Assessment/Initial Study (EA/IS) for the Delta Mendota Canal Subsidence Correction Project (Project) that was released for public review on February 13, 2023. We understand that the Draft EA/IS was prepared jointly by the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), and the San Luis & Delta-Mendota Water Authority (SLDMWA), which is the operating non-federal entity for the Delta Mendota Canal (DMC).

Background on FWA and Areas of Interest

As Reclamation and SLDMWA are well aware, the Friant Water Authority (FWA) is the operating non-federal entity for the Friant-Kern Canal (FKC) pursuant to Transfer Agreement Contract No. 8-07-20-X0356-X with Reclamation. As a joint powers authority whose membership consists of water agencies with long-term water supply contracts with Reclamation for water from the Friant Division (Friant Division Contractors), FWA also has an interest in and is authorized to protect the water supplies and water rights of Friant Division Contractors.

The FKC, like the subject DMC, is a significant feature of the Central Valley Project (CVP). As acknowledged in the Draft EA/IS, although the FKC and DMC are not physically connected conveyance facilities, there is a significant interrelationship to their operations by virtue of the United States' contractual obligations to supply CVP water to the Exchange Contractors and Settlement Contractors primarily through the DMC, but under certain conditions, as prescribed in various underlying contracts, Reclamation may, in limited circumstances, make releases of San Joaquin River water from Friant Dam (a call on Friant), which, along with Millerton Lake, are facilities of the Friant Division of the CVP. Because of conditions unrelated to any reduction in the conveyance capacity of the DMC, Reclamation has made calls on Friant in 2014, 2015, 2016 (via exchanges), 2021 (via exchanges), and 2022. These calls on Friant have impacted the water supplies of irrigation, and municipal and industrial (M&I) users supplied by Friant Division Contractors, and during the worst of the drought years and most significant calls on Friant (i.e., 2014 and 2015) caused significant and long-term damage to crops, orchards, and other farm land.

Calls on Friant also impact the San Joaquin River Restoration Program (SJRRP), which is a comprehensive, long-term effort managed by various federal and state agencies to restore flows to the San Joaquin River from Friant Dam to the confluence of Merced River and restore a self-sustaining Chinook salmon fishery in the river while reducing or avoiding adverse water supply

impacts, primarily to Friant Division Contractors, from the release of restoration flows. In particular, calls on Friant reduce available water supplies and the cold-water pool in Millerton Lake, and disconnects the river, which in turn impacts the timing, temperature, and amount of restoration flows, and migration in the San Joaquin River, which can cause potentially significant impacts to the fish populations.

Response

The comment provides an overview of Friant Water Authority's (FWA's) operational area of interest and summarizes the interrelationships between FWA's water supplies from Friant Dam and CVP Exchange Contractors and Settlement Contractors deliveries through the DMC. These operational interrelationships are discussed in Appendix G (Section G.1.3) of the EA/IS; no further response is required.

Comment 3-2

Overview of FWA Concerns and Comments

FWA acknowledges and for the reasons set forth above supports the primary goal of the Proposed Project, which as set forth in Section 1.2.22 is to "restore the long-term reliability and quantity of CVP supplies delivered to south-of-Delta contractors dependent on the DMC currently affected by the reduced deliveries limited by the canal's reduced conveyance capacity." However, FWA, does have concerns with potential impacts to Friant Division water supplies in the event there is a call on Friant as a result of the protracted construction of the Proposed Project which references periodic "drawdowns" of the DMC, but based on the construction activities associated with the Proposed Project would appear to potentially necessitate dewatering of the DMC in segments, which could result in a call on Friant or could potentially occur during a call on Friant for reasons unrelated to construction activities. The Draft EA/IS does not adequately address the potential impacts on Friant Division Contractors and the SJRRP during the construction period which may either result in a call on Friant or occur during a call on Friant, thereby exacerbating impacts.

Summary of Proposed Project Construction Activities that Could Result in a Call on Friant or Could Occur During a Call on Friant Thereby Impacting Friant Division Contractors and the San Joaquin River Restoration Program

We understand that the Proposed Project is the "Raise Deficient Structures Alternative" generally described in Section 2.2, with further details regarding the Proposed Project and the construction methods and locations described in Appendices C and G. The proposed construction activities would occur over at least a seven-and-a-half-year period with work occurring every day, all year. Specific construction activities that will or could impede the conveyance of water in the DMC during construction include the following:

- Raising deficient canal concrete lining by installing new concrete lining above the existing lining along approximately 80 miles of the DMC.
- Raising the earthen embankment at deficient bank segments of the canal by adding fill material from existing borrow sites along 50 miles of canal right-of-way (ROW).
- Stabilizing the canal banks along the 18-mile earthen-lined segment of the canal (MP 98.64 to 116.59), which requires lowering the water depth in the earthen-lined segment of the canal by up to six feet during construction.
- Repairing distressed concrete lining above and below the water's surface.

- Replacing 45 impacted vehicle bridges and 36 impacted pipeline crossings.
- Modifying 17 check structures and wasteways and 82 turnouts.
- Modifying drainage structures.

Response

In response to this comment and several other comments received from FWA, Section 2.2.1.1 and Appendix C (Section C.2.2.1) in the Final EA/IS have been expanded to provide additional clarification on the proposed operation of the DMC during construction of the project. A summary of historic deliveries through the DMC (presented in Table P-1 below) shows monthly average flows in the upper DMC and lower DMC during the months identified for low-flow work, i.e., October to May. Construction actions identified as all-season work in the EA/IS, i.e., action scheduled throughout the construction period, would occur outside the canal boundary and within the DMC right of way. Therefore, the all-season construction actions are not expected to impact water supply deliveries.

As summarized in Table P-1, flows in the upper DMC can be at current capacity[1] during the low-flow work months (October to May). However, some of the proposed construction actions scheduled for completion in those low-flow months, such as embankment raise and repairs, would be completed above water surface and would not impact flows in the upper DMC. Proposed concrete lining repairs of the canal would require underwater construction work and would also be completed without drawdown to flows in the upper DMC. Modification to check structures in the upper DMC would require flows in the upper DMC to be held at levels not to exceed two-thirds of current capacity (i.e., 66 percent of current capacity). This work is scheduled to occur between November-February when average flow levels in the upper DMC are approximately 68 percent of current capacity. Higher flow levels exceeding 68 percent have been observed in wet and dry year types. During construction, in years with hydrologic conditions that would support the conveyance levels above the 66 percent limit, those additional supplies would be conveyed using available capacity in the DMC-California Aqueduct Intertie Pumping Plant and the California Aqueduct to avoid water supply impacts from the DMC's drawdown.

Historic flows in the concrete-lined segment of the lower DMC are on average less than 60 percent of capacity during the low-flow work months (October to May). Proposed low-flow construction actions, such as embankment raise of the lined portion of the lower DMC would be completed above water surface during these low flow periods and would not require flow limits in the lower DMC. Proposed concrete lining repairs of the lined canal would require underwater work and would also be completed without drawdown to flows in the lower DMC. Similar to the upper DMC, the modification of check structures along the lower DMC would require flows to be held at two-thirds of current capacity (i.e., 66 percent of current capacity). Given that flows in the lower DMC in this construction window from November through February have been lower than 60 percent of current capacity, the proposed modifications to check structures can be completed without impacting water supply to contractors that receive deliveries from the lower DMC and Mendota Pool.

[1] The DMC has been affected by subsidence generated by groundwater pumping across the Central Valley and along the length of the canal. The current capacity of the DMC has been reduced by approximately 20 percent of original design capacity in the upper DMC and by approximately 30 percent of original design capacity in the lower DMC. The DMC is no longer able to convey its original design flows while maintaining sufficient freeboard space in accordance with Reclamation Safety Standards and Guidelines.

Lastly, repairs and stabilization activities along the earthen-lined segment of the lower DMC would require water levels to be drawn down by six feet, equivalent to an average reduction of approximately one-third of the canal's current capacity in that segment. This work along the earthen-lined segment is scheduled to occur between November-and February when flow levels in this segment of the lower DMC (presented in Table 1 below) are on average approximately 25 percent of current capacity and have been lower than 60 percent of current capacity in all year types. During these construction actions, scheduled to occur in November through February, limits on water levels in the earthen-lined segment of the lower DMC of up to six feet could result in a water surface elevation in the pool higher than the DMC. If these conditions occur during construction, water will be pumped from the DMC into Mendota Pool to avoid impacts to water supply.

Table P-1. Historical Monthly Average Flow in Upper DMC and Lower DMC during the low flow months

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
WY Type	Monthly Average Flow in Upper DMC (cfs)[1,2,3]							
W	4158	3394	3941	3803	3853	2838	1539	1815
AN	2981	2720	2374	2824	2718	3718	2073	1265
BN	3542	3009	3074	2784	2867	3033	1318	1277
D	3548	3401	3266	3184	2943	3006	1813	927
C	2623	1925	1829	1481	1911	1599	1440	784
	Monthly Average Flow in Lower DMC (cfs) [4,5,6]							
W	615	442	125	160	253	218	470	464
AN	-	-	-	-	-	-	-	-
BN	1257	741	558	454	1325	356	612	1485
D	1283	997	381	390	1191	555	603	1160
C	1163	738	397	245	529	497	648	1059

Notes:
1 Source: federal exports at Jones Pumping Plant (Reclamation 2023)
2 Monthly average CVP exports from 2000-2021.
3 Original design capacity of DMC at Jones Pumping Plant is 4,600 cfs; Current capacity of DMC at Jones Pumping Plant is 4,232 cfs; Two-thirds of current capacity of DMC at Jones Pumping Plant is 2793 cfs.
4 Source: Check 21 flows collected by SLDMWA
5 Monthly average DMC flow at Check 21 from 2017-2021.
6 Original design capacity of DMC at Check 21 is 3,310 cfs ; Current capacity of DMC at Check 21 is 2,724 cfs; Two-thirds of current capacity of DMC at Check 21 is 1798 cfs.

Comment 3-3

1.1 Project Background and History

…Regional groundwater use is anticipated to allow for an additional two feet of inelastic subsidence until full implementation of the Sustainable Groundwater Management Act (SGMA) in 2040 with residual subsidence forecast to continue through the year 2070, the design life of the DMC.

Comment: *There is no citation to any reference document in support of this statement regarding the anticipated two feet of subsidence in EA/IS or in Appendix B where a similar statement is made. There is also no clear correlation between the proposed repairs to the DMC and this anticipated level of subsidence. The Groundwater Sustainability Plan for the Delta-Mendota Subbasin has been deemed incomplete by the Department of Water Resources subsequent to the release of the EA/IS. At minimum, further analysis must be prepared to support the assumption of only two additional feet of subsidence impacts through 2040. In addition, there is no effort to quantify the amount of potential residual subsidence after 2040 and how that undefined amount will be addressed as part of the Proposed Project. Finally, to the extent additional subsidence is reasonably foreseeable (which appears to be more likely than not), revised construction work, schedules, timelines, and impact analyses, particularly with respect to water supply impacts during construction must be prepared.*

Response

The excerpted text in the comment was referenced from the Groundwater Sustainability Plan (GSP) for the Northern and Central Delta-Mendota regions, November 2019, revised June 2022 (Northern and Central Delta-Mendota Regions 2022). The adopted GSP was determined to be inadequate during DWR's review in March 2023. Given DWR's findings, the referenced text in the Final EA/IS has been deleted.

The design for the proposed modifications to DMC relied on subsidence modeling completed by Reclamation using the HydroGeoSphere San Joaquin Valley Groundwater Model. The subsidence modeling forecasts the anticipated level of subsidence along the DMC through 2070 and considers anticipated subsidence post implementation of SGMA. The simulated subsidence rates along the DMC were used to estimate forecasted design flows under future conditions currently presented in Appendix C (Figure C-1). Reclamation in coordination with USGS is currently completing sensitivity evaluations of these forecasted subsidence rates using Central Valley Hydrologic Model version 2 (CVHM2).

Comment 3-4

2.2.2.1 Operations During Construction

Some drawdowns of the canal water surface would be needed to support the low-flow construction activities; however, no outages would be required, thus providing flexibility in completing construction activities while minimizing impacts to water deliveries.

Comment: *This description appears to be inconsistent with the Project Description and information provided in Appendices C and G regarding construction. For example, the Proposed Project includes repairs to the concrete lining "below the water's surface." The more detailed description of this work provided in Section C.2.2.2.1 states that: "Damaged concrete lining and material distorting the canal would be removed with underwater operations, and a grouted mattress would be installed and grouted with cement underwater at applicable locations." FWA requests detailed confirmation that absolutely no dewatering of the DMC will be required during Project construction. Alternatively, if dewatering will potentially be required, there should be a description of the work and the proposed duration. Moreover, as discussed below, whether there is dewatering or simply reductions in DMC flows, the potential impacts of such flow reductions on the water supplies of the*

Friant Division Contractors as well as restorations flows and fisheries-related impacts for the SJRRP must be analyzed.

Response

See Response to Comment 3-2. As described therein, dewatering of the DMC will not be required during Project construction and water users (including CVP Exchange Contractors and settlement contractors) receiving deliveries from the DMC will not be impacted during construction. Consequently, construction of the Proposed Action will not require the release of water from Friant Dam to meet CVP Exchange Contractor or settlement contractor delivery requirements or result in a reduction in deliveries to Friant Division contractors or SJRRP flows.

Comment 3-5

4.1.3 Environmental Consequences/Impacts of the No Action Alternative

The reduced capacity of the DMC could limit the ability of Reclamation to meet CVP Exchange Contractor delivery requirements, which could result in a further reduction in deliveries to other south-of-Delta CVP contractors or require the release of water from Friant Dam to meet these senior water right deliveries.

Comment: *FWA is uncertain if current and projected reduced capacity of the DMC could limit the ability of Reclamation to meet CVP Exchange Contractor delivery requirements from the DMC. It is unclear from the CalSim modeling (referred to in Appendix D) if simulated demands of the Exchange Contractors reflect current and future practices of transferring their substitute supplies. Exchange Contractors transfer up to 150 TAF of their substitute supply to other SOD contractors under their 2014-2038 Water Transfer Program depending on the year type. Modeling should be updated to reflect this practice as current results overstate the DMC capacity constraints during peak summer months.*

With respect to any releases of water from Friant Dam to meet Exchange Contractor requirements, such releases are based on "contract rights" under the Exchange Contract and not on any senior water rights. More importantly, this statement only appears in the No Action Alternative, and, as discussed below, no analysis of reduced DMC capacity during construction or the potential for a call on Friant is provided.

Response

As noted in Appendix D (Section 4.1) of the Draft EA/IS, restoring DMC capacity to design levels would increase the ability to meet full CVP contract demands for Exchange, Settlement, Water Service, and Repayment contractors. The San Joaquin River Exchange Contractor (SJREC) Transfers referenced in the comment develop supplemental water supplies from willing sellers within the Exchange Contractors' service area through water conservation or cropland idling that are then made available to other water users. The transfers of up to 150 TAF of SJREC water supplies in a given year are subject to several uncertainties including supply and demand for transferred supplies, hydrologic conditions and CVP water allocations. Given the uncertainty associated with these transfers, CalSIM modeling does not simulate SJREC Transfers.

As noted in Section 4.1 and Appendix G of the Draft EA/IS, the reduced capacity of the DMC could limit the ability of Reclamation to meet CVP Exchange Contractor delivery requirements, who hold senior CVP water rights for diversion of water from the San Joaquin and Kings rivers. Text in Section 4.1 and Appendix G (Section G.4.1.2) of the Draft EA/IS has been clarified to note that, in

certain circumstances, releases from Friant Dam would be made to meet Exchange Contractor delivery requirements.

Regarding potential impacts to Friant releases during construction of the Proposed Action, as was noted in Response to Comment 3-2 and further clarified in Chapter 4 (Section 4.1) and Appendix G (Section G.4.2.1) of the Final EA/IS, construction actions are not expected to cause water supply impacts to water users receiving deliveries through the DMC. Consequently, these construction actions would not require the release of water from Friant Dam to meet delivery requirements to the Exchange Contractors.

Comment 3-6

4.1.4.1 Construction of the Proposed Action

Construction of the Proposed Action is expected to last approximately seven and a half years. Some drawdowns of the canal water surface are needed to support construction activities; however, no partial outages are required, thus providing flexibility in completing construction activities without adversely impacting water supply deliveries. During construction, the Intertie Pumping Plant could be used to maintain CVP deliveries consistent with normal operations, in coordination with California Department of Water Resources (DWR). It is anticipated that because no outages would be needed, impacts to CVP water supply deliveries during construction of the Proposed Action would be minimal. In addition, Reclamation and SLDMWA would coordinate water delivery schedules during construction times to adjust water delivery as needed. **Therefore, construction of the Proposed Action would have a less than significant impact on CVP deliveries.**

Comment: *The assertion that absolutely no outage or dewatering of the DMC during the seven or more years of project construction is questionable as noted above. Putting that aside, the Project Description notes that there will be "drawdowns" of flows in the canal, but the above section contains no analysis of the impacts of such drawdowns, including whether or not at any time there could be a water supply delivery change of five percent or greater, which is deemed significant. Moreover, the Intertie is located at the northern end of the DMC and would not provide any alternative means of conveyance (as opposed to pumping) for virtually all of the DMC, which is located below the Intertie. Accordingly, the conclusion in Section 4.1.4.1 that construction of the Proposed Project would have a less than significant impact of CVP deliveries is wholly unsupported. A full analysis of potential water supply impacts from the numerous months and years where flows in the DMC will be reduced during construction of the Proposed Project must be prepared, and the revised analyses and any resulting changes to the EA/IS, including necessary mitigation measures must be made available for public review.*

Response

As noted in Response to Comment 3-2 and further clarified in Chapter 4 (Section 4.1) and Appendix G (Section G.4.2.1) of the Final EA/IS, construction actions are not expected to cause water supply impacts to water users receiving deliveries through the DMC.

Comment 3-7

COMMENTS ON THE EA/IS APPENDICES

Appendix C: Project Description

Figure C-1. Design Flows, Reduction in Flow, and Actual Flow Capacities in the DMC For Current and Future (With Future Subsidence) Conditions

Comment: *This figure displays potential future DMC capacity due to subsidence; however, nowhere in the document is their supporting analysis to justify the projections. There are references to a 2021 "Feasibility Study of the Structural Alternatives"; however, it is not listed in the references section nor is it easily found online and may not have been made available for public review.*

Response

As noted in Response to Comment 3-3, subsidence rates along the DMC were estimated using the HydroGeoSphere San Joaquin Valley Groundwater Model. The simulated subsidence rates along the DMC were used to estimate forecasted design flows under future conditions as presented in Appendix C (Figure C-1) of the Draft EA/IS. Reclamation in coordination with USGS is currently completing sensitivity evaluations of these forecasted subsidence rates using Central Valley Hydrologic Model version 2 (CVHM2). Additional clarification has been added to Appendix C (Section C.1) of the Final EA/IS regarding the subsidence modeling completed for the Proposed Action.

Comment 3-8

Table C-7. Assumptions for the Proposed Action Schedule Development

Comment: *This table provides a breakdown on the proposed construction activities, the "season designation" along with the duration of the construction work. For example, the work on the concrete lining is designated "low-flow work" but the applicable time period is (October – May) and the work is going to take over four years. The months of April and May are considered "critical" irrigation times under the Exchange Contract that governs Reclamation's delivery obligations to the Exchange Contractors and have some of the highest monthly water delivery demands of the year. These months are clearly not "low-flow work" periods and could have a significant impact on deliveries through the DMC to the Exchange Contractors during construction, which in turn could impact the water supplies of Friant Division Contractors by either resulting in a call on Friant, or if the reduced DMC flows were to occur during a call on Friant, additional demands may be made on San Joaquin River water affecting not only Friant Division Contractors but the restorations flows of the SJRRP.*

Response

As noted in Response to Comment 3-2, construction actions in the lower DMC are not expected to cause any water supply impacts to water users receiving deliveries through the DMC including the Exchange Contractors. Consequently, construction of the Proposed Action will not require the release of water from Friant Dam to meet CVP Exchange Contractor or settlement contractor delivery requirements or result in a reduction in deliveries to Friant Division contractors.

Comment 3-9

Appendix D: CalSim Modeling Technical Report

Comment: *It is unclear from the CalSim modeling if simulated demands of the Exchange Contractors reflect current and future practices of transferring their substitute supplies. Exchange Contractors transfer up to 150 TAF of their substitute supply to other SOD*

contractors under their 2014-2038 Water Transfer Program depending on the year type. Modeling should be updated to reflect this practice as current results overstate the DMC capacity constraints during peak summer months.

Response

As noted in Response to Comment 3-5, CalSIM modeling under the Proposed Action and No Action Alternative does not simulate SJREC Transfers.

Comment 3-10

Appendix G: Water Supply Technical Appendix

G.1.1 Water in California
The study area captures the CVP and SWP contractors that may be impacted by changes to the operation of the DMC and evaluates the water supply impacts that the construction and operation of the DMC Subsidence Correction Project (Project) would have on deliveries to the entirety of the study area.

G.1.3.2 Friant Division Contractors
Friant Division contractors, located on the east side of the San Joaquin Valley, receive water stored behind Friant Dam and delivered through the Friant-Kern and Madera Canals. In years in which Reclamation is otherwise unable to make contracted deliveries to Exchange Contractors, Reclamation can make a call on water stored in Millerton Lake, thereby requiring releases from Friant Dam (U.S. Congressional Research Service [CRS] 2022).

Comment: *As discussed below, despite the acknowledgement that reductions in south-of Delta deliveries to the Exchange Contactors and the Settlement Contractors (see G.1.3.3) through the DMC can result in calls on Friant and thus impacts to Friant Division Contractors (and the SJRRP), the water supply impact analysis in Appendix G fails to fully discuss such potential impacts.*

Response:

As noted in Section 4.1 and Appendix G of the Draft EA/IS, the existing reduction and forecast increased reductions to the DMC 's conveyance capacity could limit the ability of Reclamation to meet CVP Exchange Contractor delivery requirements under the No Action Alternative. These potential reductions to CVP Exchange Contractor deliveries could require releases from Friant Dam that could impact Friant Contractors under the No Action Alternative as disclosed in the Draft EA/IS. As noted in the Draft EA/IS, impacts to Friant Division Contractor water supply deliveries are not expected under the Proposed Action.

Comment 3-11

G.4.2.1 Impact WS-1: Would construction of the alternative change CVP deliveries to CVP contractors?
Construction of the Proposed Action is expected to last approximately seven and a half years. Some drawdowns of the canal water surface are needed to support construction activities, however no partial outages are required, thus providing flexibility in completing construction activities. During construction, the Intertie Pumping Plant could be used to maintain CVP deliveries consistent with existing operations, in coordination with DWR. It is anticipated that because no outages would be needed, impacts to water supply deliveries during construction of the Proposed Action would be

minimal. **Construction of the Proposed Action would have a less than significant impact on CVP deliveries.**

Comment: ***This analysis of construction impacts to water supply is cursory, the statement no "outages are required" seems suspect in light of the scope and types of construction activities, and as noted above, makes no attempt to quantify the amount or timing of "drawdowns". Moreover, there is no mention of water supply impacts to Friant Division Contractors, and no mention anywhere in the EA/IS of water supply and biological resources impacts to the SJRRP. Accordingly, the document is deficient, an appropriate analysis must be prepared, and the revised document/applicable sections reposted for public comment.***

Response

As noted in Response to Comment 3-2, construction actions in the lower DMC are not expected to cause water supply impacts to water users receiving deliveries through the DMC including the Exchange Contractors. Additional clarification has been added to Section 4.1 and Appendix G (Section G.4.2.1) of the Final EA/IS, clarifying the less than significant impact on CVP and SWP deliveries during the construction of Proposed Action.

Comment 3-12

G.4.2.2 Impact WS-2: Would operation of the alternative change CVP deliveries to CVP contractors?

Comment: ***This section contains no analysis of water supply impacts on Friant Division Contractors or the SJRRP. Accordingly, the document is deficient, an appropriate analysis must be prepared, and the revised document/applicable sections reposted for public comment.***

Response:

As noted in Chapter 4 (Section 4.1.4.2) and Appendix G (Section G.4.2.2) of the Draft EA/IS, conveyance capacity in the DMC would be restored under the Proposed Action. Those sections also note that Reclamation would be able to meet CVP Exchange Contractor deliveries during construction without impacting other south-of-Delta CVP contractors or requiring the release of water from Friant Dam. Consequently, as was indicated above in Response to Comment 3-2, water supply impacts are not expected to Friant Division Contractors or the SJRRP.

Comment 3-13

G.4.3 Mitigation Measures
No mitigation measures would be necessary to reduce impacts of the Proposed Action to the less than significant level.

Comment: Because there is no analysis of water supply impacts of the Proposed Project/Action during cons*truction or arising from operation of the Proposed Project on Friant Division Contractors or the SJRRP, there is no substantial evidence to support this finding. The requisite analysis must be prepared, determinations made as to the level of significance of any impact, and depending on such determination, appropriate mitigation may be required, and if the impact cannot be reduced to less than significant, an EIR may be required and potentially a statement of overriding considerations adopted if impacts cannot be mitigated to less than significant.*

Response

As noted in Response to Comment 3-2, construction actions under Proposed Action are not expected to cause water supply impacts to water users receiving deliveries through the DMC including the Exchange Contractors. Consequently, water supply impacts are not expected to Friant Division Contractors or the SJRRP. Additional text has been added to Chapter 5 (Section 5.1.1) of the Final EA/IS, clarifying construction actions under Proposed Action would not impact the SJRRP and contribution of Proposed Action to cumulative conditions would remain less than significant.

Comment 3-14

Comment: ***Neither Appendix G nor M (Biological Survey Report) address potential water supply and related biological resources impacts on the San Joaquin River Restoration Program that may be affected by a call on Friant resulting from any temporary or permanent interruption or reduction in deliveries of substitute water to the Exchange Contractors and Settlement Contractors through the DMC. The requisite analysis must be prepared, determinations made as to the level of significance of any impact, and depending on such determination, appropriate mitigation may be required, and if the impact cannot be reduced to less than significant, an EIR may be required and potentially a statement of overriding considerations adopted if impacts cannot be mitigated to less than significant.***

Response:

As noted in Response to Comment 3-2 and 3-13, the Proposed Action is not expected to cause water supply impacts to Friant Division Contractors or the SJRRP.

Comment Letter 4, Brian Clements, San Joaquin Valley Air Pollution Control District

Comment 4-1

The San Joaquin Valley Air Pollution Control District (District) has reviewed the Environmental Assessment/Mitigated Negative Declaration (EA/MND) from the San Luis & Delta-Mendota Water Authority (SLDMWA) for the Delta-Mendota Canal Subsidence Correction project. Per the MND, the project consists of raising deficient concrete lining segments and bank segments to meet the minimum freeboard requirements, installing riprap for erosion protection to stabilize the banks along the earthen-lined segment, replacing bridges and pipeline crossings that do not have enough clearance above water surface elevation to meet minimum required clearings, raising the gates of check structures and waste ways to design level and modify impacted structures, and evaluate existing drainage structures to modify them for safe passage of storm water (Project). The Project is located at various locations along the Delta-Mendota canal that runs through Alameda, San Benito, Santa Clara, San Joaquin, Stanislaus, Merced, and Fresno Counties. The comments contained in this letter are only intended for the portions of this Project that will be taking place within the jurisdiction of the District, specifically, the portions within San Joaquin, Stanislaus, Merced, Madera, and Fresno Counties.

Response

The comment acknowledges receipt of the EA/IS and summarizes the project description detailed in Chapter 2 and Appendix C of the Draft EA/IS; no further response is required.

Comment 4-2

1) Project Related Emissions

Based on information provided to the District, specific annual criteria pollutant emissions from construction and operation associated with the portions of the Project within the District's jurisdiction are not expected to exceed any of the significance thresholds as identified in the District's Guidance for Assessing and Mitigating Air Quality Impacts (GAMAQI): https://www.valleyair.org/transportation/GAMAQI.pdf

1a) Construction Emissions

The District recommends, to reduce impacts from construction-related diesel exhaust emissions, the project proponent should utilize the cleanest available off-road construction equipment, including the latest tier equipment.

Response

The comment accurately summarizes the less than significant impacts associated with criteria pollutant emissions from the construction and operation of the Proposed Action. Additionally, the commenter recommends that the cleanest available construction equipment be utilized for off-road construction equipment to further reduce criteria pollutant emissions. Page I1-4 in Appendix I1 of the Draft EA/IS describes the construction emission estimation methodology and details that all off-road construction equipment was assumed to meet USEPA Tier 4 Final engine standards. Therefore, consistent with the commenter's recommendation and the information presented in the Draft EA/IS, it is anticipated that the project proponent would utilize the cleanest available off-road construction equipment.

Comment 4-3

2) Health Risk Screening/Assessment

The EA/MND stated "Construction impacts under the Proposed Action would be temporary and highly mobile, occurring for short periods along various points of the 116 mile DMC…". While construction emissions generated would be temporary, there is still a potential risk of exposure to sensitive receptors from substantial pollutant concentrations.

To determine the potential construction related health impacts on surrounding receptors (residences, businesses, hospitals, day-care facilities, health care facilities, etc.) a Prioritization and/or a Health Risk Assessment (HRA) should be performed. These health risk determinations should quantify and characterize potential Toxic Air Contaminants (TACs) identified by the Office of Environmental Health Hazard Assessment/California Air Resources Board (OEHHA/CARB) that pose a present or potential hazard to human health.

The health risk analysis should evaluate all potential air emissions from construction, including multi-year construction (e.g., to diesel exhaust emitted from heavy-duty offroad earth moving equipment during construction).

Prioritization (Screening Health Risk Assessment):

A "Prioritization" is the recommended method for a conservative screening-level health risk assessment. The Prioritization should be performed using the California Air Pollution Control Officers Association's (CAPCOA) methodology.

The District recommends that a more refined analysis, in the form of an HRA, be performed for any project resulting in a Prioritization score of 10 or greater. This is because the prioritization results are a conservative health risk representation, while the detailed HRA provides a more accurate health risk evaluation.

To assist land use agencies and project proponents with Prioritization analyses, the District has created a prioritization calculator based on the aforementioned CAPCOA guidelines, which can be found here:
http://www.valleyair.org/busind/pto/emission_factors/Criteria/Toxics/Utilities/PRIORITIZATION-CALCULATOR.xls

Health Risk Assessment:

Prior to performing an HRA, it is strongly recommended that land use agencies/project proponents develop and submit for District review a health risk modeling protocol that outlines the sources and methodologies that will be used to perform the HRA. This step will ensure all components are addressed when performing the HRA.

A development project would be considered to have a potentially significant health risk if the HRA demonstrates that the project-related health impacts would exceed the District's significance threshold of 20 in a million for carcinogenic risk, or 1.0 for either the Acute or Chronic Hazard Indices.

A project with a significant health risk would trigger all feasible mitigation measures. The District strongly recommends that development projects that result in a significant health risk not be approved by the land use agency.

The District is available to review HRA protocols and analyses. For HRA submittals please provide the following information electronically to the District for review:

- HRA (AERMOD) modeling files
- HARP2 files
- Summary of emissions source locations, emissions rates, and emission factor calculations and methodologies.

For assistance, please contact the District's Technical Services Department by:

- E-Mailing inquiries to: hramodeler@valleyair.org
- Calling (559) 230-5900

Recommended Measure: Development projects resulting in TAC emissions should be located an adequate distance from residential areas and other sensitive receptors in accordance to CARB's Air Quality and Land Use Handbook: A Community Health Perspective located at https://ww3.arb.ca.gov/ch/handbook.pdf.

Response

The commenter requests that a health risk screening assessment be conducted consistent with CAPCOA Prioritization assessment guidelines utilizing the District's Prioritization calculation tool. CAPCOA's Prioritization methodology and the District's Prioritization calculation tool are designed to be utilized by facilities with annual operational emissions of TAC (CARB and CAPCOA 2015). However, the Project is a highly mobile, short-term construction action which is not expected to result in a change to annual TAC emissions from operations of the Delta-Mendota Canal relative to

existing conditions. Nevertheless, in response to the District's request, the Prioritization screening methodology has been adapted for use in this short-duration project and a screening assessment has been completed.

The calculations completed for the Prioritization assessment have been incorporated into the EA/IS as Appendix I3 of the Final EA/IS. The overall maximum total Prioritization score for the Project's construction TAC emissions, including those TAC from diesel engine exhaust and fugitive construction dust, at the maximally impacted receptor would be 4.8. This is below the level at which the District recommends a more detailed health risk assessment be necessitated. Thus, this Prioritization assessment confirms the finding, as described in Chapter 4 (Section 4.3) and Appendix I1 of the Draft EA/IS, that the Proposed Action would not exposure sensitive receptors to substantial pollutant concentrations.

The commenter recommends that development projects resulting in TAC emissions be located an adequate distance from residential areas and other sensitive receptors. This is not applicable to the Project, as the Project would not result in ongoing, permanent TAC emissions. In addition, the project area is located in a largely rural and agricultural landscape, away from population centers.

Comment 4-4

3) District Rules and Regulations

The District issues permits for many types of air pollution sources, and regulates some activities that do not require permits. A project subject to District rules and regulations would reduce its impacts on air quality through compliance with the District's regulatory framework. In general, a regulation is a collection of individual rules, each of which deals with a specific topic. As an example, Regulation II (Permits) includes District Rule 2010 (Permits Required), Rule 2201 (New and Modified Stationary Source Review), Rule 2520 (Federally Mandated Operating Permits), and several other rules pertaining to District permitting requirements and processes.

The list of rules below is neither exhaustive nor exclusive. Current District rules can be found online at: www.valleyair.org/rules/1ruleslist.htm. To identify other District rules or regulations that apply to future projects, or to obtain information about District permit requirements, the project proponents are strongly encouraged to contact the District's Small Business Assistance (SBA) Office at (559) 230-5888.

3a) District Rules 2010 and 2201 - Air Quality Permitting for Stationary

Sources

Stationary Source emissions include any building, structure, facility, or installation which emits or may emit any affected pollutant directly or as a fugitive emission. District Rule 2010 (Permits Required) requires operators of emission sources to obtain an Authority to Construct (ATC) and Permit to Operate (PTO) from the District. District Rule 2201 (New and Modified Stationary Source Review) requires that new and modified stationary sources of emissions mitigate their emissions using Best Available Control Technology (BACT).

The portions of the Project within the Districts jurisdiction may be subject to District Rule 2010 (Permits Required) and Rule 2201 (New and Modified Stationary Source Review) and may require District permits. Prior to construction, the project proponent should submit to the District an application for an ATC. For further information or assistance, the project proponent may contact the District's SBA Office at (559) 230-5888.

3b) District Rule 9510 - Indirect Source Review (ISR)

The District has reviewed the information provided and determined that there is no construction of a new building, facility, or structure, or reconstruction of a building, facility, or structure for the purpose of increasing capacity or activity. Therefore, the project does not meet the definition of a "Development Project", as defined in District Rule 9510 section 3.13, and District Rule 9510 requirements and related fees do not apply to the portions of the Project within the District's jurisdiction.

3c) District Rule 4002 (National Emissions Standards for Hazardous Air Pollutants)

In the event an existing building will be renovated, partially demolished or removed, the portions of the Project within the Districts jurisdiction may be subject to District Rule 4002. This rule requires a thorough inspection for asbestos to be conducted before any regulated facility is demolished or renovated. Information on how to comply with District Rule 4002 can be found online at: http://www.valleyair.org/busind/comply/asbestosbultn.htm

3d) District Rule 4601 (Architectural Coatings)

The portions of the Project within the Districts jurisdiction may be subject to District Rule 4601 since it may utilize architectural coatings. Architectural coatings are paints, varnishes, sealers, or stains that are applied to structures, portable buildings, pavements or curbs. The purpose of this rule is to limit VOC emissions from architectural coatings. In addition, this rule specifies architectural coatings storage, cleanup and labeling requirements. Additional information on how to comply with District Rule 4601 requirements can be found online at: http://www.valleyair.org/rules/currntrules/r4601.pdf

3e) District Regulation VIII (Fugitive PM10 Prohibitions)

The project proponent may be required to submit a Construction Notification Form or submit and receive approval of a Dust Control Plan prior to commencing any earthmoving activities as described in Regulation VIII, specifically Rule 8021 – *Construction, Demolition, Excavation, Extraction, and Other Earthmoving Activities.*

Should the project result in at least 1-acre in size, the project proponent shall provide written notification to the District at least 48 hours prior to the project proponents intent to commence any earthmoving activities pursuant to District Rule 8021 (Construction, Demolition, Excavation, Extraction, and Other Earthmoving Activities). Also, should the project result in the disturbance of 5-acres or more, or will include moving, depositing, or relocating more than 2,500 cubic yards per day of bulk materials, the project proponent shall submit to the District a Dust Control Plan pursuant to District Rule 8021 (Construction, Demolition, Excavation, Extraction, and Other Earthmoving Activities). For additional information regarding the written notification or Dust Control Plan requirements, please contact District Compliance staff at (559) 230-5950.

The application for both the Construction Notification and Dust Control Plan can be found online at: https://www.valleyair.org/busind/comply/PM10/forms/DCP-Form.docx

Information about District Regulation VIII can be found online at: http://www.valleyair.org/busind/comply/pm10/compliance_pm10.htm

3f) Other District Rules and Regulations

The portions of the Project within the Districts jurisdiction may also be subject to the following District rules: Rule 4102 (Nuisance) and Rule 4641 (Cutback, Slow Cure, and Emulsified Asphalt, Paving and Maintenance Operations).

Response

The comment summarizes the District's Rules and Regulations, which may be applicable to the Project. During implementation of the Project, SLDMWA will comply with all applicable District rules.

Comment 4-5

District Comment Letter

The District recommends that a copy of the District's comments be provided to the Project proponent.

Response

SLDMWA and Reclamation acknowledge receipt of the District's comments.

P.4 References

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California Department of Fish and Wildlife (CDFW). 2012. *Staff Report on Burrowing Owl Mitigation. California Department of Fish and Game*. Accessed on April 25, 2022, https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=83843&inline=true

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Northern and Central Delta-Mendota Regions. 2022. *Groundwater Sustainability Plan for the Northern and Central Delta-Mendota Regions — Appendix B: Common Chapter*. November 2019, revised June 2022. Accessed on April 6, 2023. Available at: https://sgma.water.ca.gov/portal/gsp/preview/13, under "Supporting Documents".

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Delta-Mendota Canal Subsidence Correction Project Environmental Assessment/Initial Study

Appendix Q: Public Comment Letters

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State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Central Region
1234 East Shaw Avenue
Fresno, California 93710
(559) 243-4005
www.wildlife.ca.gov

Comment ID: 1

GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

March 20, 2023

Pablo Arroyave
San Luis and Delta-Mendota Water Authority
P.O. Box 2157
Los Banos, California 93635
(209) 832-6200
Pablo.arroyave@sldmwa.org

Subject: Delta-Mendota Canal Subsidence Correction Project – Initial Study/Mitigated Negative Declaration (IS/MND) Project (Project)
SCH No.: 2023020323

Dear Pablo Arroyave:

The California Department of Fish and Wildlife (CDFW) received an Initial Study (IS)/ Mitigated Negative Declaration (MND) from the San Luis and Delta Mendota Water Authority for the above-referenced Project pursuant to the California Environmental Quality Act (CEQA) and CEQA Guidelines.[1]

Thank you for the opportunity to provide comments and recommendations regarding those activities involved in the Project that may affect California fish and wildlife. Likewise, CDFW appreciates the opportunity to provide comments regarding those aspects of the Project that CDFW, by law, may be required to carry out or approve through the exercise of its own regulatory authority under Fish and Game Code. While the comment period may have passed, CDFW would appreciate if the Fresno County Department of Public Works and Planning will still consider our comments.

CDFW ROLE

CDFW is California's **Trustee Agency** for fish and wildlife resources and holds those resources in trust by statute for all the people of the State (Fish & G. Code, §§ 711.7, subd. (a) & 1802; Pub. Resources Code, § 21070; CEQA Guidelines § 15386, subd. (a)). CDFW, in its trustee capacity, has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and habitat necessary for biologically sustainable populations of those species (*Id*., § 1802). Similarly, for

1-1

[1] CEQA is codified in the California Public Resources Code in section 21000 et seq. The "CEQA Guidelines" are found in Title 14 of the California Code of Regulations, commencing with section 15000.

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purposes of CEQA, CDFW is charged by law to provide, as available, biological expertise during public agency environmental review efforts, focusing specifically on projects and related activities that have the potential to adversely affect fish and wildlife resources.

CDFW is also submitting comments as a **Responsible Agency** under CEQA (Pub. Resources Code, § 21069; CEQA Guidelines, § 15381). CDFW expects to exercise regulatory authority as provided by the Fish and Game Code. As proposed, for example, the Project will be subject to CDFW's lake and streambed alteration regulatory authority (Fish & G. Code, § 1600 et seq.). Likewise, to the extent implementation of the Project as proposed may result in "take" as defined by State law of any species protected under the California Endangered Species Act (CESA) (Fish & G. Code, § 2050 et seq.), related authorization as provided by the Fish and Game Code will be required.

Nesting Birds: CDFW has jurisdiction over actions with potential to result in the disturbance or destruction of active nest sites or the unauthorized take of birds. Fish and Game Code sections that protect birds, their eggs and nests include sections 3503 (regarding unlawful take, possession or needless destruction of the nest or eggs of any bird), 3503.5 (regarding the take, possession or destruction of any birds-of-prey or their nests or eggs), and 3513 (regarding unlawful take of any migratory nongame bird).

Water Pollution: Pursuant to Fish and Game Code section 5650, it is unlawful to deposit in, permit to pass into, or place where it can pass into "Waters of the State" any substance or material deleterious to fish, plant life, or bird life, including non-native species. It is possible that without mitigation measures, implementation of the Project could result in pollution of Waters of the State from storm water runoff or construction-related erosion. Potential impacts to streams/lakes include the following: increased sediment input from road or structure runoff; and toxic runoff associated with development activities and implementation. The Regional Water Quality Control Board and United States Army Corps of Engineers also have jurisdiction regarding discharge and pollution to "Waters of the State".

1-1

PROJECT DESCRIPTION SUMMARY

Proponent: San Luis and Delta-Mendota Water Authority

Objective: Since its original construction, the Delta-Mendota Canal (DMC) has been affected by land subsidence which has reduced the capacity the DMC can convey while operating in accordance with Reclamation Safety Standards and Guidelines. These limits on conveyance capacity have introduced operational constraints that can affect deliveries to south-of-Delta Central Valley Project (CVP) contractors. The continued, safe, and reliable operation of the DMC is critical to the users that it serves and the economies that it supports. The proposed project would restore the designed conveyance capacity of the DMC (a maximum flow capacity of 4,600 cubic feet per

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second (cfs) at the origin and a minimum flow capacity of 3,210 cfs at the terminus) by (1) raising deficient concrete lining segments and bank segments to meet the minimum freeboard requirements; (2) installing riprap for erosion protection to stabilize the banks along the earthen-lined segment; (3) replacing bridges and pipeline crossings that do not have enough clearance above water surface elevation to meet minimum required clearings; (4) raising the gates of check structures and wasteways to design level and modify impacted structures; and (5) evaluating existing drainage structures to modify them for safe passage of stormwater. 1-2

Location: Per Project information, Project effects would occur within Alameda, San Joaquin, Stanislaus, Merced, Fresno, San Benito and Santa Clara Counties.

Timeframe: None given.

COMMENTS AND RECOMMENDATIONS

CDFW offers the following comments and recommendations to assist the San Luis and Delta-Mendota Water Authority in adequately identifying and/or mitigating the Project's significant, or potentially significant, direct and indirect impacts on fish and wildlife (biological) resources. Editorial comments or other suggestions may also be included to improve the environmental document for this Project. 1-3

Per California Natural Diversity Database (CNDDB) 2023 records, the Project site is within the geographic range of the Federal endangered (FE)/State threatened (ST) San Joaquin kit fox (*Vulpes macrotis mutica*), the State candidate-listed as endangered Crotch bumble bee (*Bombus crotchii*), the ST Swainson's hawk (*Buteo swainsoni*), the ST tricolored blackbird (*Agelaius tricolor*), and State Species of Special Concern (SSC) burrowing owl (*Athene cunicularia*).

San Joaquin Kit Fox (SJKF)

SJKF occurrences have been documented to the east of the DMC in the Firebaugh area (CDFW 2023). The Project has the potential to temporarily disturb and permanently alter suitable habitat for SJKF and directly impact individuals if present during construction, and other activities.

SJKF den in a variety of areas such as right-of-ways (ROW), agricultural and fallow/ruderal habitat, dry stream channels, and canal levees, and populations can fluctuate over time. SJKF are also capable of occupying urban environments (Cypher and Frost 1999). SJKF may be attracted to Project areas due to the type and level of ground-disturbing activities and the loose, friable soils resulting from intensive ground disturbance. SJKF will forage in fallow and agricultural fields and utilize streams and canals as dispersal corridors. As a result, there is potential for SJKF to occupy all suitable habitat within the proposed Project boundary and surrounding area. 1-4

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The Project area is within, adjacent to, and crosses through several areas of highly suitable habitat. Therefore, subsequent ground-disturbing activities have the potential to significantly impact local SJKF populations.

For all Project-specific components including construction, CDFW recommends that a qualified biologist conduct a habitat assessment in advance of Project implementation, to determine if the Project area or its immediate vicinity contains suitable habitat for SJKF in support of the CEQA document.

1-4

CDFW recommends assessing presence/absence of SJKF by having qualified biologists conducting surveys of Project areas and a 500-foot buffer of Project areas to detect SJKF and their sign. CDFW also recommends following the United States Fish and Wildlife Service (USFWS) "Standardized recommendations for protection of the San Joaquin kit fox prior to or during ground disturbance" (2011).

SJKF detection warrants consultation with CDFW to discuss how to avoid take or, if avoidance is not feasible, to acquire an Incidental Take Permit (ITP) prior to ground-disturbing activities, pursuant to Fish and Game Code section 2081 subdivision (b).

Crotch Bumble Bee (CBB)

The proposed Project location is within CBB range (CDFW 2023). Suitable CBB habitat includes areas of grasslands and upland scrub that contain requisite habitat elements, such as small mammal burrows. CBB primarily nest in late February through late October underground in abandoned small mammal burrows but may also nest under perennial bunch grasses or thatched annual grasses, under brush piles, in old bird nests, and in dead trees or hollow logs (Williams et al. 2014; Hatfield et al. 2015). Overwintering sites utilized by CBB mated queens include soft, disturbed soil (Goulson 2010), or under leaf litter or other debris (Williams et al. 2014). Therefore, potential ground disturbance and vegetation removal associated with Project implementation may significantly impact local CBB populations.

1-5

CBB was once common throughout most of central and southern California; however, it now appears to be absent from most of it, especially in the central portion of its historic range within California's Central Valley (Hatfield et al. 2014). Analyses by the Xerces Society et al. (2018) suggest there have been sharp declines in relative abundance by 98% and persistence by 80% over the last ten years.

CDFW recommends that a qualified biologist conduct focused surveys for CBB, and their requisite habitat features prior to Project implementation to evaluate impacts resulting from potential ground- and vegetation-disturbing activities that may result from the approval of the IS/MND.

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If surveys cannot be completed, CDFW recommends that all small mammal burrows and thatched/bunch grasses be avoided by a minimum of 50 feet to avoid take and potentially significant impacts. If ground-disturbing activities will occur during the overwintering period (October through February), consultation with CDFW is warranted to discuss how to implement Project activities and avoid take. Any detection of CBB prior to or during Project implementation warrants consultation with CDFW to discuss how to avoid take.

1-5

If CBB is identified during surveys, consultation with CDFW is warranted to determine if the Project can avoid take. If take cannot be avoided, take authorization prior to any ground-disturbing activities may be warranted. Take authorization would occur through acquisition of an ITP by CDFW, pursuant to Fish and Game Code section 2081 subdivision (b).

Swainson's Hawk (SWHA)

SWHA have the potential to nest near the Project site. The CNDDB shows SWHA occurrences throughout the Project vicinity (CDFW 2023).

Without appropriate avoidance and minimization measures for SWHA, potential significant impacts that may result from Project activities include nest abandonment, and/or loss of foraging habitat that would reduce nesting success (loss or reduced health or vigor of eggs or young). Any take of SWHA without appropriate incidental take authorization would be a violation of Fish and Game Code.

SWHA exhibit high nest-site fidelity year after year and lack of suitable nesting habitat in the San Joaquin Valley limits their local distribution and abundance (CDFW 2016). The Project as proposed will involve noise, groundwork, and movement of workers that could affect nests and has the potential to result in nest abandonment, significantly impacting local nesting SWHA.

1-6

To evaluate potential impacts, CDFW recommends that a qualified wildlife biologist conduct surveys for nesting SWHA following the survey methods developed by the Swainson's Hawk Technical Advisory Committee (SWHA TAC, 2000) prior to project implementation. The survey protocol includes early season surveys to assist the project proponent in implementing necessary avoidance and minimization measures, and in identifying active nest sites prior to initiating ground-disturbing activities.

If ground-disturbing Project activities are to take place during the normal bird breeding season (March 1 through September 15), CDFW recommends that additional pre-activity surveys for active nests be conducted by a qualified biologist no more than 10 days prior to the start of Project implementation. CDFW recommends a minimum no-disturbance buffer of ½-mile be delineated around active nests until the breeding season has ended or until a qualified biologist has determined that the birds have fledged and are no longer reliant upon the nest or parental care for survival.

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CDFW recommends that in the event an active SWHA nest is detected during surveys and the ½-mile no-disturbance buffer around the nest cannot feasibly be implemented, consultation with CDFW is warranted to discuss how to implement the project and avoid take. If take cannot be avoided, take authorization through the issuance of an ITP, pursuant to Fish and Game Code section 2081 subdivision (b) is necessary to comply with CESA. 1-6

Tricolored Blackbird (TRBL)

TRBL occurrences have been documented near certain portions of the Project site (CDFW 2023). TRBL colonies require suitable nesting habitat, nearby freshwater, and nearby foraging habitat including semi-natural grasslands, agricultural croplands or alkali scrub (Beedy et al. 2017). Habitat surrounding the Project area may provide suitable foraging habitat for TRBL.

CDFW recommends that Project activities be timed to avoid the normal bird breeding season (February 1 through September 15). However, if Project activities must take place during that time, CDFW recommends that a qualified wildlife biologist conduct surveys for nesting TRBL no more than 10 days prior to the start of implementation to evaluate presence/absence of TRBL nesting colonies in proximity to Project activities and to evaluate potential Project-related impacts in support of the CEQA document.

If an active TRBL nesting colony is found during preconstruction surveys, CDFW recommends implementation of a minimum 300-foot no-disturbance buffer in accordance with CDFW's "Staff Guidance Regarding Avoidance of Impacts to Tricolored Blackbird Breeding Colonies on Agriculture Fields in 2015" (CDFW 2015). CDFW advises that this buffer remain in place until the breeding season has ended or until a qualified biologist has determined that nesting has ceased, the birds have fledged, and are no longer reliant upon the colony or parental care for survival. It is important to note that TRBL colonies can expand over time and for this reason, the colony should be reassessed to determine the extent of the breeding colony within 10 days for Project initiation. 1-7

In the event that a TRBL nesting colony is detected during surveys, consultation with CDFW is warranted to discuss how to implement the Project and avoid take, or if avoidance is not feasible, to acquire an ITP, pursuant to Fish and Game Code section 2081 subdivision (b), prior to any ground-disturbing activities.

Burrowing Owl (BUOW)

BUOW have been observed near the DMC Project site (CDFW 2023) throughout the length of the project area. BUOW inhabit open/disturbed grassland and/or adjacent canal banks, ROWs, vacant lots, etc. containing small mammal burrows, a requisite habitat feature used by BUOW for nesting and cover. Review of aerial imagery 1-8

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indicates that some of the Project site is bordered by annual grassland and potentially fallow agricultural fields.

Potentially significant direct impacts associated with subsequent activities include burrow collapse, inadvertent entrapment, nest abandonment, reduced reproductive success, reduction in health and vigor of eggs and/or young, and direct mortality of individuals.

BUOW rely on burrow habitat year-round for their survival and reproduction. Habitat loss and degradation are considered the greatest threats to BUOW in California's Central Valley (Gervais et al. 2008). Therefore, subsequent ground-disturbing activities associated with the Project have the potential to significantly impact local BUOW populations. In addition, and as described in CDFW's "Staff Report on Burrowing Owl Mitigation" (CDFG 2012), excluding and/or evicting BUOW from their burrows is considered a potentially significant impact under CEQA.

CDFW recommends assessing presence/absence of BUOW by having a qualified biologist conduct surveys following the California Burrowing Owl Consortium's "Burrowing Owl Survey Protocol and Mitigation Guidelines" (CBOC 1993) and CDFW's Staff Report on Burrowing Owl Mitigation" (CDFG 2012) in support of the CEQA document. Specifically, CBOC and CDFW's Staff Report suggest three or more surveillance surveys conducted during daylight with each visit occurring at least three weeks apart during the peak breeding season (April 15 to July 15), when BUOW are most detectable.

1-8

CDFW recommends no-disturbance buffers, as outlined in the "Staff Report on Burrowing Owl Mitigation" (CDFG 2012), be implemented prior to and during any ground-disturbing activities. Specifically, CDFW's Staff Report recommends that impacts to occupied burrows be avoided in accordance with the following table unless a qualified biologist approved by CDFW verifies through non-invasive methods that either: 1) the birds have not begun egg laying and incubation; or 2) that juveniles from the occupied burrows are foraging independently and are capable of independent survival.

Location	Time of Year	Level of Disturbance		
		Low	Med	High
Nesting sites	April 1-Aug 15	200 m*	500 m	500 m
Nesting sites	Aug 16-Oct 15	200 m	200 m	500 m
Nesting sites	Oct 16-Mar 31	50 m	100 m	500 m

* meters (m)

If BUOW are found within these recommended buffers and avoidance is not possible, it is important to note that according to the Staff Report (CDFG 2012), exclusion is not a take avoidance, minimization, or mitigation method and is considered a potentially significant impact under CEQA. However, if necessary, CDFW recommends that

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burrow exclusion be conducted by qualified biologists and only during the non-breeding season, before breeding behavior is exhibited and after the burrow is confirmed empty through non-invasive methods, such as surveillance. CDFW recommends replacement of occupied burrows with artificial burrows at a ratio of 1 burrow collapsed to 1 artificial burrow constructed (1:1) as mitigation for the potentially significant impact of evicting BUOW. BUOW may attempt to colonize or re-colonize an area that will be impacted; thus, CDFW recommends ongoing surveillance, at a rate that is sufficient to detect BUOW if they return. 1-8

Lake and Streambed Alteration

The Project includes evaluating existing drainage structures and may require modification for safe passage of stormwater. Therefore, the Project may be subject to CDFW's regulatory authority pursuant Fish and Game Code Section 1600 et seq. Fish and Game Code section 1602 requires the Project proponent to notify CDFW prior to commencing any activity that may (a) substantially divert or obstruct the natural flow of any river, stream, or lake; (b) substantially change or use any material from the bed, bank, or channel of any river, stream, or lake; or (c) deposit debris, waste or other materials that could pass into any river, stream, or lake. "Any river, stream, or lake" includes those that are ephemeral or intermittent as well as those that are perennial in nature. For additional information on notification requirements, please contact our staff in the LSA Program at (559) 243-4593, or by electronic mail at R4LSA@wildlife.gov. 1-9

Federally Listed Species

CDFW also recommends consulting with the USFWS on potential impacts to Federal listed species including, but not limited to, SJKF. Take under the Federal Endangered Species Act (FESA) is more broadly defined than CESA; take under FESA also includes significant habitat modification or degradation that could result in death or injury to a listed species by interfering with essential behavioral patterns such as breeding, foraging, or nesting. Consultation with the USFWS in order to comply with FESA is advised well in advance of any ground disturbing activities. 1-10

More information on survey and monitoring protocols for sensitive species can be found at CDFW's website (https://www.wildlife.ca.gov/Conservation/Survey-Protocols). If you have any questions, please contact Kelley Nelson, Environmental Scientist, at the address provided on this letterhead, by telephone at (559) 580-3194, or by electronic mail at Kelley.Nelson@wildlife.ca.gov.

Sincerely,

DocuSigned by:
Julie Vance
FA83F09FE08945A...

Julie A. Vance
Regional Manager

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cc: Regional Water Quality Control Board
Central Valley Region
1685 “E” Street
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Comment ID: 2

14 March 2023

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COMMENTS TO REQUEST FOR REVIEW FOR THE MITIGATED NEGATIVE DECLARATION, DELTA-MENDOTA CANAL SUBSIDENCE CORRECTION PROJECT, SCH#2023020323, ALAMEDA, FRESNO, MERCED, SAN BENITO, SAN JOAQUIN, SANTA CLARA, AND STANISLAUS COUNTIES

Pursuant to the State Clearinghouse's 13 February 2023 request, the Central Valley Regional Water Quality Control Board (Central Valley Water Board) has reviewed the *Request for Review for the Mitigated Negative Declaration* for the Delta-Mendota Canal Subsidence Correction Project, located in Alameda, Fresno, Merced, San Benito, San Joaquin, Santa Clara, and Stanislaus Counties. 2-1

Our agency is delegated with the responsibility of protecting the quality of surface and groundwaters of the state; therefore, our comments will address concerns surrounding those issues.

I. Regulatory Setting

Basin Plan

The Central Valley Water Board is required to formulate and adopt Basin Plans for all areas within the Central Valley region under Section 13240 of the Porter-Cologne Water Quality Control Act. Each Basin Plan must contain water quality objectives to ensure the reasonable protection of beneficial uses, as well as a program of implementation for achieving water quality objectives with the Basin Plans. Federal regulations require each state to adopt water quality standards to protect the public health or welfare, enhance the quality of water and serve the purposes of the Clean Water Act. In California, the beneficial uses, water quality objectives, and the Antidegradation Policy are the State's water quality standards. Water quality standards are also contained in the National Toxics Rule, 40 CFR Section 131.36, and the California Toxics Rule, 40 CFR Section 131.38. 2-2

The Basin Plan is subject to modification as necessary, considering applicable laws, policies, technologies, water quality conditions and priorities. The original Basin Plans were adopted in 1975, and have been updated and revised periodically as required, using Basin Plan amendments. Once the Central Valley Water Board has

adopted a Basin Plan amendment in noticed public hearings, it must be approved by the State Water Resources Control Board (State Water Board), Office of Administrative Law (OAL) and in some cases, the United States Environmental Protection Agency (USEPA). Basin Plan amendments only become effective after they have been approved by the OAL and in some cases, the USEPA. Every three (3) years, a review of the Basin Plan is completed that assesses the appropriateness of existing standards and evaluates and prioritizes Basin Planning issues. For more information on the *Water Quality Control Plan for the Sacramento and San Joaquin River Basins*, please visit our website: http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/

Antidegradation Considerations

All wastewater discharges must comply with the Antidegradation Policy (State Water Board Resolution 68-16) and the Antidegradation Implementation Policy contained in the Basin Plan. The Antidegradation Implementation Policy is available on page 74 at: https://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/sacsjr_201805.pdf

In part it states:

2-2

Any discharge of waste to high quality waters must apply best practicable treatment or control not only to prevent a condition of pollution or nuisance from occurring, but also to maintain the highest water quality possible consistent with the maximum benefit to the people of the State.

This information must be presented as an analysis of the impacts and potential impacts of the discharge on water quality, as measured by background concentrations and applicable water quality objectives.

The antidegradation analysis is a mandatory element in the National Pollutant Discharge Elimination System and land discharge Waste Discharge Requirements (WDRs) permitting processes. The environmental review document should evaluate potential impacts to both surface and groundwater quality.

II. Permitting Requirements

Construction Storm Water General Permit

Dischargers whose project disturb one or more acres of soil or where projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, are required to obtain coverage under the General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (Construction General Permit), Construction General Permit Order No. 2009-0009-DWQ. Construction activity subject to this permit includes clearing, grading, grubbing, disturbances to the ground, such as stockpiling, or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility. The Construction General Permit requires the development and implementation of a Storm Water Pollution Prevention

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Plan (SWPPP). For more information on the Construction General Permit, visit the State Water Resources Control Board website at: http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml

Clean Water Act Section 404 Permit

If the project will involve the discharge of dredged or fill material in navigable waters or wetlands, a permit pursuant to Section 404 of the Clean Water Act may be needed from the United States Army Corps of Engineers (USACE). If a Section 404 permit is required by the USACE, the Central Valley Water Board will review the permit application to ensure that discharge will not violate water quality standards. If the project requires surface water drainage realignment, the applicant is advised to contact the Department of Fish and Game for information on Streambed Alteration Permit requirements. If you have any questions regarding the Clean Water Act Section 404 permits, please contact the Regulatory Division of the Sacramento District of USACE at (916) 557-5250.

Clean Water Act Section 401 Permit – Water Quality Certification

If an USACE permit (e.g., Non-Reporting Nationwide Permit, Nationwide Permit, Letter of Permission, Individual Permit, Regional General Permit, Programmatic General Permit), or any other federal permit (e.g., Section 10 of the Rivers and Harbors Act or Section 9 from the United States Coast Guard), is required for this project due to the disturbance of waters of the United States (such as streams and wetlands), then a Water Quality Certification must be obtained from the Central Valley Water Board prior to initiation of project activities. There are no waivers for 401 Water Quality Certifications. For more information on the Water Quality Certification, visit the Central Valley Water Board website at: https://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_certification/

2-3

Waste Discharge Requirements – Discharges to Waters of the State

If USACE determines that only non-jurisdictional waters of the State (i.e., "non-federal" waters of the State) are present in the proposed project area, the proposed project may require a Waste Discharge Requirement (WDR) permit to be issued by Central Valley Water Board. Under the California Porter-Cologne Water Quality Control Act, discharges to all waters of the State, including all wetlands and other waters of the State including, but not limited to, isolated wetlands, are subject to State regulation. For more information on the Waste Discharges to Surface Water NPDES Program and WDR processes, visit the Central Valley Water Board website at:https://www.waterboards.ca.gov/centralvalley/water_issues/waste_to_surface_water/

Projects involving excavation or fill activities impacting less than 0.2 acre or 400 linear feet of non-jurisdictional waters of the state and projects involving dredging activities impacting less than 50 cubic yards of non-jurisdictional waters of the state may be eligible for coverage under the State Water Resources Control Board Water

Quality Order No. 2004-0004-DWQ (General Order 2004-0004). For more information on the General Order 2004-0004, visit the State Water Resources Control Board website at: https://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2004/wqo/wqo2004-0004.pdf

Dewatering Permit

If the proposed project includes construction or groundwater dewatering to be discharged to land, the proponent may apply for coverage under State Water Board General Water Quality Order (Low Threat General Order) 2003-0003 or the Central Valley Water Board's Waiver of Report of Waste Discharge and Waste Discharge Requirements (Low Threat Waiver) R5-2018-0085. Small temporary construction dewatering projects are projects that discharge groundwater to land from excavation activities or dewatering of underground utility vaults. Dischargers seeking coverage under the General Order or Waiver must file a Notice of Intent with the Central Valley Water Board prior to beginning discharge.

For more information regarding the Low Threat General Order and the application process, visit the Central Valley Water Board website at: http://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2003/wqo/wqo2003-0003.pdf

For more information regarding the Low Threat Waiver and the application process, visit the Central Valley Water Board website at: https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/waivers/r5-2018-0085.pdf

2-3

Limited Threat General NPDES Permit

If the proposed project includes construction dewatering and it is necessary to discharge the groundwater to waters of the United States, the proposed project will require coverage under a National Pollutant Discharge Elimination System (NPDES) permit. Dewatering discharges are typically considered a low or limited threat to water quality and may be covered under the General Order for *Limited Threat Discharges to Surface Water* (Limited Threat General Order). A complete Notice of Intent must be submitted to the Central Valley Water Board to obtain coverage under the Limited Threat General Order. For more information regarding the Limited Threat General Order and the application process, visit the Central Valley Water Board website at: https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2016-0076-01.pdf

NPDES Permit

If the proposed project discharges waste that could affect the quality of surface waters of the State, other than into a community sewer system, the proposed project will require coverage under a National Pollutant Discharge Elimination System (NPDES) permit. A complete Report of Waste Discharge must be submitted with the Central Valley Water Board to obtain a NPDES Permit. For more information

regarding the NPDES Permit and the application process, visit the Central Valley Water Board website at: https://www.waterboards.ca.gov/centralvalley/help/permit/

2-3

If you have questions regarding these comments, please contact me at (916) 464-4684 or Peter.Minkel2@waterboards.ca.gov.

Peter Minkel

Peter Minkel
Engineering Geologist

cc: State Clearinghouse unit, Governor's Office of Planning and Research, Sacramento

Friant
WATER AUTHORITY

Comment ID:3

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March 14, 2023

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South-Central California Area Office
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Pablo Arroyave
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RE: COMMENTS ON DRAFT ENVIRONMENTAL ASSESSMENT/INITIAL STUDY FOR THE DELTA MENDOTA CANAL SUBSIDENCE CORRECTION PROJECT

Dear Ms. Emerson and Mr. Arroyave,

The Friant Water Authority respectfully submits these comments on the Draft Environmental Assessment/Initial Study (EA/IS) for the Delta Mendota Canal Subsidence Correction Project (Project) that was released for public review on February 13, 2023. We understand that the Draft EA/IS was prepared jointly by the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), and the San Luis & Delta-Mendota Water Authority (SLDMWA), which is the operating non-federal entity for the Delta Mendota Canal (DMC).

3-1

Background on FWA and Areas of Interest

As Reclamation and SLDMWA are well aware, the Friant Water Authority (FWA) is the operating non-federal entity for the Friant-Kern Canal (FKC) pursuant to Transfer Agreement Contract No. 8-07-20-X0356-X with Reclamation. As a joint powers authority whose membership consists of water agencies with long-term water supply contracts with Reclamation for water from the Friant Division (Friant Division Contractors), FWA also has an interest in and is authorized to protect the water supplies and water rights of Friant Division Contractors.

The FKC, like the subject DMC, is a significant feature of the Central Valley Project (CVP). As acknowledged in the Draft EA/IS, although the FKC and DMC are not physically connected conveyance facilities, there is a significant interrelationship to their operations by virtue of the United States' contractual obligations to supply CVP water to the Exchange Contractors and Settlement

Contractors[1] primarily through the DMC, but under certain conditions, as prescribed in various underlying contracts, Reclamation may, in limited circumstances, make releases of San Joaquin River water from Friant Dam (a call on Friant), which, along with Millerton Lake, are facilities of the Friant Division of the CVP. Because of conditions unrelated to any reduction in the conveyance capacity of the DMC, Reclamation has made calls on Friant in 2014, 2015, 2016 (via exchanges), 2021 (via exchanges), and 2022. These calls on Friant have impacted the water supplies of irrigation, and municipal and industrial (M&I) users supplied by Friant Division Contractors, and during the worst of the drought years and most significant calls on Friant (i.e., 2014 and 2015) caused significant and long-term damage to crops, orchards, and other farm land. 3-1

Calls on Friant also impact the San Joaquin River Restoration Program (SJRRP), which is a comprehensive, long-term effort managed by various federal and state agencies to restore flows to the San Joaquin River from Friant Dam to the confluence of Merced River and restore a self-sustaining Chinook salmon fishery in the river while reducing or avoiding adverse water supply impacts, primarily to Friant Division Contractors, from the release of restoration flows. In particular, calls on Friant reduce available water supplies and the cold-water pool in Millerton Lake, and disconnects the river, which in turn impacts the timing, temperature, and amount of restoration flows, and migration in the San Joaquin River, which can cause potentially significant impacts to the fish populations.

Overview of FWA Concerns and Comments

FWA acknowledges and for the reasons set forth above supports the primary goal of the Proposed Project, which as set forth in Section 1.2.2[2] is to "restore the long-term reliability and quantity of CVP supplies delivered to south-of-Delta contractors dependent on the DMC currently affected by the reduced deliveries limited by the canal's reduced conveyance capacity." However, FWA, does have concerns with potential impacts to Friant Division water supplies in the event there is a call on Friant as a result of the protracted construction of the Proposed Project which references periodic "drawdowns" of the DMC, but based on the construction activities associated with the Proposed Project would appear to potentially necessitate dewatering of the DMC in segments, which could result in a call on Friant or could potentially occur during a call on Friant for reasons unrelated to construction activities. The Draft EA/IS does not adequately address the potential impacts on Friant Division Contractors and the SJRRP during the construction period which may either result in a call on Friant or occur during a call on Friant, thereby exacerbating impacts. 3-2

[1] Unless otherwise defined in this letter, all initially capitalized terms have the definition set forth in the Draft EA/IS.

[2] All Section references are to the Draft EA/IS or applicable Appendix.

Summary of Proposed Project Construction Activities that Could Result in a Call on Friant or Could Occur During a Call on Friant Thereby Impacting Friant Division Contractors and the San Joaquin River Restoration Program

We understand that the Proposed Project is the "Raise Deficient Structures Alternative" generally described in Section 2.2, with further details regarding the Proposed Project and the construction methods and locations described in Appendices C and G. The proposed construction activities would occur over at least a seven-and-a-half-year period with work occurring every day, all year. Specific construction activities that will or could impede the conveyance of water in the DMC during construction include the following:

3-2

- Raising deficient canal concrete lining by installing new concrete lining above the existing lining along approximately 80 miles of the DMC.
- Raising the earthen embankment at deficient bank segments of the canal by adding fill material from existing borrow sites along 50 miles of canal right-of-way (ROW).
- Stabilizing the canal banks along the 18-mile earthen-lined segment of the canal (MP 98.64 to 116.59), which requires lowering the water depth in the earthen-lined segment of the canal by up to six feet during construction.
- Repairing distressed concrete lining above and below the water's surface.
- Replacing 45 impacted vehicle bridges and 36 impacted pipeline crossings.
- Modifying 17 check structures and wasteways and 82 turnouts.
- Modifying drainage structures.

Comments on the EA/IS

1.1 Project Background and History

… Regional groundwater use is anticipated to allow for an additional two feet of inelastic subsidence until full implementation of the Sustainable Groundwater Management Act (SGMA) in 2040 with residual subsidence forecast to continue through the year 2070, the design life of the DMC.

3-3

Comment: ***There is no citation to any reference document in support of this statement regarding the anticipated two feet of subsidence in EA/IS or in Appendix B where a similar statement is made. There is also no clear correlation between the proposed repairs to the DMC and this anticipated level of subsidence. The Groundwater Sustainability Plan for the Delta-Mendota Subbasin has been deemed incomplete by the Department of Water Resources subsequent to the release of the EA/IS. At minimum, further analysis must be prepared to support the assumption of only two additional feet of subsidence impacts through 2040. In addition, there is no effort to quantify the amount of potential residual subsidence after 2040 and how that undefined amount will be addressed as part of the Proposed Project. Finally, to the extent additional subsidence is reasonably foreseeable (which appears to be more likely than not), revised***

construction work, schedules, timelines, and impact analyses, particularly with respect to water supply impacts during construction must be prepared. 3-3

2.2.2.1 Operations During Construction
Some drawdowns of the canal water surface would be needed to support the low-flow construction activities; however, no outages would be required, thus providing flexibility in completing construction activities while minimizing impacts to water deliveries.

Comment: ***This description appears to be inconsistent with the Project Description and information provided in Appendices C and G regarding construction. For example, the Proposed Project includes repairs to the concrete lining "below the water's surface." The more detailed description of this work provided in Section C.2.2.2.1 states that: "Damaged concrete lining and material distorting the canal would be removed with underwater operations, and a grouted mattress would be installed and grouted with cement underwater at applicable locations." FWA requests detailed confirmation that absolutely no dewatering of the DMC will be required during Project construction. Alternatively, if dewatering will potentially be required, there should be a description of the work and the proposed duration. Moreover, as discussed below, whether there is dewatering or simply reductions in DMC flows, the potential impacts of such flow reductions on the water supplies of the Friant Division Contractors as well as restorations flows and fisheries-related impacts for the SJRRP must be analyzed.*** 3-4

4.1.2 Significance Criteria (Surface Water Supply)

Comment: ***We note the following statement for reference to our comments below***: "If water supply delivery changes are a reduction of five percent or greater, water supply impacts would be considered significant." (Emphasis added.)

4.1.3 Environmental Consequences/Impacts of the No Action Alternative
… The reduced capacity of the DMC could limit the ability of Reclamation to meet CVP Exchange Contractor delivery requirements, which could result in a further reduction in deliveries to other south-of-Delta CVP contractors or require the release of water from Friant Dam to meet these senior water right deliveries. 3-5

Comment: ***FWA is uncertain if current and projected reduced capacity of the DMC could limit the ability of Reclamation to meet CVP Exchange Contractor delivery requirements from the DMC. It is unclear from the CalSim modeling (referred to in Appendix D) if simulated demands of the Exchange Contractors reflect current and future practices of transferring their substitute supplies. Exchange Contractors transfer up to 150 TAF of their substitute supply to other SOD contractors under their 2014-2038 Water Transfer Program depending on the year type. Modeling should be updated to reflect this***

practice as current results overstate the DMC capacity constraints during peak summer months.

With respect to any releases of water from Friant Dam to meet Exchange Contractor requirements, such releases are based on "contract rights" under the Exchange Contract and not on any senior water rights. More importantly, this statement only appears in the No Action Alternative, and, as discussed below, no analysis of reduced DMC capacity during construction or the potential for a call on Friant is provided.

3-5

4.1.4.1 Construction of the Proposed Action

Construction of the Proposed Action is expected to last approximately seven and a half years. Some drawdowns of the canal water surface are needed to support construction activities; however, no partial outages are required, thus providing flexibility in completing construction activities without adversely impacting water supply deliveries. During construction, the Intertie Pumping Plant could be used to maintain CVP deliveries consistent with normal operations, in coordination with California Department of Water Resources (DWR). It is anticipated that because no outages would be needed, impacts to CVP water supply deliveries during construction of the Proposed Action would be minimal. In addition, Reclamation and SLDMWA would coordinate water delivery schedules during construction times to adjust water delivery as needed. **Therefore, construction of the Proposed Action would have a less than significant impact on CVP deliveries.**

3-6

Comment*: The assertion that absolutely no outage or dewatering of the DMC during the seven or more years of project construction is questionable as noted above. Putting that aside, the Project Description notes that there will be "drawdowns" of flows in the canal, but the above section contains no analysis of the impacts of such drawdowns, including whether or not at any time there could be a water supply delivery change of five percent or greater, which is deemed significant. Moreover, the Intertie is located at the northern end of the DMC and would not provide any alternative means of conveyance (as opposed to pumping) for virtually all of the DMC, which is located below the Intertie. Accordingly, the conclusion in Section 4.1.4.1 that construction of the Proposed Project would have a less than significant impact of CVP deliveries is wholly unsupported. A full analysis of potential water supply impacts from the numerous months and years where flows in the DMC will be reduced during construction of the Proposed Project must be prepared, and the revised analyses and any resulting changes to the EA/IS, including necessary mitigation measures must be made available for public review.*

COMMENTS ON THE EA/IS APPENDICES

Appendix C: Project Description

3-7

Figure C-1. Design Flows, Reduction in Flow, and Actual Flow Capacities in the DMC For Current and Future (With Future Subsidence) Conditions

3-7

Comment: ***This figure displays potential future DMC capacity due to subsidence; however, nowhere in the document is their supporting analysis to justify the projections. There are references to a 2021 "Feasibility Study of the Structural Alternatives"; however, it is not listed in the references section nor is it easily found online and may not have been made available for public review.***

Table C-7. Assumptions for the Proposed Action Schedule Development

Comment: ***This table provides a breakdown on the proposed construction activities, the "season designation" along with the duration of the construction work. For example, the work on the concrete lining is designated "low-flow work" but the applicable time period is (October – May) and the work is going to take over four years. The months of April and May are considered "critical" irrigation times under the Exchange Contract that governs Reclamation's delivery obligations to the Exchange Contractors and have some of the highest monthly water delivery demands of the year. These months are clearly not "low-flow work" periods and could have a significant impact on deliveries through the DMC to the Exchange Contractors during construction, which in turn could impact the water supplies of Friant Division Contractors by either resulting in a call on Friant, or if the reduced DMC flows were to occur during a call on Friant, additional demands may be made on San Joaquin River water affecting not only Friant Division Contractors but the restorations flows of the SJRRP.***

3-8

Appendix D: CalSim Modeling Technical Report

Comment: ***It is unclear from the CalSim modeling if simulated demands of the Exchange Contractors reflect current and future practices of transferring their substitute supplies. Exchange Contractors transfer up to 150 TAF of their substitute supply to other SOD contractors under their 2014-2038 Water Transfer Program depending on the year type. Modeling should be updated to reflect this practice as current results overstate the DMC capacity constraints during peak summer months.***

3-9

Appendix G: Water Supply Technical Appendix

G.1.1 Water in California

…The study area captures the CVP and SWP contractors that may be impacted by changes to the operation of the DMC and evaluates the water supply impacts that the construction and operation of the DMC Subsidence Correction Project (Project) would have on deliveries to the entirety of the study area.

3-10

G.1.3.2 Friant Division Contractors

Friant Division contractors, located on the east side of the San Joaquin Valley, receive water stored behind Friant Dam and delivered through the Friant-Kern and Madera Canals. In years in which Reclamation is otherwise unable to make contracted deliveries to Exchange Contractors, Reclamation can make a call on water stored in Millerton Reservoir, thereby requiring releases from Friant Dam (U.S. Congressional Research Service [CRS] 2022).

3-10

Comment: ***As discussed below, despite the acknowledgement that reductions in south-of Delta deliveries to the Exchange Contactors and the Settlement Contractors (see G.1.3.3) through the DMC can result in calls on Friant and thus impacts to Friant Division Contractors (and the SJRRP), the water supply impact analysis in Appendix G fails to fully discuss such potential impacts.***

G.4.2.1 Impact WS-1: Would construction of the alternative change CVP deliveries to CVP contractors?

Construction of the Proposed Action is expected to last approximately seven and a half years. Some drawdowns of the canal water surface are needed to support construction activities, however no partial outages are required, thus providing flexibility in completing construction activities. During construction, the Intertie Pumping Plant could be used to maintain CVP deliveries consistent with existing operations, in coordination with DWR. It is anticipated that because no outages would be needed, impacts to water supply deliveries during construction of the Proposed Action would be minimal. **Construction of the Proposed Action would have a less than significant impact on CVP deliveries.**

3-11

Comment: ***This analysis of construction impacts to water supply is cursory, the statement no "outages are required" seems suspect in light of the scope and types of construction activities, and as noted above, makes no attempt to quantify the amount or timing of "drawdowns". Moreover, there is no mention of water supply impacts to Friant Division Contractors, and no mention anywhere in the EA/IS of water supply and biological resources impacts to the SJRRP. Accordingly, the document is deficient, an appropriate analysis must be prepared, and the revised document/applicable sections reposted for public comment.***

G.4.2.2 Impact WS-2: Would operation of the alternative change CVP deliveries to CVP contractors?

3-12

Comment: ***This section contains no analysis of water supply impacts on Friant Division Contractors or the SJRRP. Accordingly, the document is deficient, an appropriate analysis must be prepared, and the revised document/applicable sections reposted for public comment.***

G.4.3 Mitigation Measures
No mitigation measures would be necessary to reduce impacts of the Proposed Action to the less than significant level.

Comment: ***Because there is no analysis of water supply impacts of the Proposed Project/Action during construction or arising from operation of the Proposed Project on Friant Division Contractors or the SJRRP, there is no substantial evidence to support this finding. The requisite analysis must be prepared, determinations made as to the level of significance of any impact, and depending on such determination, appropriate mitigation may be required, and if the impact cannot be reduced to less than significant, an EIR may be required and potentially a statement of overriding considerations adopted if impacts cannot be mitigated to less than significant.*** 3-13

Comment: ***Neither Appendix G nor M (Biological Survey Report) address potential water supply and related biological resources impacts on the San Joaquin River Restoration Program that may be affected by a call on Friant resulting from any temporary or permanent interruption or reduction in deliveries of substitute water to the Exchange Contractors and Settlement Contractors through the DMC. The requisite analysis must be prepared, determinations made as to the level of significance of any impact, and depending on such determination, appropriate mitigation may be required, and if the impact cannot be reduced to less than significant, an EIR may be required and potentially a statement of overriding considerations adopted if impacts cannot be mitigated to less than significant.*** 3-14

Respectfully Submitted,

Donald M. Davis
General Counsel

Ian Buck-Macleod
Water Resources Manager

Comment ID: 4

San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT

HEALTHY AIR LIVING™

March 17, 2023

Pablo Arroyave
San Luis & Delta-Mendota Water Authority
P.O. Box 2157
Los Banos, CA 93635

Project: Delta-Mendota Canal Subsidence Correction Project Draft Environmental Assessment/Initial Study

District CEQA Reference No: 20230177

Dear Mr. Arroyave:

The San Joaquin Valley Air Pollution Control District (District) has reviewed the Environmental Assessment/Mitigated Negative Declaration (EA/MND) from the San Luis & Delta-Mendota Water Authority (SLDMWA) for the Delta-Mendota Canal Subsidence Correction project. Per the MND, the project consists of raising deficient concrete lining segments and bank segments to meet the minimum freeboard requirements, installing riprap for erosion protection to stabilize the banks along the earthen-lined segment, replacing bridges and pipeline crossings that do not have enough clearance above water surface elevation to meet minimum required clearings, raising the gates of check structures and waste ways to design level and modify impacted structures, and evaluate existing drainage structures to modify them for safe passage of storm water (Project). The Project is located at various locations along the Delta-Mendota canal that runs through Alameda, San Benito, Santa Clara, San Joaquin, Stanislaus, Merced, and Fresno Counties. The comments contained in this letter are only intended for the portions of this Project that will be taking place within the jurisdiction of the District, specifically, the portions within San Joaquin, Stanislaus, Merced, Madera, and Fresno Counties. 4-1

The District offers the following comments regarding the Project:

1) **Project Related Emissions** 4-2

Based on information provided to the District, specific annual criteria pollutant emissions from construction and operation associated with the portions of the Project within the District's jurisdiction are not expected to exceed any of the significance thresholds as identified in the District's Guidance for Assessing and

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Mitigating Air Quality Impacts (GAMAQI):
https://www.valleyair.org/transportation/GAMAQI.pdf.

4-2

1a) Construction Emissions

The District recommends, to reduce impacts from construction-related diesel exhaust emissions, the project proponent should utilize the cleanest available off-road construction equipment, including the latest tier equipment.

2) Health Risk Screening/Assessment

The EA/MND stated "Construction impacts under the Proposed Action would be temporary and highly mobile, occurring for short periods along various points of the 116 mile DMC…". While construction emissions generated would be temporary, there is still a potential risk of exposure to sensitive receptors from substantial pollutant concentrations.

To determine the potential construction related health impacts on surrounding receptors (residences, businesses, hospitals, day-care facilities, health care facilities, etc.) a Prioritization and/or a Health Risk Assessment (HRA) should be performed. These health risk determinations should quantify and characterize potential Toxic Air Contaminants (TACs) identified by the Office of Environmental Health Hazard Assessment/California Air Resources Board (OEHHA/CARB) that pose a present or potential hazard to human health.

The health risk analysis should evaluate all potential air emissions from construction, including multi-year construction (e.g., to diesel exhaust emitted from heavy-duty off-road earth moving equipment during construction).

4-3

Prioritization (Screening Health Risk Assessment):
A "Prioritization" is the recommended method for a conservative screening-level health risk assessment. The Prioritization should be performed using the California Air Pollution Control Officers Association's (CAPCOA) methodology.

The District recommends that a more refined analysis, in the form of an HRA, be performed for any project resulting in a Prioritization score of 10 or greater. This is because the prioritization results are a conservative health risk representation, while the detailed HRA provides a more accurate health risk evaluation.

To assist land use agencies and project proponents with Prioritization analyses, the District has created a prioritization calculator based on the aforementioned CAPCOA guidelines, which can be found here:
http://www.valleyair.org/busind/pto/emission_factors/Criteria/Toxics/Utilities/PRIORITIZATION-CALCULATOR.xls

Health Risk Assessment:
Prior to performing an HRA, it is strongly recommended that land use agencies/ project proponents develop and submit for District review a health risk modeling protocol that outlines the sources and methodologies that will be used to perform the HRA. This step will ensure all components are addressed when performing the HRA.

A development project would be considered to have a potentially significant health risk if the HRA demonstrates that the project-related health impacts would exceed the District's significance threshold of 20 in a million for carcinogenic risk, or 1.0 for either the Acute or Chronic Hazard Indices.

A project with a significant health risk would trigger all feasible mitigation measures. The District strongly recommends that development projects that result in a significant health risk not be approved by the land use agency. 4-3

The District is available to review HRA protocols and analyses. For HRA submittals please provide the following information electronically to the District for review:

- HRA (AERMOD) modeling files
- HARP2 files
- Summary of emissions source locations, emissions rates, and emission factor calculations and methodologies.

For assistance, please contact the District's Technical Services Department by:

- E-Mailing inquiries to: hramodeler@valleyair.org
- Calling (559) 230-5900

Recommended Measure: Development projects resulting in TAC emissions should be located an adequate distance from residential areas and other sensitive receptors in accordance to CARB's Air Quality and Land Use Handbook: A Community Health Perspective located at https://ww3.arb.ca.gov/ch/handbook.pdf.

3) District Rules and Regulations

The District issues permits for many types of air pollution sources, and regulates some activities that do not require permits. A project subject to District rules and regulations would reduce its impacts on air quality through compliance with the District's regulatory framework. In general, a regulation is a collection of individual rules, each of which deals with a specific topic. As an example, Regulation II (Permits) includes District Rule 2010 (Permits Required), Rule 2201 (New and Modified Stationary Source Review), Rule 2520 (Federally Mandated Operating 4-4

Permits), and several other rules pertaining to District permitting requirements and processes.

The list of rules below is neither exhaustive nor exclusive. Current District rules can be found online at: www.valleyair.org/rules/1ruleslist.htm. To identify other District rules or regulations that apply to future projects, or to obtain information about District permit requirements, the project proponents are strongly encouraged to contact the District's Small Business Assistance (SBA) Office at (559) 230-5888.

3a) District Rules 2010 and 2201 - Air Quality Permitting for Stationary Sources

Stationary Source emissions include any building, structure, facility, or installation which emits or may emit any affected pollutant directly or as a fugitive emission. District Rule 2010 (Permits Required) requires operators of emission sources to obtain an Authority to Construct (ATC) and Permit to Operate (PTO) from the District. District Rule 2201 (New and Modified Stationary Source Review) requires that new and modified stationary sources of emissions mitigate their emissions using Best Available Control Technology (BACT).

4-4

The portions of the Project within the Districts jurisdiction may be subject to District Rule 2010 (Permits Required) and Rule 2201 (New and Modified Stationary Source Review) and may require District permits. Prior to construction, the project proponent should submit to the District an application for an ATC. For further information or assistance, the project proponent may contact the District's SBA Office at (559) 230-5888.

3b) District Rule 9510 - Indirect Source Review (ISR)

The District has reviewed the information provided and determined that there is no construction of a new building, facility, or structure, or reconstruction of a building, facility, or structure for the purpose of increasing capacity or activity. Therefore, the project does not meet the definition of a "Development Project", as defined in District Rule 9510 section 3.13, and District Rule 9510 requirements and related fees do not apply to the portions of the Project within the District's jurisdiction.

3c) District Rule 4002 (National Emissions Standards for Hazardous Air Pollutants)

In the event an existing building will be renovated, partially demolished or removed, the portions of the Project within the Districts jurisdiction may be subject to District Rule 4002. This rule requires a thorough inspection for asbestos to be conducted before any regulated facility is demolished or

renovated. Information on how to comply with District Rule 4002 can be found online at: http://www.valleyair.org/busind/comply/asbestosbultn.htm.

3d) District Rule 4601 (Architectural Coatings)

The portions of the Project within the Districts jurisdiction may be subject to District Rule 4601 since it may utilize architectural coatings. Architectural coatings are paints, varnishes, sealers, or stains that are applied to structures, portable buildings, pavements or curbs. The purpose of this rule is to limit VOC emissions from architectural coatings. In addition, this rule specifies architectural coatings storage, cleanup and labeling requirements. Additional information on how to comply with District Rule 4601 requirements can be found online at: http://www.valleyair.org/rules/currntrules/r4601.pdf

4-4

3e) District Regulation VIII (Fugitive PM10 Prohibitions)

The project proponent may be required to submit a Construction Notification Form or submit and receive approval of a Dust Control Plan prior to commencing any earthmoving activities as described in Regulation VIII, specifically Rule 8021 – *Construction, Demolition, Excavation, Extraction, and Other Earthmoving Activities.*

Should the project result in at least 1-acre in size, the project proponent shall provide written notification to the District at least 48 hours prior to the project proponents intent to commence any earthmoving activities pursuant to District Rule 8021 (Construction, Demolition, Excavation, Extraction, and Other Earthmoving Activities). Also, should the project result in the disturbance of 5-acres or more, or will include moving, depositing, or relocating more than 2,500 cubic yards per day of bulk materials, the project proponent shall submit to the District a Dust Control Plan pursuant to District Rule 8021 (Construction, Demolition, Excavation, Extraction, and Other Earthmoving Activities). For additional information regarding the written notification or Dust Control Plan requirements, please contact District Compliance staff at (559) 230-5950.

The application for both the Construction Notification and Dust Control Plan can be found online at:
https://www.valleyair.org/busind/comply/PM10/forms/DCP-Form.docx

Information about District Regulation VIII can be found online at:
http://www.valleyair.org/busind/comply/pm10/compliance_pm10.htm

3f) Other District Rules and Regulations

The portions of the Project within the Districts jurisdiction may also be subject to the following District rules: Rule 4102 (Nuisance) and Rule 4641 (Cutback, Slow Cure, and Emulsified Asphalt, Paving and Maintenance Operations).

4-4

4) District Comment Letter

The District recommends that a copy of the District's comments be provided to the Project proponent.

4-5

If you have any questions or require further information, please contact Matt Crow by e-mail at Matt.Crow@valleyair.org or by phone at (559) 230-5931.

Sincerely,

Brian Clements
Director of Permit Services



For: Mark Montelongo
Program Manager

Delta-Mendota Canal Subsidence Correction Project Environmental Assessment/Initial Study

Appendix R: Errata Sheets

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Appendix R Errata Sheets

R.1 Introduction

This appendix contains all text changes to the Draft Environmental Assessment/Initial Study (EA/IS). Changes in text are signified by strikeouts where text is removed and by italics where text is added.

R.2 Table of Contents

The list of appendices on Page ii of the Draft EA/IS is revised as follows:

Appendix A – Supplemental Materials
Appendix B – Plan Formulation Technical Memorandum
Appendix C – Project Description
Appendix D – CalSim Modeling Technical Report
Appendix E – Regulatory Settings
Appendix F – Existing Conditions Supporting Information
Appendix G – Water Supply Technical Appendix
Appendix H – Water Quality Technical Appendix
Appendix I1 – Air Quality Technical Appendix
Appendix I2 – Air Quality and Greenhouse Gas Emissions Calculations
Appendix I3 – Health Risk Screening Assessment Calculations
Appendix J – Greenhouse Gas Emissions Technical Appendix
Appendix K – Noise and Vibration Calculations
Appendix L – Traffic and Transportation Technical Appendix
Appendix M – Biological Survey Report
Appendix N – Archeological Survey and Evaluation Report
Appendix O – Cumulative Projects
Appendix P – Public Comments and Responses
Appendix Q – Public Comment Letters
Appendix R – Errata Sheets
Appendix S – Mitigation Monitoring and Reporting Plan

R.3 Chapter 1 Introduction

Page 1-3

The second to last sentence in the second paragraph in Section 1.1 on Page 1-3 of the Draft EA/IS is revised as follows:

~~Regional groundwater use is anticipated to allow for an additional two feet of inelastic subsidence until full implementation of the Sustainable Groundwater Management Act (SGMA) in 2040, with residual elastic subsidence forecast to continue through the design life of the canal.~~

R.4 Chapter 2 Project Description

Page 2-1

The following text was added before the last sentence in the second paragraph in Section 2.1 on Page 2-1 of the Draft EA/IS:

> *Subsidence modeling was completed by Reclamation using the HydroGeoSphere San Joaquin Valley Groundwater Model to forecast the anticipated level of subsidence along the DMC through 2070. The simulated subsidence rates along the DMC were used to estimate forecasted design flows under future conditions.*

Page 2-4

The following text was added after the first sentence in Section 2.2.2.1 on Page 2-4 of the Draft EA/IS:

> *The proposed concrete lining and associated embankment raise low-flow construction actions in the upper DMC would be completed above water surface and would not impact flows. Proposed concrete lining repairs of the canal in the upper DMC would require underwater work and would also be completed without drawdown to flows. Modification to check structures in the upper DMC would require flows in the upper DMC to be held at levels not to exceed two thirds of current capacity (i.e., 66 percent of current capacity) between November through February of the construction duration.*
>
> *The proposed embankment raise low-flow construction action in the lower DMC would be completed above water surface and would not impact flows. Proposed concrete lining repairs of the lined canal would require underwater work and would also be completed without drawdown to flows in the lower DMC. Similar to the upper DMC, modification of check structures along the lower DMC would require flows to be held at two thirds of current capacity (i.e., 66 percent of current capacity). Repairs and stabilization activities along the earthen-lined segment of the lower DMC would require water levels to be drawn down by six feet from November through February, which is equivalent to an average reduction of approximately one third of the canal's current capacity in that segment. During these construction actions, limits on water levels in the earthen-lined segment of up to six feet could result in a water surface elevation in the Mendota Pool higher than the DMC, depending on inflow rates into Mendota Pool from the San Joaquin River. If these conditions were to occur during construction, water would be pumped from the DMC into Mendota Pool.*

R.5 Chapter 3 Affected Environment/Environmental Settings

Page 3-6

The last sentence of Section 3.5.2 on Page 3-6 of the Draft EA/IS is revised as follows:

> Based on existing habitat conditions, species-specific habitat requirements, known occurrence records, or direct observations recorded during biological surveys, a total of *54*~~53~~ special-status species—24 plants and ~~29~~*30* wildlife species —were identified as having the potential to occur in the Project area, as summarized in Table M-2 of Appendix M.

Page 3-6 and 3-7

The first sentence and last sentence in Section 3.5.2.2 on Page 3-6 and 3-7 of the Draft EA/IS is revised as follows:

> The following ~~29~~*30* animal species have the potential to occur in the Project area: pallid bat (Antrozous pallidus), Townsend's big-eared bat (Corynorhinus townsendii), western mastiff bat (*Eumops perotis californicus*), western red bat (Lasiurus blossevilii), American badger (Taxidea taxus), San Joaquin kit fox (Vulpes macrotis mutica), tricolored blackbird (Agelaius tricolor), grasshopper sparrow (Ammodramus savannarum), golden eagle (Aquila chrysaetos), short-eared owl (Asio flammeus), burrowing owl (Athene cunicularia), Swainson's hawk (Buteo swainsoni), northern harrier (Circus hudsonius), white-tailed kite (Elanus leucurus), loggerhead shrike (Lanius ludovicianus), song sparrow ('Modesto' population) (Melospiza melodia), yellow-headed blackbird (Xanthocephalus xanthocephalus), California tiger salamander – central California distinct population segment (Ambystoma californiense), California red-legged frog (Rana draytonii), western spadefoot toad (Spea hammondii), western pond turtle (Emys marmorata), longhorn fairy shrimp (Branchinecta longiantenna), vernal pool fairy shrimp (Branchinecta lynchi), vernal pool tadpole shrimp (*Lepidurus packardi*), northern California legless lizard (Anniella pulchra), California glossy snake (Arizona elegans occidentalis), San Joaquin whipsnake (Masticophis flagellum ruddocki), coast horned lizard (Phrynosoma blainvillii), ~~and~~ giant garter snake (Thamnophis gigas)*, and Crotch bumble bee (Bombus crotchii)*.

R.6 Chapter 4 Impact Evaluation

Page 4-2

The fourth sentence of the second paragraph in Section 4.1.3 on Page 4-2 of the Draft EA/IS is revised as follows:

> The reduced capacity of the DMC could limit the ability of Reclamation to meet CVP Exchange Contractor *or settlement contractor* delivery requirements, which could result in a further reduction in deliveries to other south-of-Delta CVP contractors or require the release of water from Friant Dam to meet ~~these senior water right deliveries~~ *CVP Exchange Contractor or settlement contractor delivery requirements, which could result in a reduction in deliveries to Friant Division contractors.*

Page 4-2 and 4-3

The following text in Section 4.1.4.1 on Page 4-2 and 4-3 of the Draft EA/IS is revised as follows:

Construction of the Proposed Action is expected to last approximately seven and a half years. Some drawdowns of the canal water surface are needed to support construction activities; however, no partial outages are required, thus providing flexibility in completing construction activities without adversely impacting water supply deliveries. *The modifications in the upper DMC requiring drawdowns limiting flows to levels not to exceed two-thirds of current capacity (i.e., 66 percent of current capacity) would be scheduled to occur between November-February. Average flow levels in the upper DMC during these drawdown periods are approximately 68 percent of current capacity. Higher flow levels exceeding 68 percent have been observed in wet and dry year types. During construction, in years with hydrologic conditions that would support the conveyance levels above the 66 percent limit, those additional supplies would be conveyed using available capacity in the DMC-California Aqueduct Intertie Pumping Plant and the California Aqueduct* ~~During construction, the Intertie Pumping Plant could be used to maintain CVP deliveries~~ ~~consistent with normal operations~~, in coordination with California Department of Water Resources (DWR). It is anticipated that ~~because no outages would be needed~~ *with use of the Intertie Pumping Plant,* impacts to CVP water supply deliveries *in the upper DMC* during construction of the Proposed Action would be minimal.

The proposed modification of check structures along the lower DMC would require flows to be held at two thirds of current capacity (66 percent of current capacity) between November through February of the construction duration. In the past five years, flows in the lower DMC have been lower than 60 percent of current capacity during the low-flow work months (October through May). Consequently, proposed modifications to check structures would be completed without impacting deliveries to contractors receiving supplies from the lower DMC and Mendota Pool. Repairs and stabilization activities along the earthen-lined segment of the lower DMC would require water levels to be drawn down by six feet, holding conveyance levels to approximately two thirds of the canal's current capacity (66 percent of current capacity) in that segment. This work is scheduled to occur between November-February when flow levels in the earthen-lined segment of the lower DMC are on average approximately 25 percent of current capacity and have been lower than 60 percent of current capacity in all year types. During these construction actions, scheduled to occur between November through February, limits on water levels in the earthen-lined segment of the lower DMC of up to five feet could result in a water surface elevation in the pool higher than the DMC. If these conditions occur during construction, water will be pumped from the DMC into Mendota Pool to avoid impacts to water supply to all water users receiving deliveries from Mendota Pool, including CVP Exchange Contractors and settlement contractors. The scheduling of construction actions requiring limits on DMC conveyance capacity to periods with lower demands and lower flows in the canal will support uninterrupted deliveries to water users (including CVP Exchange Contractors and settlement contractors) from the DMC. Consequently, construction of the Proposed Action is not expected to require the release of water from Friant Dam to meet CVP Exchange Contractor or settlement contractor delivery requirements, which could result in a reduction in deliveries to Friant Division contractors. In addition, Reclamation and SLDMWA would coordinate water delivery schedules during construction times to adjust water delivery as needed. **Therefore, construction of the Proposed Action would have a less than significant impact on CVP deliveries.**

Page 4-6

The following sentence was added at the end of Section 4.3.1 on Page 4-6 of the Draft EA/IS:

Appendix I3 provides a health risk screening tool assessment, which was conducted to assess construction-related TAC emissions. The assessment utilized SJVAPCD's Prioritization tool, with inputs modified to reflect the short-term and temporary exposure of construction activities.

Page 4-7

The following sentence was added to the second paragraph under Section 4.3.4.1 on Page 4-7 of the Draft EA/IS:

> *The health risk screening assessment of construction-related TAC emissions, presented in Appendix I3, confirmed that construction TAC emissions would not be expected to result in significant health risks to sensitive receptors nearest to project activities.*

Page 4-15

The first sentence under Section 4.9.4.1 on Page 4-15 of the Draft EA/IS is revised as follows:

> The Proposed Action would have direct and indirect impacts on *5*~~53~~ special-status species, as described in Appendix M.

Page 4-24

The first bullet under Section 4.14.4.2 on Page 4-24 of the Draft EA/IS is revised as follows:

1) Overall implementation and monitoring of the MMs for biological resources and the terms and conditions of any agency permits/authorizations throughout the duration of Project construction and restoration/revegetation of riparian habitat~~, per BIO-2e~~.

Page 4-26

The following text was added to the end of Section 4.14.4.2 on Page 4-26 of the Draft EA/IS:

> *Prior to project implementation, Reclamation will consult with USFWS to ensure its actions do not jeopardize the continued existence of any federally listed species or destroy/adversely modify critical habitat pursuant to Section 7(a)(2) of the ESA. If consultation with USFWS results in the issuance of a biological opinion, the Proposed Action will be conducted in compliance with all reasonable and prudent measures and terms and conditions set forth in the biological opinion.*
>
> *To inform discussions between SLDMWA and CDFW regarding the potential for the Proposed Action to impact species currently protected under the CESA, and out of an abundance of caution, a qualified biologist familiar with the behavior and life history of the Crotch bumble bee will conduct surveys to determine the presence/absence of the species within the project area within 1 year prior to the initiation of construction. These surveys will be conducted during the Crotch bumble bee flying season (i.e., March 1 to September 1) when the species is most likely to be detected above ground. Survey results, including negative findings, will be submitted to CDFW prior to the initiation of project-related ground-disturbing activities. At a minimum, the survey report will provide the following:*
>
> *a. A description and map of the survey area, focusing on areas that could provide suitable habitat for the Crotch bumble bee.*
>
> *b. Field survey conditions that include the name(s) of qualified biologist(s) and their qualifications, date and time of the survey, survey duration, general weather conditions, and survey goals.*
>
> *c. A map(s) showing the location of Crotch bumble bee nests/colonies identified during the surveys.*
>
> *d. A description of the physical (e.g., soil, moisture, slope) and biological (e.g., plant composition) conditions where each Crotch bumble bee nest/colony was found. A sufficient description of biological*

conditions, primarily impacted habitat, including native plant composition (e.g., density, cover, and abundance) within the impacted habitat (e.g., species list separated by vegetation class, density, cover, and abundance of each plant species).

Prior to Project implementation, SLDMWA will consult with CDFW if any species protected under CESA are confirmed present within the project area and it is determined that take of one or more of these species cannot be avoided during Project implementation. Should it be determined that the Proposed Action would result in take of one or more species protected under CESA, SLDMWA would obtain take authorization through the acquisition of an ITP from CDFW, pursuant to Fish and Game Code Section 2081 subdivision (b).

Page 4-36

The following text in Section 4.14.6.1 on Page 4-36 of the Draft EA/IS is revised as follows:

~~Prepare for unexpected failures of erosion control measures.~~ To prepare for unexpected failures of erosion control measures, a supply of erosion control materials will be maintained on-site during the construction period to facilitate a quick response to unanticipated storm events or emergencies.

R.7 Chapter 5 Cumulative Effects

Page 5-1

The first paragraph in Section 5.1.1 on Page 5-1 of the Draft EA/IS is revised as follows:

Cumulative impacts on water supply resulting from concurrent projects would be associated with the short-term impacts of water supply delivery interruptions as a result of any required construction drawdown. The Proposed Action requires some drawdowns of the canal; however, CVP and SWP operations are closely coordinated by Reclamation and DWR and reductions in deliveries would be avoided to the maximum extent practical. This would include construction of the Proposed Action and the California Aqueduct – San Luis Canal Embankment and Liner Raise Project, which would be timed to ensure adequate capacity is maintained to prevent water supply delivery interruptions. *In addition, because the Proposed Action would maintain adequate capacity during construction to avoid water supply interruptions, there would be no impact on the operation of the San Joaquin River Restoration Program.* **Therefore, the construction of the Proposed Action in combination with concurrent projects would not result in significant cumulative impacts on surface water supply.**

R.8 Appendix B

Page 1-3

The second-to-last sentence of the second paragraph on Page 1-3 in Appendix B of the Draft EA/IS is revised as follows:

~~Regional groundwater use is anticipated to allow for an additional two feet of inelastic subsidence until full implementation of the Sustainable Groundwater Management Act (SGMA) in 2040, with residual elastic subsidence forecast to continue through the design life of the canal.~~

R.9 Appendix C

Page C-1

The following sentences were added before the last sentence in the second paragraph of Section C.1 on Page C-1 in Appendix C of the Draft EA/IS:

> *Subsidence modeling was completed using the HydroGeoSphere San Joaquin Valley Groundwater Model to forecast the anticipated level of subsidence along the DMC through 2070. The simulated subsidence rates along the DMC were used to estimate forecasted design flows under future conditions.*

Page C-14 and C-15

The following text was added after the first sentence in Section C.2.2.1 on Pages C-14 and C-15 in Appendix C of the Draft EA/IS:

> *The proposed concrete lining and associated embankment raise low-flow construction actions in the upper DMC would be completed above water surface and would not impact flows. Proposed concrete lining repairs of the canal in the upper DMC would require underwater work and would also be completed without drawdown to flows. Modification to check structures in the upper DMC would require flows in the upper DMC to be held at levels not to exceed two thirds of current capacity (i.e., 66 percent of current capacity) between November through February of the construction duration.*
>
> *The proposed embankment raise low-flow construction action in the lower DMC would be completed above water surface and would not impact flows. Proposed concrete lining repairs of the lined canal would require underwater work and would also be completed without drawdown to flows in the lower DMC. Similar to the upper DMC, modification of check structures along the lower DMC would require flows to be held at two third of current capacity (66 percent of current capacity). Lastly, repairs and stabilization activities along the earthen-lined segment of the lower DMC would require water levels to be drawdown by up to six feet from October through May, which is equivalent to an average reduction of approximately one third of the canal's current capacity in that segment. During these construction actions, limits on water levels in the earthen-lined segment of up to six feet could result in a water surface elevation in the Mendota Pool higher than the DMC, depending on inflow rates into Mendota Pool from the San Joaquin River. If these conditions were to occur during construction, water would be pumped from the DMC into Mendota Pool.*

R.10 Appendix D

Page 1-1

The last sentence in the first paragraph in Section 1.1.1 on Page 1-1 in Appendix D of the Draft EA/IS:

The purpose and need of Reclamation's Proposed Action is to restore the originally authorized conveyance capacity of the DMC (the design capacity conveys a variable flow rate decreasing from 4,600 cubic feet per second (cfs) at the upstream end to 3,210~~4~~ cfs at the downstream end).

Page 1-1 and 1-2

Section 1.1.2 on Page 1-1 and 1-2 in Appendix D of the Draft EA/IS was revised as follows:

Under CEQA, a lead agency must identify the objectives sought by the proposed project when that project requires an Environmental Impact Report (EIR) (CEQA Guidelines Section 15124(b)). Although a statement of project objectives is not required under CEQA for an IS, the additional information provided in this section is consistent with CEQA Guidelines. The primary goal for the Project is to *restore* ~~or replace~~ conveyance capacity in the DMC lost to regional subsidence. The objectives of the Project are as follows:

1. To *restore* ~~increase~~ the long-term reliability and quantity of CVP supplies delivered to south-of-Delta contractors dependent on the DMC currently affected by reduced deliveries limited by the canal's reduced conveyance capacity.
2. To support the safe long-term operation of the DMC consistent with its design for freeboard and clearances between maximum water surface elevations and structures crossing the canal.

Page 1-2

A new section was added under Section 1.1.2 on Page 1-2 in Appendix D of the Draft EA/IS:

1.1.2.1 Additional Goals and Objectives

The Project is being designed and implemented to achieve the primary goals and objectives listed above. CEQA Guideline 15124(b) states that the goals and objectives may also outline Project benefits. The additional benefits of the Project are as follows:

- *Restore capacity of the DMC for the short-term conveyance of transferred water[1] to provide increased water supply reliability and operational flexibility to south-of-Delta CVP contractors and potentially convey surface water supplies for other contractors.*
- *Design and maintain the restored capacity of the DMC for a service life of at least 50 years to avoid potential future reductions in conveyance capacity resulting from continued subsidence forecast following Project implementation.*

Page 1-2

The following footnote was added to Section 1.1.2.1 on Page 1-2 in Appendix D of the Draft EA/IS:

[1] Environmental compliance for the transfer actions including sellers making water available and the conveyance of transferred water to south-of-Delta CVP contractors is analyzed outside this EA/IS in separate environmental compliance documents, including but not limited to the Long-Term Water Transfers environmental document, available here: https://www.usbr.gov/mp/nepa/nepa_project_details.php?Project_ID=18361.

R.11 Appendix G

Page G-10

The last sentence of the first paragraph under Section G.4.1.2 on Page G-10 in Appendix G of the Draft EA/IS is revised as follows:

> The reduced capacity of the DMC could limit the ability of Reclamation to meet CVP Exchange Contractor *or settlement contractor* delivery requirements, which could result in a reduction in deliveries to other south-of-Delta CVP contractors to meet ~~these senior water right deliveries~~*CVP Exchange Contractor delivery requirements or settlement contractor delivery requirements, which could result in a reduction in deliveries to Friant Division contractors.*

Page G-11

The following text in Section G.4.2.1 on Page G-11 in Appendix G of the Draft EA/IS is revised as follows:

> During construction, the Intertie Pumping Plant could be used to maintain CVP deliveries *in the upper DMC* consistent with existing operations, in coordination with DWR. It is anticipated that ~~because no outages would be needed~~*with use of the Intertie Pumping Plant,* impacts to water supply deliveries *in the upper DMC* during construction of the Proposed Action would be minimal.

Page G-12

The following text in Section G.4.2.1 on Page G-12 in Appendix G of the Draft EA/IS is revised as follows:

> *The proposed modification of check structures along the lower DMC would require flows to be held at two thirds of current capacity (66 percent of current capacity) between November through February of the construction duration. In the past five years, flows in the lower DMC have been lower than 60 percent of current capacity during the low-flow work months (October through May). Consequently, proposed modifications to check structures would be completed without impacting deliveries to contractors receiving supplies from the lower DMC and Mendota Pool. Repairs and stabilization activities along the earthen-lined segment of the lower DMC would require water levels to be drawn down by up to six feet, holding conveyance levels to approximately two thirds of the canal's current capacity (66 percent of current capacity) in that segment. This work is scheduled to occur between November-February when flow levels in the earthen-lined segment of the lower DMC are on average approximately 25 percent of current capacity and have been lower than 60 percent of current capacity in all year types. During these construction actions, scheduled to occur between November through February, limits on water levels in the earthen-lined segment of the lower DMC of up to six feet could result in a water surface elevation in the pool higher than the DMC. If these conditions occur during construction, water will be pumped from the DMC into Mendota Pool to avoid impacts to water supply to all water users receiving deliveries from Mendota Pool, including CVP Exchange Contractors and settlement contractors. The scheduling of construction actions requiring limits on DMC conveyance capacity to periods with lower demands and lower flows in the canal will support uninterrupted deliveries to water users (including CVP Exchange Contractors and settlement contractors) from the DMC. Consequently, construction of the Proposed Action is not expected to require the release of water from Friant Dam to meet CVP Exchange Contractor or settlement contractor delivery requirements, which could result in a reduction*

in deliveries to Friant Division contractors. In addition, Reclamation and SLDMWA would coordinate water delivery schedules during construction times to adjust water delivery as needed. ***Therefore, construction of the Proposed Action would have a less than significant impact on CVP deliveries.***

R.12 Appendix I1

Page I1-5

The following text was added to the end of Section I1.2.1 on Page I1-5 in Appendix I1of the Draft EA/IS:

A health risk screening assessment was conducted to assess construction-related TAC emissions. The assessment utilized SJVAPCD's Prioritization tool, with inputs modified to reflect the short-term and temporary exposure of construction activities.

Page I1-8

The following sentence was added to the paragraph under Section I1.4.2.2 on Page I1-8 in Appendix I1 of the Draft EA/IS:

A health risk screening assessment of project construction TAC emissions, included in Appendix I3, confirmed that construction TAC emissions would not be expected to result in significant health risks to sensitive receptors nearest to project activities.

R.13 Appendix I3

Appendix I3 was added to the Final EA/IS to include the Health Risk Screening Assessment requested by the San Joaquin Valley Air Pollution Construction District during the public comment period. Appendix I3: Health Risk Screening Assessment is attached at the end of this document.

R.14 Appendix M

Page M-3

The fourth sentence under Section M.1.2 on Page M-3 in Appendix M of the Draft EA/IS is revised as follows:

Based on existing habitat conditions, species-specific habitat requirements, known occurrence records, and/or direct observations recorded during biological surveys, a total of *54*~~53~~ special-status species were identified has having the potential to occur in the Project area as summarized in Table M-2.

Page M-11

The following table row was added under the Invertebrates section of Table M-2 on Page M-11 in Appendix M of the Draft EA/IS:

INVERTEBRATES			
Bombus crotchii Crotch bumble bee	*-- / SC / --*	*Grasslands and upland scrub that contain requisite habitat elements including suitable nesting sites, floral resources, and overwintering sites for queens.*	***Moderate:** The Project area is within the known species range. Potentially suitable annual grassland habitat is present throughout the Project area. However, existing grassland habitats are fragmented and highly degraded because of regular maintenance to control weedy vegetation. There are three occurrences reported within 3.1 miles of the Project area, all of which were recorded prior to 1960. Despite the marginal nature of existing grassland habitats and the lack of recent occurrences documented in the vicinity, the Crotch bumble bee is conservatively considered to have moderate potential to occur within the Project area where potentially suitable habitats are present.*

Page M-26

The following section was added to the end of Section M.4.2.1 on Page M-26 in Appendix M of the Draft EA/IS:

Crotch Bumble Bee

According to CNDDB records, three occurrences of the Crotch bumble bee have been documented in the vicinity (i.e., within 5 miles) of the Project area. However, these occurrences were all recorded prior to 1960. The nearest recent (documented within the last 20 years) occurrence of the species was recorded approximately 18 miles away from the Project area. Marginally suitable annual grassland habitats occur throughout the Project area. Habitat suitability for the Crotch bumble bee is dependent on the presence of suitable nesting sites, floral resources, and overwintering sites. Crotch bumble bees primarily nest from late February through late October in abandoned small mammal burrows but may also nest under perennial bunch grasses or thatched annual grasses, beneath brush piles, in old bird nests, and in dead trees or hollow logs (Williams et al. 2014). Crotch bumble bees are generalist foragers capable of collecting pollen and nectar from a wide variety of flowering plants (Williams et al. 2014). Little is known about the overwintering sites used by Crotch bumble bees; however, bumble bees generally overwinter in soft disturbed soil or under leaf litter.

Annual grassland habitats within the Project area are considered marginally suitable for the Crotch bumble bee because they are within the DMC ROW, which is subject to regular maintenance to control weedy vegetation (e.g., blading and discing, herbicide use). Blading and discing involves using a grader- or tractor-mounted blade or disc to scrape or shallowly till the soil. These activities disturb the upper soil horizons,

which is not conducive to maintaining the types of underground cavities typically used by Crotch bumble bees for nesting. Blading and discing may also result in the removal of flowering plants providing potential pollen and nectar resources. Similarly, herbicides used to control weeds along the DMC ROW may reduce the availability of floral resources for Crotch bumble bees within the Project area.

Despite the marginal nature of existing annual grassland habitats, Crotch bumble bees have potential to occur within the Project area where such habitats are present. Therefore, ground disturbance associated with Project implementation has the potential to impact the Crotch bumble bee through direct mortality from being crushed in underground burrows or collisions with vehicles or equipment. Additionally, ground disturbance may result in the loss of foraging plants; changes in foraging behavior; nest abandonment; reduced nest success; and reduced health and vigor of eggs, young and/or queens. Based on the findings of the 2022 surveys, potential Crotch bumble bee nesting, foraging, and overwintering habitat is ubiquitous throughout the Project area. Therefore, the avoidance of areas that may provide suitable Crotch bumble bee habitat is infeasible. Similarly, avoidance of the Crotch bumble bee overwintering period is infeasible as construction work would be required year-round to achieve Project objectives. For these reasons, the Proposed Action has the potential to result in impacts due to direct disturbance and/or habitat loss. Given the marginal quality of the habitat present and the many decades throughout which no Crotch bumble bees have been observed within the Project area, however, no substantial adverse effect on this species, either directly or through habitat modifications, is anticipated. Nevertheless, in accordance with MM BIO-2, upon any detection of Crotch bumble bees prior to or during Project implementation, SLDMWA would coordinate with CDFW to identify applicable species-specific avoidance and minimization measures, determine whether compensatory mitigation would be required, and obtain take authorization, if necessary. ***Therefore, with the implementation of MM BIO-2, impacts on the Crotch bumble bee would be less than significant****.*

Page M-32 and M-33

The following text was added to the end of MM BIO-2 on Pages M-32 and M-33 in Appendix M of the Draft EA/IS as follows:

Prior to Project implementation, Reclamation will consult with USFWS to ensure its actions do not jeopardize the continued existence of any federally listed species or destroy/adversely modify critical habitat pursuant to Section 7(a)(2) of the ESA. If consultation with USFWS results in the issuance of a biological opinion, the Proposed Action will be conducted in compliance with all reasonable and prudent measures and terms and conditions set forth in the biological opinion.

To inform discussions between SLDMWA and CDFW regarding the potential for the Proposed Action to impact species currently protected under the CESA, and out of an abundance of caution, a qualified biologist familiar with the behavior and life history of the Crotch bumble bee will conduct surveys to determine the presence/absence of the species within the project area within 1 year prior to the initiation of construction. These surveys will be conducted during the Crotch bumble bee flying season (i.e., March 1 to September 1) when the species is most likely to be detected above ground. Survey results, including negative findings, will be submitted to CDFW prior to the initiation of project-related ground disturbing activities. At a minimum, the survey report will provide the following:

a. A description and map of the survey area, focusing on areas that could provide suitable habitat for the Crotch bumble bee.

b. Field survey conditions that include the name(s) of qualified biologist(s) and their qualifications, date and time of the survey, survey duration, general weather conditions, and survey goals.

c. A map(s) showing the location of Crotch bumble bee nests/colonies identified during the surveys.

d. A description of the physical (e.g., soil, moisture, slope) and biological (e.g., plant composition) conditions where each Crotch bumble bee nest/colony was found. A sufficient description of biological conditions, primarily impacted habitat, including native plant composition (e.g., density, cover, and abundance) within the impacted habitat (e.g., species list separated by vegetation class, density, cover, and abundance of each plant species).

Prior to Project implementation, SLDMWA will consult with CDFW if any species protected under CESA are confirmed present within the project area and it is determined that take of one or more of these species cannot be avoided during project implementation. Should it be determined that the Proposed Action would result in take of one or more species protected under CESA, SLDMWA would obtain take authorization through the acquisition of an ITP from CDFW, pursuant to Fish and Game Code Section 2081 subdivision (b).

Page M-46

The following reference was added to the end of the reference list on Page M-46 in Appendix M of the Draft EA/IS:

Williams, P. H., R. W. Thorp, L. L. Richardson, and S.R. Colla. 2014. The Bumble bees of North America: An Identification guide. Princeton, New Jersey: Princeton University Press.

R.15 Appendix O

Page O-4

The last sentence of Section 0.1.6 on Page O-4 in Appendix O of the Draft EA/IS is revised as follows:

The USACE Sacramento District is serving as the lead agency and preparing a stand-alone EIS with cooperation of National Marine Fisheries Service, the U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and Reclamation~~. The draft EIS was to be released for public review in early Summer of 2022 but is still pending at this time~~ (USACE 2022).

Page O-5 and O-6

Section O.1.10 was added on Page O-5 and O-6 in Appendix O of the Draft EA/IS:

O.1.10 San Joaquin River Restoration Program

The San Joaquin River Restoration Program (SJRRP) is a comprehensive long-term effort to restore flows to the San Joaquin River from Friant Dam to the confluence of Merced River and restore a self-sustaining Chinook salmon fishery in the river while reducing or avoiding adverse water supply impacts from restoration flows. The restoration program is the product of more than 18 years of litigation, which culminated in a Stipulation of Settlement on the lawsuit known as Natural Resource Defense Council, et al., v. Kirk Rodgers, et al. The settling parties reached agreement on the terms and conditions of the settlement, which was subsequently approved by Federal Court on October 23, 2006. The settling parties include the Natural Resources Defense Council, Friant Water Users Authority, and the U.S. Departments of the Interior and Commerce. The settlement's two primary goals are to:

- *Restore and maintain fish populations in "good condition" in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish, and;*

- *Reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the settlement.*

The settlement requires specific releases of water from Friant Dam to the confluence of the Merced River, which are designed primarily to meet the various life stage needs for spring- and fall-run Chinook salmon. The release schedule assumes continuation of the current average Friant Dam release of 116,741 AF, with additional flow requirements depending on the year type. Interim flows began in October 2009, and full restoration flows would begin no later than January 2014. Salmon would be reintroduced in the upper reaches no later than December 31, 2012. There are many physical improvements within and near the San Joaquin River that have/will be undertaken to fully achieve the river restoration goal. The improvements will occur in two separate phases that will focus on a combination of water releases from Friant Dam, as well as structural and channel improvements.

The project was authorized and funded with the passage of San Joaquin River Restoration Settlement Act, part of the Omnibus Public Land Management Act of 2009 (Public Law 111-11) (SJRRP 2023).

Page O-16

The following reference was added to the reference list under San Joaquin Restoration Program on Page O-16 in Appendix O of the Draft EA/IS:

———. *2023. San Joaquin River Restoration Program Website. Accessed on April 10, 2023. Available at: http://www.restoresjr.net/projects/*

Delta-Mendota Canal Subsidence Correction Project Environmental Assessment/ Initial Study

Appendix S: Mitigation Monitoring and Reporting Plan

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Appendix S Mitigation Monitoring and Reporting Program

S.1 Introduction

The proposed Delta-Mendota Canal Subsidence Correction Project (Project) would result in the potential for significant environmental impacts associated with water quality, traffic and transportation, hazardous materials, biological resources, cultural resources, and geology, seismicity, and soils. Mitigation measures have been incorporated into the Project to reduce impacts. The mitigation measures for the Project must be adopted by Bureau of Reclamation (Reclamation) and the San Luis & Delta-Mendota Water Authority (SLDMWA), in conjunction with adoption of the Environmental Assessment/Initial Study (EA/IS).

Section 21081.6 of the Public Resources Code (PRC) and California Environmental Quality Act (CEQA) Guidelines section 15097 require the Lead Agency for each project that is subject to CEQA to monitor performance of the mitigation measures included in any environmental document to ensure that implementation does, in fact, take place. The PRC requires the Lead Agency to adopt a monitoring and reporting program for assessing and ensuring the implementation of required mitigation measures.

In accordance with PRC Section 21081.6, SLDMWA has developed this Mitigation Monitoring and Reporting Program (MMRP) for the Project. The purpose of the MMRP is to ensure activities associated with transferring water comply with all applicable environmental mitigation requirements.

S.2 Mitigation and Monitoring

Table S-1 lists the mitigation measures identified in the EA/IS, responsible parties, method for verification, and the time frame for implementation. SLDMWA, as the CEQA lead agency, is the ultimate agency responsible to make sure that mitigation measures are implemented. Other parties, including Reclamation, as the National Environmental Policy Act (NEPA) lead agency will have a role in implementation.

Table S-1. Mitigation Measures

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
WQ-1	**Prepare Site-Specific Stormwater Pollution Prevention Plan (SWPPP)** The objectives of the SWPPP would be to: (1) identify pollutant sources that may affect the quality of stormwater associated with construction activity; and (2) identify, construct, and implement stormwater pollution prevention measures to reduce pollutants in stormwater discharges during and after construction. The SWPPP would also include details of how the sediment and erosion control practices, referred to as BMPs would be implemented. The implementation of the SWPPP would comply with state and federal water quality regulations.	Reclamation/ SLDMWA in coordination with Construction contractor(s)	Final Design and Construction contract requirement	Prior to, during, and after construction
TR-1	**Develop a Temporary Traffic Control Plan** The following construction management actions will be documented in a temporary traffic control plan developed by the contractor as a requirement that will be included in its construction contract. The temporary traffic control plan will be submitted for California Department of Transportation's review and approval during the Encroachment Permit process. Construction contractors will install signage at roadways and intersections identified as dangerous in accordance with the California Manual on Uniform Traffic Control Devices guidelines warning motorists of slow-moving construction traffic and lane closures. Signage shall also be posted at these locations one month in advance to allow motorists time to plan for delays or alternate routes. Construction contractors shall implement dust abatement and perform proper construction traffic management actions, including signage warning motorists of construction activity and traffic controls like flaggers or temporary traffic lights where construction equipment will be entering roadways, to reduce conflicts during periods of high traffic volume in and around each construction site and to avoid conflicts with emergency responders entering and existing the area during an emergency.	Reclamation/ SLDMWA in coordination with Construction contractor(s)	Final Design and Construction contract requirement	Prior to and during construction

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	In addition to the temporary traffic control plan, before the initiation of any construction actions, construction contractors shall develop and adhere to a health and safety plan outlining all applicable Occupational Safety and Health Administration (OSHA) requirements, and important traffic safety plans, including identification of emergency access routes in and through construction areas that would still need to be kept clear at all times during construction. The health and safety plan shall include coordination with emergency service personnel to ensure adequate mitigation for all impacts.			
HAZ-1	**Activity Containment and Spills Management** During construction and operations, all associated activities, equipment, and machinery shall be restricted to the canal ROW. To ensure containment, construction contractors should place boundaries and noticeable signs of entry and exit, restricting access to within the ROW. All construction equipment and vehicles used shall be maintained properly according to manufacturer specifications and should be inspected to identify and fix any excessive fluid leakages prior to arriving to the construction site. Additionally, the construction contractor shall also prepare a Spill Prevention and Response Plan for preventing spills and responding to chemical or hazardous substance spills. This plan will include spill prevention management, including employee training, hazardous substance inventory, and spill response equipment. The plan will also include a spill response plan, including evacuation procedures, spill containment and cleanup, and reporting a release.	Reclamation/ SLDMWA in coordination with Construction contractor(s)	Construction contract requirement	Prior to and during construction
HAZ-2	**Risk Reduction – Airborne Hazardous Materials** To reduce risks of hazards involving release of airborne hazardous materials, the construction contractor shall implement the United States OSHA's regulations for asbestos and lead (29 C.F.R. 1910.1001, 1926.1101, and 1926.62) prior to demolition of any structures that could contain asbestos or lead paint. Demolition of structures suspected to contain lead paint (structures built prior to 1978) should be wetted prior to demolition to reduce the likelihood of inhaling lead dust particles. Construction workers should be outfitted in the	Reclamation/ SLDMWA in coordination with Construction contractor(s)	Construction contract requirement	During construction prior to excavation and/or demolition

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	proper personal protective equipment, including an appropriate respirator, before completing demolition work. Under AB 203, the construction contractor shall implement health and safety awareness training before excavation of any topsoil to reduce infection of by Valley fever. Safety and MMs that should be included in the training include wetting down soil before digging to reduce aggravation of dust and dirt, wearing a N95 mask or respirator, and halting work in the presence of a dust storm or windy conditions and staying indoors or in an enclosed area away from dust.			
HAZ-3	**Fire Prevention Controls** Construction contracts should be required to provide (1) fire prevention controls such as spark arrestors and (2) fire safety training to avoid risk of wildfire. Since work is year-round, all temporary heaters should be used in accordance with manufacturer instructions and monitored by employees in compliance with fire safety training. In addition, the construction contractor shall prepare a Fire Prevention Plan to prevent a fire from occurring, compliant with OSHA regulations. The plan shall include: • List of all major fire hazards, proper handling and storage procedures for hazardous materials, potential ignition sources and their control, and the type of fire protection equipment necessary to control each major hazard • Procedures to control accumulations of flammable and combustible waste materials • Procedures for regular maintenance of safeguards installed on heat-producing equipment to prevent the accidental ignition of combustible materials • Name or job title of employees responsible for maintaining equipment to prevent or control sources of ignition or fires; and • Name or job title of employees responsible for the control of fuel source hazards	Reclamation/ SLDMWA in coordination with Construction contractor(s)	Construction contract requirement	Prior to construction

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
HAZ-4	**Contaminated Soil/Groundwater Remediation Plan** The construction contractor in coordination with the Lead Agencies shall work with the California Department of Parks and Recreation (CDPR) and the Central Valley Regional Water Quality Control Board (RWQCB) to review existing monitoring data of the hazardous materials/waste sites within the study area to evaluate the potential for interacting with hazardous soil contamination during construction. If the construction contractor and the Lead Agencies (as the responsible party for this potential disturbance) determine that interaction with contaminated soil cannot be avoided and these construction actions could generate a release of this soil to nearby water bodies or elsewhere off-site, the construction contractor shall prepare a Contaminated Soil/ Groundwater Remediation Plan. This remediation plan shall detail the nature of the contaminants on-site, measures required to avoid interaction with these contaminants including (if necessary) a pre-construction cleanup of the site, and a response action plan in the event of an inadvertent release of contaminated soils from the construction site. This plan shall be submitted to the CDPR and the Central Valley RWQCB for review and approval prior to the initiation of any construction.	Reclamation, SLDMWA, and Construction contractor(s)	Final Design and Construction contract requirement	Prior to construction
HAZ-5	**Airport Safety** Construction contracts shall include requirements for the contractor to prepare a construction safety plan prior to any construction activities in collaboration with the City of Tracy Department of Parks and Recreation (owners of the Tracy Municipal Airport) to coordinate construction activities, including a schedule, coordination of personnel with aviation radios, and notice requirements. The contractor shall also coordinate with emergency service personnel to ensure adequate mitigation for all impacts.	Reclamation, SLDMWA, and Construction contractor(s)	Construction contract requirement	Prior to construction
BIO-1	**Measures to Minimize Impacts on Special-Status Plants** A botanical survey shall be conducted prior to construction activities to determine the presence or absence of special-status plant species within the Project area. The surveys shall be conducted in general accordance with the	SLDMWA and Reclamation	Field verification	Prior to and during construction

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	Protocols for Surveying and Evaluating Impacts to Special-Status Native Plant Populations and Natural Communities (CDFW 2021) and shall be timed to appropriately coincide with the blooming period of special-status plant species with the potential to occur in the Project disturbance areas. If more than five years lapse after the botanical survey is conducted prior to ground disturbance, two botanical surveys (early and late season) shall be conducted in all suitable habitat located within the Project disturbance areas to determine the presence or absence of special-status plants. If special-status plant species are found during the botanical surveys, the locations of the special-status plants and a 50-foot buffer will be marked as avoidance areas both in the field using flagging, staking, fencing, or similar devices and on construction plans. If non-listed, special-status plants are identified during botanical surveys and complete avoidance is not practicable, and the Project would directly or indirectly affect more than 25 percent of a local occurrence by either number of plants or square footage of occupied habitat, then a qualified biologist will determine whether implementation of a conservation plan is recommended. If federal- or state-listed plants are identified during botanical surveys and complete avoidance is not practicable, coordination with California Department of Fish and Wildlife (CDFW) and/or United States Fish and Wildlife Service (USFWS) will be conducted as appropriate to develop the conservation plan. No take of state-listed or federally listed species will occur without an Incidental Take Permit from either CDFW or USFWS. The special-status plant conservation plan may consist of, but would not necessarily be limited to, purchase of mitigation credits at a regional conservation bank; plant salvage and relocation; collection and subsequent planting of seed or incorporating seed from native nursery into seed mix used for revegetation efforts; stockpiling, storing, and replacing topsoil containing the local seed bank; or other measures determined practicable based on the species and site conditions. If on-site conservation measures are implemented, the objective is to restore the impacted special-status plant species community			

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	to pre-existing conditions by providing for the restoration of a self-sustaining population of special-status plants in the general area where the impact occurred at a minimum of a 1:1 ratio (e.g., number of plants, square footage occupied). For on site conservation measures, the conservation plan will identify success criteria and provide for annual or other regular monitoring to evaluate whether the conservation effort has met the success criteria. The conservation plan will also include measures for remedial actions (e.g., additional plantings, supplemental irrigation, increased monitoring) if monitoring efforts indicate that success criteria are not being met. For some species and site conditions, the biologist may determine that a conservation plan is not recommended. Some of these circumstances may include but are not limited to the following: (1) there are other nearby populations that will not be disturbed; (2) plant relocation, seeding, or revegetation would not have a reasonable probability of success; (3) implementation of measures could result in detrimental effects on existing special-status plant populations; or (4) incompatibility with required operations and maintenance activities. If the biologist determines, in coordination with CDFW and/or USFWS, that a conservation plan is not warranted, then no additional measures are required.			
BIO-2	**General Measures to Minimize Impacts on Special-Status Animal Species** A Biological Resources Management and Monitoring Plan (BRMMP) shall be developed and implemented for the Project. The BRMMP shall provide for the following: 1) Overall implementation and monitoring of the MMs for biological resources and the terms and conditions of any agency permits/authorizations throughout the duration of Project construction and restoration/revegetation of riparian habitat, per BIO-2c. 2) Designation of an overall Project biologist and the roles and responsibilities of the Project biologist and other monitoring biologists and the roles of Reclamation, SLDMWA, and construction personnel in coordinating and implementing the BRMMP.	Reclamation, SLDMWA, and Construction contractor(s) with Project Biologist	Field verification and documentation on file with Reclamation	Prior to, during and after construction

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	3) Adaptive management in scheduling worker environmental awareness training (WEAT) and conducting pre-construction surveys for special-status species. In some cases, additional biological surveys beyond those identified in the MMs may be warranted to proactively avoid biological constraints or conflicts with protective measures. For example, early monitoring for nesting birds or occupied mammal burrows may be needed to preserve opportunities for vegetation removal, removal of nesting starts before egg laying, and burrow monitoring and closure prior to the initiation of breeding or nesting activities. 4) Procedure and authorizations required to modify the MMs, if needed, to resolve conflicts with constructability requirements or other measures required by agency permits/authorizations or to provide for equivalent avoidance/minimization of adverse effects on sensitive biological resources under changing conditions over the life of Project construction. For example, nesting birds or other special-status species may initiate nesting or denning activities in proximity to construction areas while active construction activities are ongoing, including those within the 'no-disturbance buffers.' In these cases, it may be that the animals are acclimated to the level of construction disturbance, and continuance of construction activities would not be expected to adversely affect the animals or their nesting/breeding activities (assuming that increased levels of disturbance or closer proximity of construction activities is not planned). The BRMMP will include provisions for how these and similar circumstances will be addressed and how determinations regarding additional biological monitoring or agency coordination will be addressed. 5) Procedure to record and document implementation of the MMs and other measures including any pre-construction survey reports, WEAT sign-in forms, routine biological monitoring forms, photographs, and other materials related to implementation of the BRMMP.			

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	6) Procedure to comply with the terms and conditions and notification and reporting requirements of any agency permits/authorizations required for the Project, and the procedure for coordination/consultation with resource or permitting agencies, as necessary. 7) Procedure to inform, document, and monitor restoration and revegetation activities associated with restoring temporary impacts on terrestrial and aquatic habitats and vegetation communities. This includes any post-construction monitoring/reporting and remedial measures that may be required. Prior to the initiation of ground disturbance, a qualified biologist(s) will conduct a WEAT for all construction personnel. Training sessions will be repeated for all new personnel before they access the Project site. Sign-in sheets identifying attendees and the contractor/company they represent will be prepared for each training session, and records of attendance will be maintained by the Project. At minimum, the WEAT will include a description of the protected species and biological resources that may occur in the Project area and their physical description, habitats, and natural history, as well as the measures that are being implemented to avoid or minimize Project-related impacts, penalties for noncompliance, and the boundaries of the work area. As appropriate, training will be conducted in languages other than English to ensure that employees and contractors understand their roles and responsibilities. A written summary of the training will be provided to all attendees, and an electronic copy will be provided so that the Project can make and distribute future copies. The WEAT will be conducted annually, at minimum, for all construction personnel. A litter control program will be instituted at each Project site. All workers will place their food scraps, paper wrappers, food containers, cans, bottles, and other trash in covered or closed trash containers. The trash containers should be removed from the Project area at the end of each working day. No firearms (except as possessed by federal, state, or local law enforcement officers) or pets will be permitted on construction sites.			

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	To prevent inadvertent entrapment of wildlife during construction, all excavated steep-walled holes or trenches greater than two-feet deep should be covered or filled at the end of each working day or provided with one or more escape ramps no greater than 200 feet apart. Before such trenches or holes are filled, they shall be thoroughly inspected for trapped animals. If protected species are found in any of the holes or trenches, work shall cease until an escape ramp is provided and the animal leaves on its own volition, or until the animal has been relocated by a USFWS-approved biologist, and/or in coordination with USFWS, as appropriate. All construction activity will be confined within the Project site, which may include temporary access roads, haul roads, and staging areas specifically designated and marked for these purposes. Restoration and revegetation work associated with temporary impacts shall be done using California native plant material from on-site or local sources (i.e., local ecotype). Plant materials from non-local sources shall be allowed only with written authorization from USFWS. To the maximum extent practical (i.e., presence of natural lands), topsoil shall be removed, cached, and returned to the site according to successful restoration protocols. Loss of soil from runoff or erosion shall be prevented with straw bales, straw wattles, or similar means provided they do not entangle, block escape, or dispersal routes of listed animal species. The Project construction area shall be delineated with high visibility temporary fencing, flagging, or other barrier to prevent encroachment of construction personnel and equipment onto any sensitive areas during Project work activities. Such fencing shall be inspected and maintained daily until completion of the Project. The fencing will be removed only when all construction equipment is removed from the site. No Project activities will occur outside the delineated Project construction area. Only USFWS-approved personnel holding valid permits issued pursuant to Section 10(a)(l)(A) of the Act will be allowed to trap or capture listed species.			

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	Any relocation plan will be approved by USFWS prior to release of any listed species. Tightly woven fiber netting or similar material (no monofilament material) will be used for erosion control or other purposes at the Project site to ensure that animals do not become trapped. Prior to project implementation, Reclamation will consult with USFWS to ensure its actions do not jeopardize the continued existence of any federally listed species or destroy/adversely modify critical habitat pursuant to Section 7(a)(2) of the ESA. If consultation with USFWS results in the issuance of a biological opinion, the Proposed Action will be conducted in compliance with all reasonable and prudent measures and terms and conditions set forth in the biological opinion. Prior to project implementation, SLDMWA will consult with CDFW to determine whether the Proposed Action can be implemented such that take of species protected under CESA can be avoided. Should it be determined that take of one or more species protected under CESA cannot be avoided, SLDMWA would obtain take authorization through acquisition of an Incidental Take Permit from CDFW, pursuant to Fish and Game Code section 2081 subdivision (b).			
BIO-3	**Measures to Minimize Impacts on Bats** To the extent practicable, the removal of large trees with cavities or the modification of canal infrastructure with the potential to provide bat roosts will occur before maternity colonies form (i.e., prior to March 1) or after young are volant (able to fly) (i.e., after August 15). If construction (including the removal of large trees and/or the modification of canal infrastructure) occurs during the non-volant season (March 1 to August 15), a qualified biologist will conduct a pre-construction survey of the Project area for maternity colonies. The pre-construction survey will be performed no more than 14 days prior to the implementation of construction activities (including staging and equipment access). If a lapse in construction activities for 14 days or more occurs between those dates, another pre-construction survey will be performed. If any maternity colonies are detected, appropriate	SLDMWA and Reclamation	Field verification	Prior to and during construction

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	conservation measures (as determined by a qualified biologist) will be implemented. These measures may include, but are not limited to, establishing a construction-free buffer zone around the maternity colony site, biological monitoring of the maternity colony, and delaying construction activities within the vicinity of the maternity site.			
BIO-4	**Measures to Minimize Impacts on the American Badger** Any American badger detected within the Project area during Project-related activities will be allowed to move out of the work area of its own volition. Concurrent with other required surveys, during winter and spring months before new Project activities, and concurrent with other pre-construction surveys (e.g., San Joaquin kit fox [SJKF] and burrowing owl), a qualified biologist will perform a survey to identify the presence of active or inactive American badger dens. If this species is not found, no further mitigation will be required. If badger dens are identified within the construction footprint during the surveys or afterward, they will be inspected and closed using the following methodology: • When unoccupied dens are encountered outside of work areas but within 100 feet of proposed activities, vacated dens will be inspected to ensure they are empty and temporarily covered using plywood sheets or similar materials. • If badger occupancy is determined at a given site within the work area, work activities at that site should be halted. Depending on the den type, reasonable and prudent measures to avoid harming badgers will be implemented and will include seasonal limitations on Project construction near the site (e.g., restricting the construction period to avoid spring–summer pupping season) or establishing a construction exclusion zone around the identified site or resurveying the den at a later time to determine the species' presence or absence. • Badgers will be passively relocated using burrow exclusion (e.g., installing one-way doors on burrows) or similar CDFW-approved	SLDMWA and Reclamation	Field verification	Prior to construction

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	exclusion methods. In unique situations, it may be necessary to actively relocate badgers (using live traps) to protect individuals from potentially harmful situations. Such relocation would be performed with advance CDFW coordination and concurrence.			
BIO-5	**Measures to Minimize Impacts on San Joaquin Kit Fox** Determine the presence of SJKF dens: a) Pre-construction monitoring will be performed no less than 14 days and no more than 30 days prior to construction to identify kit fox habitat features within the Project Area. b) Areas within which pre-construction monitoring have been completed more than 30 days prior to construction will be re-inventoried not more than 30 days prior to construction. c) Pre-construction monitoring for dens will be conducted by qualified biologists familiar with SJKF biology, natural history, and potential dens. d) Pipes and culverts will be searched for SJKF immediately prior to being moved or sealed to ensure that an animal has not been trapped. If SJKF is observed, a USFWS-approved biologist will gently encourage it to leave the area (i.e., without using loud noise, physical force, or physical movement of the pipe or culvert such that the animal could be injured or startled while it is leaving the area). Identify and document locations of potential or occupied dens (natal or non-natal) and their status (occupied or unoccupied). Definitions: a) Known den: any existing natural den or manmade structure that is used or has been used at any time in the past by SJKF. Evidence of use may include historical records, past or current radiotelemetry or spotlighting data, kit fox sign such as tracks, scat, and/or prey remains, or other reasonable proof that a given den is being or has been used by a kit fox. USFWS discourages use of the terms "active" and "inactive" when referring to any kit fox den because a great percentage of occupied dens show no evidence of use, and because kit foxes change dens	SLDMWA and Reclamation with Project Biologist	Field verification	Prior to and during construction

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	often, with the result that the status of a given den may change frequently and abruptly. b) Potential den: any subterranean hole within the species' range that has entrances of appropriate dimensions (five to eight inches in diameter) for which available evidence is insufficient to conclude that it is being used or has been used by a kit fox. Potential dens shall include the following: (1) any suitable subterranean hole five to eight inches in diameter within the species' range; or (2) any den or burrow of another species (e.g., coyote, badger, red fox, or ground squirrel) that otherwise has appropriate characteristics for kit fox use. c) Natal/pupping den: any den used by kit foxes to whelp and/or rear their pups. Natal/pupping dens may be larger with more numerous entrances than dens occupied exclusively by adults. These dens typically have more kit fox tracks, scat, and prey remains in the vicinity of the den, and may have a broader apron of matted dirt and/or vegetation at one or more entrances. A natal den, defined as a den in which kit fox pups are actually whelped but not necessarily reared, is a more restrictive version of the pupping den. In practice, however, it is difficult to distinguish between the two, therefore, for purposes of this definition either term applies. d) Atypical den: any manmade structure which has been or is being occupied by SJKF. Atypical dens may include pipes, culverts, and diggings beneath concrete slabs and buildings. Identify and execute appropriate action(s) regarding notification, buffers, excavation and fill, or seal off: a) Occupied natal den: if an occupied natal den is visible or encountered within the Project limits or on publicly accessible land sufficiently close to the Project construction area such that it would be disturbed (based on qualified biologist opinion and monitoring), USFWS and CDFW will			

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	be contacted immediately and before any Project action occurs to determine permissible actions to permit resumption of work. b) Unless determined necessary for safety or constructability by Reclamation, SLDMWA, or the Project contractor, the Project site will not be lighted between sunset and sunrise. c) Pipes or culverts with a diameter greater than four inches will be capped or taped closed when it is ascertained that no SJKF are present. Any SJKF found in a pipe or culvert will be allowed to escape unimpeded. If a natural den or burrow is determined to meet size criteria (i.e., greater than four inches in diameter) and cannot be avoided per the no-disturbance buffers recommended in the USFWS *Standardized Recommendations for Protection of the SJKF Prior to or During Ground Disturbance* (USFWS 2011) or shall be destroyed, the following guidelines will be followed: a) Prior to den destruction, areas scheduled for construction within the vicinity of potential SJKF dens shall be monitored by a qualified biologist to determine their status. Monitoring will begin with pedestrian surveys to identify locations of potential SJKF dens and observe for suitable surrounding habitat. Because it is logistically impractical to monitor all dens using remote cameras and tracking medium (or to hand excavate to confirm vacancy), baited camera traps may be used to assess presence or absence of SJKF activity. Prior to ground-disturbing activities in Project segments that require excavation, baited camera traps will be deployed in approximate 0.25-mile increments for four consecutive nights. Baited camera traps may be placed farther than 0.25 mile apart, depending on the suitability of surrounding habitat and land uses that are observed during pedestrian surveys and in areas with lower densities of potential SJKF dens. If no SJKFs are detected by the camera traps during this time period, it can be assumed that SJKFs are not currently using the area, and ground-disturbing activities may commence in that area. If a SJKF is detected by			

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	a camera trap, then further investigation will be required, as described below. b) If a SJKF is detected by a baited camera trap or otherwise observed in an area, further pre-construction monitoring will be conducted to determine which den(s) are being used. Baited camera traps will be deployed in the area, and tracking medium will be placed at the entrances of suspected dens to monitor the area for four consecutive nights. If no SJKF activity is observed during this period, the den will be deemed unoccupied and destroyed immediately under the supervision of a USFWS-approved biologist to preclude subsequent use. If SJKF activity is observed at the den during this period, then the den will be monitored for at least five consecutive days from the time of observation to allow any resident animal to move to another den during its normal activities. Use of the den can be discouraged during this period by partially plugging the entrance(s) with soil in such a manner that any resident animal can escape easily. Destruction of the den may begin when, in the judgment of a USFWS-approved biologist, the animal has vacated. The biologist will be trained and familiar with SJKF biology. If the animal is still present after five or more consecutive days of plugging and monitoring, the den may be excavated when, in the judgment of a USFWS-approved biologist, it is temporarily vacant (e.g., during the animal's normal foraging activities). All den destruction shall be conducted under the supervision of a USFWS-approved biologist. c) All dens requiring excavation will be excavated under the supervision of a USFWS-approved biologist. In no event will an excavation that meets the definition of a confined space (i.e., a space large enough and so configured that a person can bodily enter but has limited or restricted means for entry or exit) be initiated. In this circumstance, discouragement (as described above) would be used.			

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	d) The den will be fully excavated and then filled with dirt and compacted so that SJKF cannot reenter or use the den during the construction period. If, at any point during excavation, an SJKF is discovered inside the den, the excavation activity will cease immediately, and monitoring of the den will be resumed. Destruction of the den may be resumed when, in the judgment of a USFWS-approved biologist, the animal has escaped from the partially destroyed den. Before and during construction: • Project-related vehicles should observe a daytime speed limit of 20 mph throughout the site in all Project areas, except on county roads and state and federal highways; this is particularly important at night when SJKFs are most active. Nighttime construction should be minimized to the extent possible. However, if it does occur, then the speed limit should be reduced to 10 mph. Off-road traffic outside of designated Project areas should be prohibited. • Kit foxes are attracted to den-like structures, such as pipes, and may enter stored pipes and become trapped or injured. All construction pipes, culverts, or similar structures with a diameter of four inches or greater that are stored at a construction site for one or more overnight periods should be thoroughly inspected for SJKFs before the pipe is subsequently buried, capped, or otherwise used or moved in any way. If a SJKF is discovered inside a pipe, that section of pipe should not be moved until USFWS has been consulted. If necessary, and under the direct supervision of the biologist, the pipe may be moved only once to remove it from the path of construction activity, until the fox has escaped. • A representative shall be appointed by the Project proponent who will be the contact source for any employee or contractor who might inadvertently kill or injure a SJKF or who finds a dead, injured or entrapped SJKF. The representative will be identified during the			

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	employee education program and their name and telephone number shall be provided to USFWS. • In the case of trapped animals, escape ramps or structures should be installed immediately to allow the animal(s) to escape, or USFWS should be contacted for guidance. If at any time a trapped or injured kit fox is discovered, USFWS and CDFW shall be contacted as noted below. • Any contractor, employee, or military or agency personnel who are responsible for inadvertently killing or injuring a SJKF shall immediately report the incident to their representative. This representative shall contact USFWS immediately in the case of a dead, injured, or entrapped SJKF. • The Sacramento Fish and Wildlife Office and CDFW shall be notified in writing within three working days of the accidental death or injury to a SJKF during Project-related activities. Notification shall include the date, time, and location of the incident or of the finding of a dead or injured animal and any other pertinent information. • New sightings of SJKF shall be reported to the CNDDB. A copy of the reporting form and a topographic map clearly marked with the location of where the SJKF was observed should also be provided to USFWS. • Because this species most actively forages during dusk and dawn, to the extent practicable, all construction activities will cease one-half hour before sunset and will not begin prior to one-half hour before sunrise. Except when necessary for driver or pedestrian safety, lighting of a Project site by artificial lighting during nighttime hours is prohibited.			
BIO-6	**Measures to Minimize Impacts on the Tricolored Blackbird and the Yellow-Headed Blackbird** Prior to construction, appropriately timed surveys for tricolored blackbirds and yellow-headed blackbirds will be conducted in areas supporting potentially suitable habitat within 0.25 mile of construction areas. Habitat within 0.25 mile	SLDMWA and Reclamation with Project Biologist	Field verification	Prior to construction

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	of tricolored blackbird or yellow-headed blackbird colonies will be avoided during nesting season, which can begin as early as mid-March and extend through August. If colonies cannot be avoided, CDFW will be consulted to potentially reduce buffer distances with active monitoring during construction by a qualified biologist.			
BIO-7	**Measures to Minimize Impacts on the Burrowing Owl** A minimum of one pre-construction survey for burrowing owls within a minimum of 500 feet of the Project area (where accessible) will be conducted by a qualified biologist within 15 days prior to the initiation of construction activities in a given area, regardless of the timing of construction. Pre-construction surveys each year of construction during the nonbreeding season (September 1 to January 31) will take place in order to determine the presence of burrowing owls before breeding activities begin. If any occupied burrows are identified, appropriate conservation measures (as determined by a qualified biologist) will be implemented. No disturbance will occur within 150 feet of occupied burrows during the nonbreeding season (September 1 to January 31) or within 250 feet during the breeding season (February 1 to August 31). These measures may also include establishing a construction-free buffer zone around the active nest site in coordination with the CDFW, biological monitoring of the active nest site, and delaying construction activities in the vicinity of the active nest site until the young have fledged. If burrowing owls are detected within the Project area during the nonbreeding season and maintaining a 150-foot, no-disturbance buffer is not practicable, a qualified biologist will submit an exclusion and passive relocation plan to CDFW. The exclusion and passive relocation plan will generally follow the guidelines outlined in Appendix E of the Staff Report on Burrowing Owl Mitigation (CDFW 2012). The exclusion and passive relocation plan will consist of installing one-way doors in potential burrows, daily monitoring, and collapsing burrows once it is determined that the burrows are unoccupied. Exclusion may only take place during the nonbreeding season (September 1 to January 31) and may be an ongoing effort during this time period. This will allow the owls to exit burrows if	SLDMWA and Reclamation	Field verification	Prior to construction

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	they are present, but not return. The exclusion and passive relocation plan will also detail plans to replace collapsed burrows with artificial burrows at a minimum 1:1 ratio or describe why artificial burrows are not needed (e.g., numerous available natural burrows are available in nearby areas that will not be disturbed). Monitoring of collapsed burrows will be conducted as needed so that burrowing owls do not recolonize the area prior to construction disturbance. If occupied burrows are detected during the breeding season and maintaining a 250-foot no-disturbance buffer is not practicable, CDFW will be consulted to determine alternative measures to minimize the potential for disturbance to occupied burrows and nesting activities. Measures may include but are not limited to continuous biological monitoring by a qualified biologist until it has been determined that the young have fledged and are no longer reliant on the nest or parental care for survival or construction is complete. No direct disturbance of burrows with eggs or young can be conducted without written authorization from the CDFW and USFWS.			
BIO-8	**Measures to Minimize Impacts on the Golden Eagle, Swainson's Hawk, Northern Harrier, or White-Tailed Kite** For construction activities that occur between February 1 and August 31, a qualified biologist will conduct pre-construction surveys for golden eagles, Swainson's hawks, northern harriers, and white-tailed kites. The pre-construction surveys will include the Project footprint and a minimum of a 0.50-mile radius where access is permitted around the construction area in suitable nesting habitat (i.e., large trees for Swainson's hawk and white-tailed kite, cliff faces for golden eagle, and grasslands for northern harrier). The pre-construction surveys will be conducted no more than 10 days before ground disturbance in a given area and will be phased based on the construction schedule. If nesting golden eagles, Swainson's hawks, northern harriers, or white-tailed kites are detected, an appropriate no-disturbance buffer (minimum of 500 feet for northern harrier, 0.50 mile for golden eagle, Swainson's hawk, and white-	SLDMWA and Reclamation	Field verification	Prior to and during construction

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	tailed kite) will be established and monitored daily by a qualified biologist. Buffers will be maintained until a qualified biologist has determined that the young have fledged and are no longer reliant on the nest or parental care for survival. A 0.50-mile no-disturbance buffer will also be maintained from any overwintering eagles if they are detected in the Project area or surrounding areas; the buffer will be maintained for the duration that the bird(s) are present. If any bald eagles or golden eagles are detected, Reclamation will coordinate with USFWS, as necessary, to comply with the Bald and Golden Eagle Protection Act. If maintaining the minimum no-disturbance buffer around an active golden eagle, Swainson's hawk, northern harrier, or white-tailed kite nest (or any overwintering eagles) is not practicable, CDFW will be consulted to determine whether reduced minimum no-disturbance buffers are appropriate based on site-specific circumstances (e.g., visual barriers between nest and construction area, existing level of disturbance) or to identify alternative measures to minimize the potential for Project-related disturbance to the nest site that could result in nest abandonment or other forms of take. Measures may include, but are not limited to, continuous biological monitoring by a qualified biologist until it has been determined that the young have fledged and are no longer reliant on the nest or parental care for survival or construction is complete. If the nesting pair shows signs of distress (i.e., adults leaving the nest when eggs or young chicks are present) as a result of Project-related activities, the monitoring biologist will have authority to stop work until it is determined that the adults have returned and are no longer showing signs of distress. If trees suitable for nesting by Swainson's hawk are scheduled to be removed during the non-nesting season, a qualified biologist will conduct a pre-construction survey during the nesting season prior to tree removal to determine whether Swainson's hawks are using the trees for nesting. If the trees proposed for removal are being used by nesting Swainson's hawk, consultation with CDFW will take place per BIO-8. prior to tree removal.			

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	If CESA compliance is required, and consultation with CDFW results in a determination that take of an active Swainson's hawk nest cannot be avoided, then take authorization pursuant to CESA will be obtained from CDFW prior to initiation of any activities that are likely to result in such take. If an active golden eagle or white-tailed kite nest may not be avoidable, then all activities that are likely to result in take will be delayed until a qualified biologist has determined that the young have fledged and are no longer reliant on the nest or parental care for survival.			
BIO-9	**Measures to Minimize Impacts on Nesting Migratory Birds** To the extent practicable, vegetation removal will be scheduled to avoid the breeding season for nesting raptors and other special-status birds (generally February 1 through August 31, depending on the species). Removal of vegetation outside of the nesting season is intended to minimize the potential for delays in vegetation removal because of active nests. Regardless of when vegetation removal is scheduled, a qualified biologist will conduct a minimum of one pre-construction survey for nesting migratory birds and raptors within the Project area and a buffer (250 feet for migratory birds, 500 feet for raptors) around the Project area (where accessible) for all construction-related activities that will occur during the nesting season. The pre-construction survey will be conducted no more than 15 days prior to the initiation of construction in a given area and will be phased based on the construction schedule. Because of the ongoing, phased approach to construction, multiple pre-construction surveys per year may be required. If an active nest is found, a construction-free buffer zone (250 feet for migratory birds, 500 feet for raptors) will be established around the active nest site. If establishment of the construction-free buffer zone is not practicable, appropriate conservation measures (as determined by a qualified biologist) will be implemented. These measures may include, but are not limited to, consultation with CDFW to establish a different construction-free buffer zone around the active nest site, daily biological monitoring of the active nest site,	SLDMWA and Reclamation	Field verification	Prior to construction

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	and delaying construction activities in the vicinity of the active nest site until the young have fledged. If removal of bridges or other bridge work is scheduled to occur during the swallow nesting season, exclusionary devices (e.g., netting) will be installed around the bridges prior to the initiation of the avian breeding season (before February 15) during the same year as the bridges are scheduled for removal and after a qualified biologist has determined no active nests (i.e., nests with eggs or young) are present. The exclusionary devices will remain in place until August 15 or until the bridge removal or other bridge work is completed. The exclusionary devices will be anchored such that swallows cannot attach their nests to the structure through gaps. Exclusionary devices will be regularly inspected as necessary to confirm that they are adequately preventing initiation of nest building. If swallows have breached the exclusionary devices and began building nests on the structure, nesting material (i.e., partially built nests) can be removed only if a qualified biologist has determined that eggs or young are not present. No removal of nests with eggs or young can be conducted without written authorization from CDFW and USFWS, or until a qualified biologist has determined that the nest is no longer active (e.g., the nest has failed, the young have fledged and are no longer dependent on the nest).			
BIO-10	**Measures to Minimize Impacts on the California Tiger Salamander (CTS) and the California Red-legged Frog (CRLF)** Before and during construction: • Protocol presence/absence surveys shall be conducted by a USFWS-approved biologist in suitable habitat prior to construction with a negative finding. As the Project is multi-year, protocol presence/absence surveys can be conducted in portions of the Project area that have work scheduled the following year. Alternatively, presence can be assumed in suitable habitat and the measures below can be implemented.	SLDMWA and Reclamation with Project Biologist	Field verification	Prior to, during, and after construction

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	• To the maximum extent practicable, the Project design and construction implementation will avoid impacts to suitable breeding habitat. Areas of avoidance shall be indicated on Project plan sets and shall be clearly delineated in the field. Signage indicating "Environmentally Sensitive Area: Keep Out" shall be posted. • Protocol aquatic surveys shall be conducted by a USFWS-approved biologist in suitable breeding habitat within areas that will be disturbed by construction in the following year, and within 1.3 miles of those areas to detect occupied breeding resources (one survey in March, April, and May each). Any occupied breeding resources will be prioritized for avoidance. • Resources documented to support breeding populations of CTS/CRLF shall be avoided during construction with a buffer sufficient to ensure the continued functioning of that breeding resource. If adherence to this buffer is not feasible, USFWS shall be contacted to determine whether moving individuals prior to construction is authorized. • A USFWS-approved biologist shall survey the work sites where suitable habitat has been identified no more than 30 days before the onset of construction. Adult individuals detected during the surveys shall be relocated out of the area of disturbance by a USFWS-approved biologist. • Work in occupied habitat shall only occur during the dry season. • Areas beneath construction equipment and vehicles shall be inspected daily, prior to operation, for presence of CTS/CRLF under tracks/tires and within machinery by a USFWS-approved biologist until the biologist determines a designated contractor is sufficiently trained to monitor. A USFWS-approved biologist will ensure that this individual receives training consistent with USFWS requirements. A USFWS-approved biologist will be on-call to come to the site if CTS/CRLF are found.			

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	• CTS/CRLF one-way, exclusion fencing shall be installed between construction areas and occupied habitat. This fencing shall extend 1.3 miles from the boundary of the occupied habitat along the alignment of the Project area. • Overnight staging of vehicles or equipment shall be prohibited within 100 feet of occupied or assumed-occupied breeding resources. • Work in occupied breeding habitat shall only occur during the dry season. After construction: • Temporary disturbance of occupied habitat shall be mitigated by restoring the area to pre-Project contours and revegetation.			
BIO-11	**Measures to Minimize Impacts on the Western Spadefoot Toad** If a western spadefoot toad is encountered during construction activities, it will be allowed to move out of harm's way of its own volition, or a qualified biologist will relocate it to the nearest suitable habitat that is at least 100 feet outside of the construction impact area. Prior to moving equipment or materials each day, construction personnel will inspect for western spadefoot toads underneath and around equipment and other Project materials (e.g., stored pipes greater than two inches in diameter) that are located within 200 feet of aquatic habitat. If western spadefoot toads are found, they will be allowed to move out of the construction area under their own volition, or a qualified biologist will relocate individuals to the nearest suitable habitat that is at least 100 feet outside of the construction impact area.	SLDMWA and Reclamation with Project Biologist	Field verification	Prior to, during, and after construction
BIO-12	**Measures to Minimize Impacts on the Northern California Legless Lizard, California Glossy Snake, San Joaquin Coachwhip, and Coast Horned Lizard** Prior to moving equipment or materials each day, construction personnel will inspect underneath and around equipment for northern California legless lizard, California glossy snake, San Joaquin coachwhip, and coast horned lizard. If these species are encountered during construction activities, they will be allowed to	SLDMWA, Reclamation, and Construction contractor(s)	Field verification	Prior to and during construction

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	move out of harm's way of their own volition, or a qualified biologist will relocate the organism(s) to the nearest suitable habitat that is at least 100 feet outside of the construction impact area.	with Project Biologist		
BIO-13	**Measures to Minimize Impacts on the Giant Garter Snake** Before and during construction: • Protocol presence/absence surveys shall be conducted by a USFWS approved biologist in suitable habitat prior to construction. As the project is multi-year, protocol presence/absence surveys can be conducted in portions of the Project Area that have work scheduled the following year. Alternatively, presence can be assumed in suitable habitat and the measures below implemented. • Avoid construction activities within 200 feet from the banks of occupied giant garter snake aquatic habitat. Confine movement of heavy equipment to existing roadways to minimize habitat disturbance. • Construction activity within suitable habitat should be conducted between May 1 and October 1. This is the active period for giant garter snakes and direct mortality is lessened, because snakes are expected to actively move and avoid danger. Impacts to winter hibernacula should be avoided during the period of October 2 and April 30. • The Project area shall be surveyed for giant garter snakes 24 hours prior to construction activities. Survey of the Project area should be repeated if a lapse in construction activity of two weeks or more has occurred. If a snake is encountered during construction, activities shall cease until appropriate corrective measures have been completed or it has been determined that the snake will not be harmed. • Any dewatered habitat should remain dry for at least 15 consecutive days after April 15 and prior to excavating or filling of the dewatered habitat.	SLDMWA, Reclamation, and Construction contractor(s) with Project Biologist	Field verification	Prior to and during construction

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
BIO-14	**Measures to Minimize Impacts on the Western Pond Turtle** Before construction activities begin, a qualified biologist will conduct western pond turtle surveys within creeks and in other ponded areas affected by the Project. Adjacent upland areas will be examined for evidence of nests and individual turtles. The Project biologist will be responsible for the survey and for the relocation of pond turtles, if found. Construction will not proceed until reasonable effort has been made to capture and relocate as many western pond turtles as possible to minimize take. However, some individuals may remain undetected or enter sites after surveys and could be subject to injury or mortality. If a nest is observed, a biologist with the appropriate permits and prior approval from CDFW will move eggs to a suitable location or facility for incubation and release hatchlings into the creek system the following autumn.	Reclamation and SLDMWA with Project Biologist	Field verification	Prior to construction
BIO-15	**Measures to Minimize Impacts on Sensitive Natural Communities** Before and during construction: • Protocol presence/absence surveys shall be conducted by a USFWS-approved biologist in suitable habitat prior to construction with a negative finding. As the Project is multi-year, protocol presence/absence surveys can be conducted in portions of the Project area that have work scheduled the following year. Alternatively, presence can be assumed in suitable habitat. • Work in occupied listed vernal pool branchiopod habitat shall only occur during the dry season. • The authorized limits of branchiopod habitat (i.e., 250 feet from the pool edge) will be clearly staked in the field to prevent construction personnel from causing impacts to areas outside of work limits. • Where temporary impacts will occur to occupied or assumed-occupied listed vernal pool branchiopod habitat, the top one to three inches of soil shall be salvaged to preserve the cyst bank. Saved topsoil shall be covered to avoid erosion. Topsoil shall be replaced as soon as possible upon completion of work in the impacted habitat.	SLDMWA and Reclamation with Project Biologist	Field verification	Prior to, during, and after construction

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	• Overnight staging of vehicles or equipment shall be prohibited within 100 feet of occupied or assumed-occupied fairy shrimp. After construction: • Temporary impacts to listed branchiopod habitat shall mitigated for by restoring the affected area to pre-Project contours, compaction levels, and revegetation.			
BIO-16	**Measures to Minimize Impacts on Sensitive Natural Communities** Temporary and permanent impacts on sensitive natural communities known to occur within the Project area will be minimized to the greatest extent practicable. Trees and other vegetation will not be removed if it can otherwise be reasonably avoided. In determining areas where vegetation shall be removed to provide adequate access for construction or staging, consideration will be given to selecting areas that require the least amount of removal of mature trees and canopy cover in coordination with a qualified biologist. Prior to the initiation of construction activities, exclusionary fencing will be installed along the boundaries of all environmentally sensitive areas to be avoided, which will include sensitive natural communities and aquatic resources adjacent to the areas of Project-related impacts, so that impacts on environmentally sensitive areas outside of the construction area are minimized. Locations of environmentally sensitive areas and exclusionary fencing will be identified on construction plans. The exclusionary fencing will be inspected and maintained on a regular basis throughout Project construction in the areas where the fencing is needed to avoid unintended disturbance. A Post-Construction Revegetation and Monitoring Plan will be developed and implemented to provide for the restoration of temporarily impacted riparian habitats to pre-existing conditions. The plan will include provisions for the planting of native woody vegetation and native seed mix or otherwise provide for the reestablishment of self-sustaining native riparian vegetation similar to the existing native riparian vegetation community. Planting of native riparian vegetation will include, but is not limited to, replacement of any trees removed	Reclamation, SLDMWA, and Construction contractor(s) with Project Biologist	Field verification and documentation on file with Reclamation	Prior to, during and after construction

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	by the Project at a 3:1 ratio (replaced to removed) with appropriate native tree species. For the purposes of this requirement, a tree is defined as a native woody plant (i.e., tree or mature shrub) with at least one stem measuring two inches or greater diameter at breast height. The plan will also identify success criteria and provide for annual or other regular monitoring to evaluate whether the revegetation effort has met the success criteria. The plan will include measures for remedial actions (e.g., additional plantings, supplemental irrigation, increased monitoring) if monitoring efforts indicate that success criteria are not being met.			
BIO-17	**Measures to Minimize Impacts on Wetlands** Prior to any temporary or permanent impacts on aquatic resources, any required permits/authorizations from RWQCB and United States Army Corps of Engineers (USACE) will be obtained. All terms and conditions of the required permits/authorizations will be implemented. Where jurisdictional wetlands and other waters cannot be avoided, to offset temporary and permanent impacts that would occur as a result of the Project, restoration and compensatory mitigation to ensure no net loss will be provided as described below. A wetland mitigation and monitoring plan will be developed in coordination with CDFW, USACE, or RWQCB to detail mitigation and monitoring obligations for temporary and permanent impacts to wetlands and other waters owing to construction activities and for other CDFW jurisdictional areas. The plan will quantify the total acreage affected; provide for mitigation, as described below, to wetland or riparian habitat; specify annual success criteria for mitigation sites; specify monitoring and reporting requirements; and prescribe site-specific plans to compensate for wetland losses resulting from the Project consistent with USACE's no net loss policy. Prior to construction, the aquatic structure of wetland and riparian areas to be disturbed will be photo-documented and measurements of width, length, and depth will be recorded. Recontouring and revegetation of the disturbed portions of jurisdictional areas in areas temporarily affected by construction	Reclamation, SLDMWA, and Construction contractor(s) with Project Biologist	Field verification and documentation on file with Reclamation	Prior to, during and after construction

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
	prior to demobilization by the construction contractor will be completed at the end of Project construction. Creek banks will be recontoured to a more stable condition, if necessary. Revegetation will include a palette of species native to the watershed area according to a revegetation plan to be developed by Reclamation and submitted to USACE, CDFW, and RWQCB for approval. Following removal, woody trees habitat acreage would be replanted at a minimum 1:1 ratio, or as determined and agreed upon by the permitting agencies. Interim vegetation or other measures will be implemented, as necessary, to control erosion in disturbed areas prior to final revegetation. Wetland and other waters impact in the construction and inundation area will be compensated at a ratio of 2:1 or at a ratio agreed upon by the wetland permitting agencies. Compensatory mitigation will be conducted by creating or restoring wetland and aquatic habitat at an agency-approved location on nearby lands or through purchasing mitigation credits at a USACE- or CDFW-approved mitigation bank (depending on the resource). If mitigation is conducted on- or off-site, a five-year wetland mitigation and monitoring program for on- and off-site mitigation will be developed. Appropriate performance standards may include a 75-percent survival rate of restoration plantings; absence of invasive plant species; and a viable, self-sustaining creek or wetland system at the end of five years. A weed control plan for the Project to limit the spread of noxious or invasive weeds will be developed. This plan would be consistent with current integrated pest management plans already in practice on lands surrounding the reservoir. Noxious or invasive weeds include those rated as 'high' in invasiveness by the California Invasive Plant Council. The plan will include a baseline survey to identify the location and extent of invasive weeds in the Project area prior to ground-disturbing activity, a plan to destroy existing invasive weeds in the construction area prior to initiation of ground-disturbing activity, weed-containment measures while the Project is in progress, and monitoring and control of weeds following completion of construction.			

Measure No.	Mitigation Measure	Responsible Party	Method of Verification	Timing of Verification
CR-1	**Implement a Formal Agreement Document to National Historic Preservation Act (NHPA) Section 106 Compliance and Resolve any Adverse Effects/Significant Impacts to Cultural Resources** The resolution of adverse effects to historic properties occurs through the implementation of measures agreed on through consultation with the State Historic Preservation Office, Advisory Council on Historic Preservation, and other Section 106 consulting parties. These measures are discussed in the draft *Programmatic Agreement Between the Bureau of Reclamation, Interior Region 10 California-Great Basin; and the California State Historic Preservation Officer Regarding Compliance with Section 106 of the National Historic Preservation Act Pertaining to the Implementation of the Delta-Mendota Canal Subsidence Correction Project, Alameda, Contra Costa, San Joaquin, Stanislaus, Merced, and Fresno counties*, which remains in review. In general, significant impacts to cultural resources under NEPA would be mitigated through the measures agreed to through the Section 106 process. Cultural resources that are formally determined not eligible for inclusion in the National Register of Historic Places (NRHP) or the California Register of Historic Resources (CRHR) would require no further management prior to Project implementation. If cultural resources determined 'not eligible for listing in the NRHP but eligible for listing in the CRHR' are identified as part of the Project, such resources will be managed per CEQA requirements.	Reclamation, SLDMWA, and Construction contractor(s)	Documentation on file with Reclamation	Prior to and during construction
GEO-1	**Prepare for Unexpected Failures of Erosion Control Measures** To prepare for unexpected failures of erosion control measures, a supply of erosion control materials will be maintained on-site during the construction period to facilitate a quick response to unanticipated storm events or emergencies.	SLDMWA and Reclamation	Field verification	During construction

S.3 List of Acronyms

BRMMP – Biological Resources Management and Monitoring Plan
CDFW – California Department of Fish and Wildlife
CDPR – California Department of Parks and Recreation
CEQA – California Environmental Quality Act
CRHR – California Register of Historic Resources
CRLF – California red-legged frog
CTS – California Tiger Salamander
EA/IS – Environmental Assessment/Initial Study
MMRP – Mitigation Monitoring and Reporting Program
NEPA – National Environmental Policy Act
NHPA – National Historic Preservation Act
NRHP – National Register of Historic Places
OSHA – Occupational Safety and Health Administration
PRC – Public Resources Code
Project – Delta-Mendota Canal Subsidence Correction Project
Reclamation – Bureau of Reclamation
RWQCB – Regional Water Quality Control Board
SJKF – San Joaquin kit fox
SLDMWA – San Luis & Delta-Mendota Water Authority
SWPPP – Specific Stormwater Pollution Prevention Plan
USACE – United States Army Corps of Engineers
USFWS – United States Fish and Wildlife Service
WEAT – worker environmental awareness training

S.4 References

California Department of Fish and Wildlife (CDFW). 2021. *Protocols for Surveying and Evaluating Impacts to Special-status Native Plant Populations and Natural Communities*. February. Accessed on September 27, 2022. Available at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=18959&inline

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