Chapter 4
Description of Alternatives

This chapter provides a description of the No-Action Alternative and the components of the four alternative plans evaluated for feasibility in this Draft Feasibility Report. This chapter also presents the physical accomplishments of the alternative plans in comparison to the No-Action Alternative and the potential to improve conditions and accomplish the planning objectives.

Potential Temperance Flat River Mile 274 Dam Site

The alternative plans were formulated to provide a representative range of potential features, operations, and benefits of Temperance Flat RM 274 Reservoir. The alternative plans vary based on operations (conveyance routing of new water supply, potential water supply beneficiaries, and minimum carryover storage targets) and intake structure type for water temperature management (single low-level or selective-level). Variations in other physical features, such as dam design and construction approach, hydropower mitigation features, and location of outlet works/diversion tunnels, were considered during the development of feasibility designs and cost estimates, but the preferred approaches were identified during feasibility design and are reflected consistently in the alternative plans. The alternative plans are subject to refinement in the Final Feasibility Report.

- The **No-Action Alternative** considers the future conditions of the study area and the future level of demand in 2030 if an alternative plan is not implemented.

- **Alternative Plan 1** would include constructing a new dam and reservoir at RM 274 in the upstream portion of Millerton Lake, as well as diversion works, a powerhouse, valve house, transmission facilities, development of other construction areas, and relocation of affected existing facilities, all of which are features common to each alternative. Under Alternative Plan 1, Temperance Flat RM 274 Reservoir would provide about 1,260 TAF of additional storage and would provide new water supply to the Friant Division via the Friant-Kern and Madera canals and to SWP M&I contractors via the San Joaquin River.

This alternative would include minimum carryover storage targets of 340 TAF in Millerton Lake and 200 TAF in Temperance Flat RM 274 Reservoir, for a total minimum carryover storage target of 540 TAF, and would include an LLIS on Temperance Flat RM 274 Reservoir for releases to Millerton Lake.

- **Alternative Plan 2** would include constructing the same features described in Alternative 1 and providing new water supply to the Friant Division and SWP M&I contractors, and to CVP SOD contractors through routing supply to San Joaquin Valley wildlife refuges for Level 2 diversification (making the same quantity available to CVP SOD contractors from the Delta); and would include the same carryover storage and intake configuration as Alternative Plan 1.

- **Alternative Plan 3** would include constructing the same features described in Alternative 1 and providing new water supply to the Friant Division via the Friant-Kern and Madera canals, to SWP M&I contractors via the Friant-Kern Canal, and to CVP SOD contractors via the San Joaquin River; and would include the same carryover storage and intake configuration as Alternative Plan 1.

- **Alternative Plan 4** would include constructing the same common features described in Alternative 1 and providing new water supply to the Friant Division via the Friant-Kern and Madera canals, and to SWP M&I and CVP SOD contractors via the San Joaquin River; would include minimum carryover storage targets of 340 TAF in Millerton Lake and 325 TAF in Temperance Flat RM 274 Reservoir; for a total minimum carryover storage target of 665 TAF, and would include an SLIS on Temperance Flat RM 274 Reservoir for temperature management and releases to Millerton Lake.

No-Action Alternative

For Federal feasibility studies of potential water resources projects, the No-Action Alternative is intended to account for existing facilities, conditions, land uses, and reasonably foreseeable actions expected to occur in the study area. Reasonably foreseeable actions include actions with current authorization, complete funding for design and construction, and environmental permitting and compliance activities that are substantially complete. The No-Action Alternative is considered to be the basis for comparison of the potential benefits and effects of alternative plans, consistent with the Federal P&G (WRC 1983) and NEPA guidelines. If no alternative plan is determined to be feasible, the No-Action Alternative is the default option. Under the No-Action Alternative, the proposed Federal action would not be implemented.

The No-Action Alternative reflects projected conditions in 2030 if the project is not implemented (2030 is the future level of development for which water resources are simulated in Reclamation's March 2012 CalSim II Benchmark). Under the No-Action Alternative, the reasonably foreseeable actions would be in effect, but the Federal government would take no additional action to address the growing water supply reliability and operational flexibility issues in California, nor take action toward implementing a specific plan to enhance water temperature and flow conditions in the San Joaquin River from Friant Dam to the Merced River (beyond the SJRRP). Examples of reasonably foreseeable actions included in the No-Action Alternative that are reflected in water supply reliability simulations are shown in Table 4-1. The Modeling Appendix further describes the No-Action Alternative, showing which actions and projects are assumed to be part of the future condition in the Reclamation's March 2012 CalSim II Benchmark model for Investigation operations modeling efforts.

Plan formulation efforts and analysis of the alternative plans and the No-Action Alternative described in this chapter are based on CVP and SWP operational conditions described in the 2008/2009 BOs. Modeling studies will be updated, if necessary, to reflect changes in water operations when the Final Feasibility Report is prepared. As described in Chapter 3, all alternatives, including the No-Action Alternative, are formulated and evaluated based on a 100-year project life or period of analysis, consistent with P&G, NEPA, and CEQA.

Table 4-1. Reasonably Foreseeable Actions Included in No-Action Alternative Related to Water Supply Reliability

Reasonably Foreseeable Action	Description of Action	Criteria for Inclusion in No-Action Alternative
South Bay Aqueduct Improvement and Enlargement Project	Increases the capacity of the South Bay Aqueduct to 430 cfs to meet Zone 7 Water Agency's future needs and provide operational flexibility to reduce SWP peak power consumption.	Included in Future No-Action Condition of Reclamation's March 2012 CalSim II Benchmark
Contra Costa Water District Alternative Intake Project	Seeks to reduce effects to Contra Costa WD customers from seasonal fluctuations and changing conditions in the Delta by altering diversion timing and location. The total amount of diversions will not change and no significant impacts to other Delta water users are anticipated.	Project was constructed in 2010; included in Future No-Action Condition of Reclamation's March 2012 CalSim II Benchmark
San Joaquin River Agreement and Vernalis Adaptive Management Program 1999–2011	Implements the SWRCB 1995 *Water Quality Control Plan* for the lower San Joaquin River and the Delta. VAMP, officially initiated in 2000 as part of SWRCB Water Right Decision 1641, is a large-scale, long-term experimental/management program designed to protect juvenile Chinook salmon migrating from the San Joaquin River through the Delta. VAMP is also a scientific experiment to determine how salmon survival rates change in response to alterations in San Joaquin River flows and CVP and SWP exports with installation of the Head of Old River Barrier. Although VAMP expired in 2011, the No-Action Alternative includes the continued operation of VAMP or a program with similar conditions.	Project is complete; a VAMP-like operating condition is included in Existing Condition and Future No-Action Condition of Reclamation's March 2012 CalSim II Benchmark
Arvin-Edison Canal Expansion	Increases the capacity of Arvin-Edison WSD South Canal, giving MWD the ability to withdraw up to 75 TAF of water from Arvin-Edison WSD during dry years and to store up to a total of 350 TAF of SWP water.	Project is currently authorized, funded, and permitted for implementation

Key:
cfs = cubic feet per second
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
MWD = Metropolitan Water District of Southern California
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
SWP = State Water Project
SWRCB = State Water Resources Control Board
TAF = thousand acre-feet
VAMP = Vernalis Adaptive Management Program
WD = Water District
WSD = Water Storage District

The following discussions highlight the consequences of implementing the No-Action Alternative, as they relate to the objectives of the Investigation.

Increase Water Supply Reliability and System Operational Flexibility

Delta-Mendota Canal and California Aqueduct

Demands for water in the Central Valley and throughout California exceed available supplies, and the need for additional supplies is expected to grow, as discussed in Chapter 2. The population of California and the Central Valley is expected to increase by approximately 33 percent and 115 percent, respectively, by 2030 (California Department of Finance 2010). As this occurs, along with the need to maintain a healthy and vibrant industrial and agricultural economy, the demand for adequate and reliable water supplies will become more acute. Competition for available water supplies will intensify as water demands increase to support M&I, and associated urban growth relative to agricultural uses. Delivering SOD water supplies for agricultural and M&I users has also become increasingly constrained and complex. Increases in population, land-use changes, regulatory requirements, and limitations on storage and conveyance facilities would further strain available water supplies and infrastructure capacity to meet water demands.

Water conservation and reuse efforts are increasing and forced conservation resulting from increasing shortages will continue. In the past, during drought years, many water conservation measures were implemented to reduce the effects of drought. In the future, as more water conservation measures become necessary to help meet even average year demands, the impacts of droughts will be more severe. Besides forced conservation, without developing cost-efficient new sources, more reliance will be placed on shifting uses from such areas as agricultural production to urban uses. It is likely that with continued and deepening shortages in available water supplies, increasing adverse economic impacts will occur over time in the Central Valley and elsewhere in California. One possible impact is an increase in water costs, resulting in a further shift in agricultural production to areas outside California and/or outside the U.S.

Under the No-Action Alternative, a dam at Temperance Flat RM 274 would not be constructed and Friant Dam would continue operating in the future No-Action condition similar to existing conditions (with implementation of the Settlement, including Restoration Flows). The No-Action Alternative would continue to meet water supply demands at levels similar to existing conditions, but would not be able to meet the expected increased demand in California.

Enhance Water Temperature and Flow Conditions

The SJRRP Restoration Goal is implemented in the No-Action Alternative as full Restoration Flows, increasing flow releases in the San Joaquin River from Friant Dam to the Merced River. As described previously, the Restoration Flow releases to the San Joaquin River stipulated in the Settlement vary by month and water year type.

The ability to manage the necessary volumes of cold water and to release water from Friant Dam at suitable temperatures, especially in drier water years, may present challenges to restoring and maintaining naturally reproducing and self-sustaining anadromous fish. Under the No-Action Alternative, no additional actions, outside of implementation of the Settlement, including releasing Restoration Flows, would be taken to manage cold-water volumes or releases to the San Joaquin River from Friant Dam at improved temperatures for anadromous fish.

Improve Flood Management, Hydropower Generation, Recreation, San Joaquin River Water Quality, Urban Water Quality

Flood system improvements along the San Joaquin River below Friant Dam are currently underway or will be initiated in the future by USACE, DWR, and local/regional flood management districts. Additionally, modifications to San Joaquin River flow conveyance features below Friant Dam will be initiated in the future by Reclamation under the SJRRP.

California's demand for electricity is expected to significantly increase in the future. Under the No-Action Alternative, PG&E is assumed to relicense the existing Kerckhoff Hydroelectric Project under the FERC in 2022. PG&E will have decommissioned the No. 2 unit in the Kerckhoff Powerhouse (PG&E 2012), which would decrease the powerhouse capacity below the 30 MW Renewable Portfolio Standard limit.

As California's population continues to grow, demands for water-oriented recreation at and near the lakes, reservoirs, streams, and rivers of the Central Valley would grow significantly. Regional population growth in the vicinity of Millerton Lake is expected to result in increased demand for recreation and increased visitation at Millerton Lake (Reclamation and State Parks 2010).

Several activities to improve San Joaquin River water quality conditions through reducing pollutant concentrations and/or

reducing pollutant loading to the river are underway, including continued implementation of the Westside Regional Drainage Plan and the Grassland Bypass Project.

A complementary action recommended for continued study in the CALFED ROD under the Conveyance and Water Quality programs was to facilitate water quality exchanges and similar programs to make available high-quality Sierra Nevada water in the eastern San Joaquin Valley to urban interests receiving water from the Delta (CALFED 2000a). Under the No-Action Alternative, there would be no actions to increase storage in the upper San Joaquin River watershed to enhance operational flexibility to meet water quality goals in the Delta or facilitate water quality exchanges to improve urban water quality.

Features, Operations, and Assumptions Common to All Alternative Plans

As described in Chapter 3, all alternative plans in this report include constructing Temperance Flat RM 274 Dam and Reservoir in the upstream portion of Millerton Lake (as shown in Figure 4-1). This site was chosen for feasibility-level evaluation after a detailed plan formulation and site selection process considering 22 separate storage sites. Four alternative plans were formulated and evaluated to assess feasibility and provide a range of potential operations and features to address, in varying degrees, Investigation planning objectives. Mitigation measures have not been completely identified at this stage in the Investigation and will be further developed for the Final Feasibility Report and EIS/EIR. The following features, operations, and assumptions are common to all alternative plans. Additional details are in the Engineering Summary Appendix and Modeling Appendix.

Temperance Flat RM 274 Dam and Reservoir

Temperance Flat RM 274 Dam would be an RCC arch gravity dam. The dam site would be located 6.8 miles upstream from Friant Dam and 1 mile upstream from the confluence of Fine Gold Creek and Millerton Lake. Figure 4-1 shows the extent of Temperance Flat RM 274 Reservoir and related project features in the reservoir area.

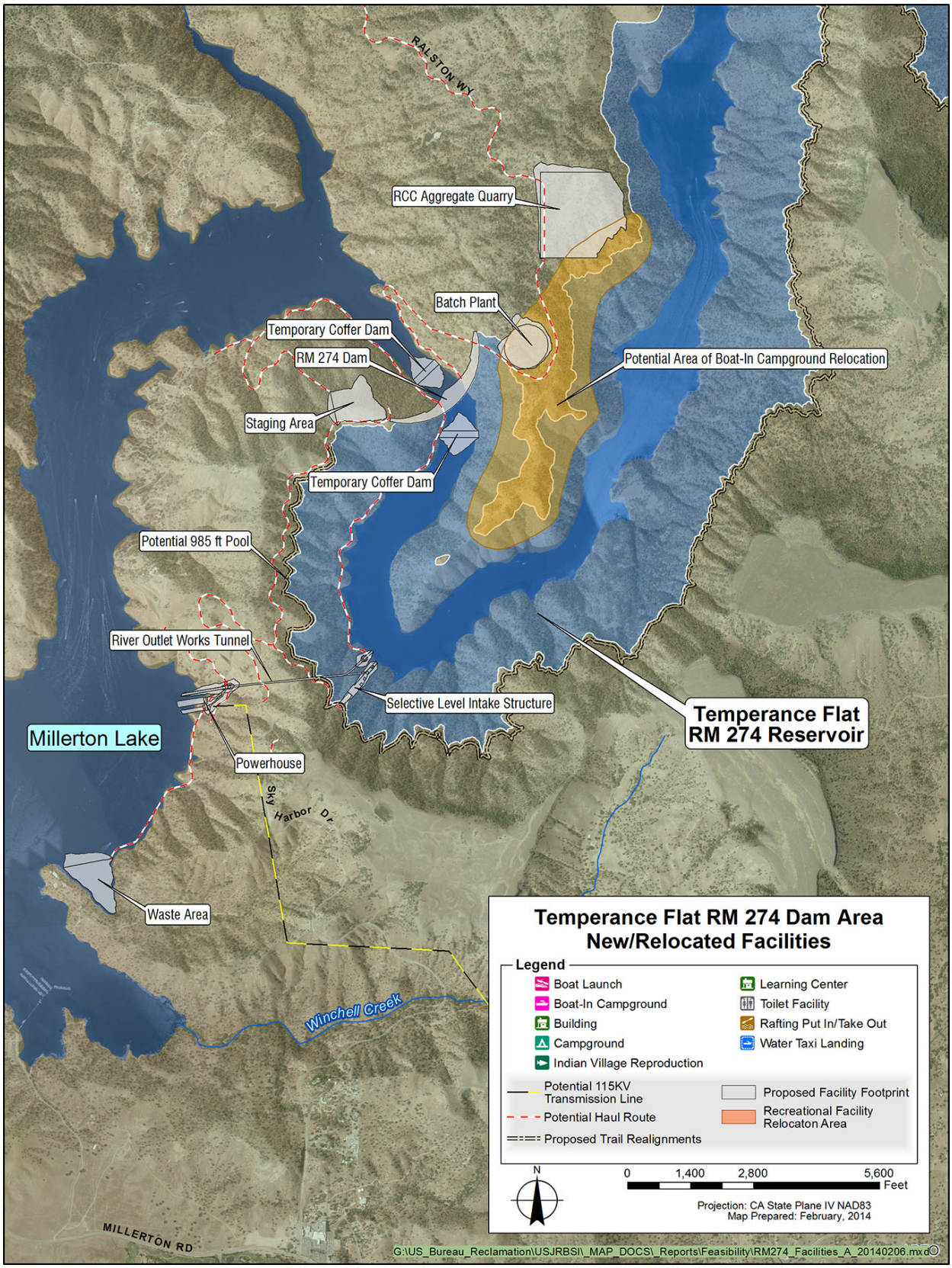

Figure 4-1. Temperance Flat RM 274 Reservoir Project Features

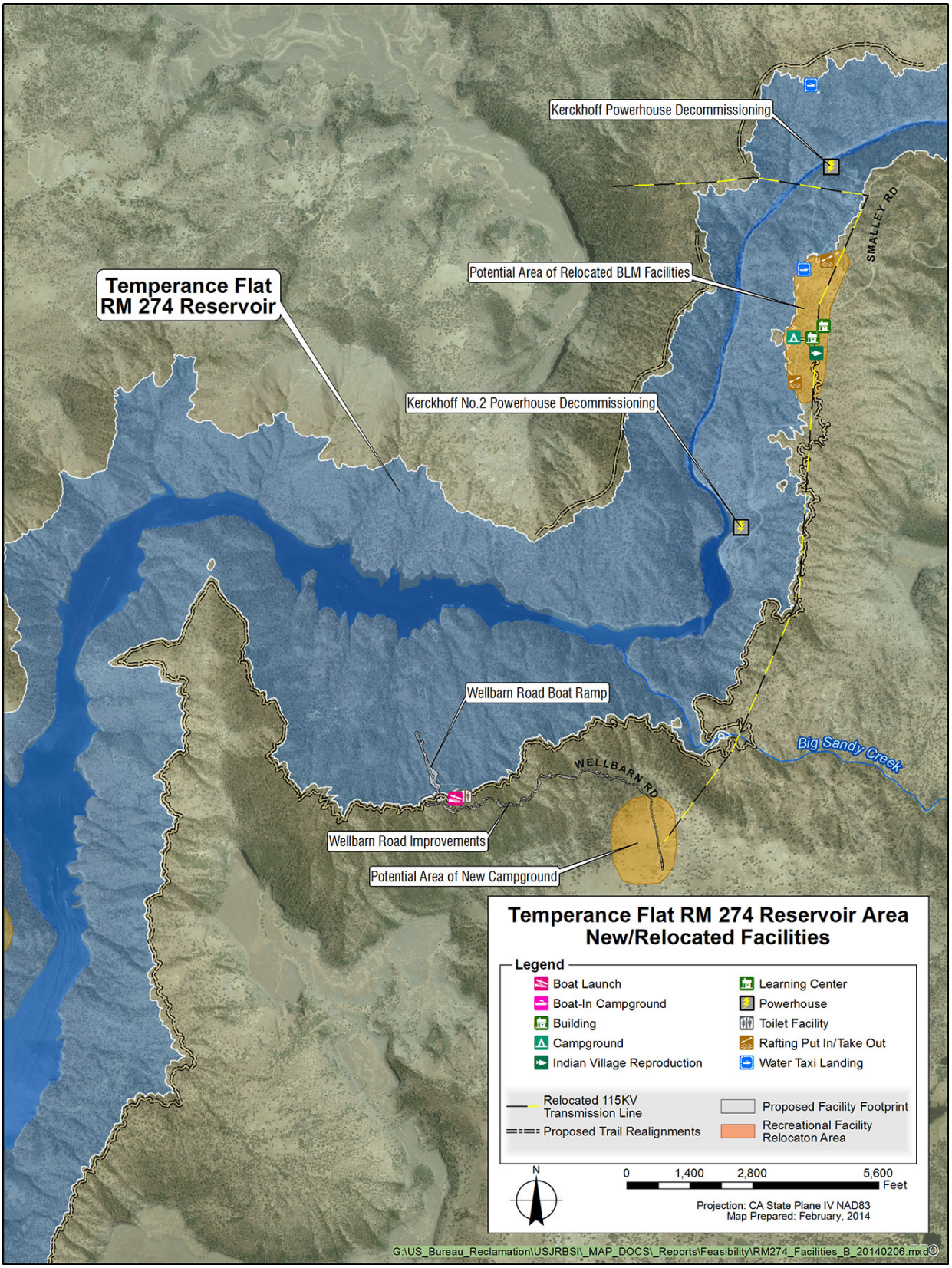

Figure 4-1. Temperance Flat RM 274 Reservoir Project Features (contd.)

The dam would be approximately 665 feet high, from a base elevation of 340 in the bottom of Millerton Lake (San Joaquin River channel) at the upstream face to the dam crest at elevation 1,005. The width of the dam crest would be approximately 3,360 feet. The overflow section of Temperance Flat RM 274 Dam would consist of a 665-foot-wide uncontrolled ogee crest spillway at elevation 985.

At a top-of-active-storage elevation of 985, the Temperance Flat RM 274 Reservoir would provide about 1,260 TAF additional storage (1,331 TAF total storage, of which 75 TAF would overlap with Millerton Lake), and would have a surface area of about 5,700 acres. Temperance Flat RM 274 Reservoir would reduce the Millerton Lake storage volume to 449 TAF and surface area to 3,890 acres. The reservoir would extend about 18.5 miles upstream from RM 274 to Kerckhoff Dam. At the top of active storage, the reservoir would reach to about 12 feet below the crest of Kerckhoff Dam.

Diversion Works

A 30-foot-diameter and approximately 2,900-foot-long, concrete-lined tunnel would be constructed through the left abutment, approximately 1.5 miles upstream from the main dam. The tunnel will later serve as the outlet works tunnel for the reservoir.

Upstream and downstream cofferdams would be required to divert stream flows during construction and to prevent inundation of the site from Millerton Lake. Cofferdams would be sized for estimated diversion flows, and to allow normal operation of Millerton Lake during construction of Temperance Flat RM 274 Dam. Both cofferdams would require a minimum crest elevation of 580 and height of 240 feet to accommodate normal reservoir operation of Millerton Lake and to pass diversion flows.

Intake Structure

All alternative plans will include an intake structure that would be an inclined reinforced-concrete structure, located approximately 7,200 feet upstream from the dam and adjacent to and upstream from the outlet works entrance. The length, width, and slope of the intake structure, along with number, location, and operability of inlet gates would vary among alternative plans. Alternative-specific arrangement descriptions for the intake structure are included in the alternative-specific sections.

Powerhouse and Transmission Facilities

The Temperance Flat RM 274 Reservoir powerhouse would be located approximately 750 feet southwest from the diversion tunnel outlet portal and consist of an 85-foot-deep, reinforced-concrete substructure and 64-foot-high steel superstructure. The powerhouse would contain two 80 MW turbines, which in combination are sized to pass a design flow of 6,000 cfs. After water has passed through the turbine units, it would then flow through an approximately 490-foot-long tailrace tunnel into an open channel to Millerton Lake, regulated by a concrete weir to maintain a minimum tailwater elevation of 550 feet. An aboveground switchyard would connect to a new Temperance Flat transmission line, which would traverse approximately 5 miles southeast to the existing Kerckhoff–Sanger transmission line.

Valve House

The Temperance Flat RM 274 valve house would be sized to pass up to 20,000 cfs. Water would be directed from the outlet works tunnel in a 30-foot-diameter penstock to be diverted through the valve house and/or powerhouse, depending on operations. The valve house would be an at-grade reinforced-concrete structure connected to the powerhouse superstructure, located approximately 650 feet southwest from the diversion tunnel portal. External features would include a river outlet works chute, approximately 600 feet long, which would release into Millerton Lake.

Access Roads

Three permanent access roads would provide operations and maintenance (O&M) staff access to the dam, intake structures, and valve house/powerhouse. Permanent access roads would leave Sky Harbor Road near the valve house and have a total length of approximately 3.5 miles, and consist of two 12-foot lanes.

Haul Roads

Five temporary haul roads would provide construction access to the aggregate quarry, batch plant, dam and cofferdams, staging area, intake structures, and diversion tunnel waste area. The total length of temporary haul roads would be approximately 9.6 miles with two lanes ranging from 12 to 20 feet.

Aggregate Quarry

The aggregate quarry would provide aggregate for the main dam, cofferdam, diversion tunnel, intake structures, and valve house/powerhouse construction. The quarry would be approximately 92 acres in size and located approximately 2,500 feet northeast of the dam's right abutment, outside the proposed inundation area.

Batch Plant

The batch plant site would be located approximately 800 feet east of the dam's right abutment. Most of the batch plant site would be outside the proposed inundation area and approximately 19 acres in size. Cement and pozzolan will likely be delivered by truck to the batch plant, most likely from railroad terminals near Fresno, California.

Staging Area

The staging area would be located directly above the dam's left abutment, outside the proposed inundation area, and be approximately 21 acres in size. This area would be used for construction staging and aggregate stockpiling. Trucks would be used to transport aggregate to the dam site.

Waste Area

The waste area would be located approximately 3,200 feet southwest of the powerhouse within the existing inundation area of Millerton Lake and be approximately 21.5 acres in size. This area would be used for permanent disposal of waste rock from diversion tunnel and powerhouse excavation.

Kerckhoff Hydroelectric Project Facilities

A Temperance Flat RM 274 Reservoir, with a top of active storage at elevation 985, would inundate the existing Kerckhoff Hydroelectric Project powerhouses, Kerckhoff Powerhouse and Kerckhoff No. 2 Powerhouse. Kerckhoff Powerhouse is an aboveground facility and its site would be restored to near-natural conditions. Kerckhoff No. 2 Powerhouse is an underground facility and would be abandoned in place. The majority of mechanical and electrical equipment for both powerhouses would be removed and salvaged.

Kerckhoff Dam

Temperance Flat RM 274 Reservoir top of active storage would be just a few feet below spillway gates at the top of the Kerckhoff Dam. The top of Kerckhoff Dam would be modified to accommodate higher tailwater elevations. Inundated sections of the Kerckhoff–Le Grand and Kerckhoff–Sanger transmission lines (approximately 4 miles) would be reconstructed as the Le Grand–Sanger transmission line.

Recreational Facilities

Temperance Flat RM 274 Reservoir would affect many recreational features found along the existing Millerton Lake shoreline. Recreational facilities upstream from RM 274 include the Temperance Flat Boat-In Campground within the Millerton Lake SRA, and the San Joaquin River Trail, which connects the SRA and the BLM SJRGMA. Within the BLM SJRGMA are an extension of the San Joaquin River Trail, two footbridges, primitive campgrounds, and a reproduction Native American village. Reclamation would protect such facilities from inundation, modify existing facilities to replace affected areas (i.e., relocate facilities on site) or abandon existing facilities and replace them at other suitable sites (i.e., relocate facilities off site and upslope). Reclamation would seek to maintain the quality of visitor experiences by replacing affected recreational facility capacity with facilities providing equivalent visual resource quality, amenities, and access to the Millerton Lake SRA and SJRGMA, as well as Temperance Flat RM 274 Reservoir (e.g., new Wellbarn Road Boat Ramp). Inundated recreational facilities and associated utilities would be relocated before demolition, with the exception of facilities identified for abandonment. Additional details on recreational facilities can be found in the Engineering Summary Appendix.

Reservoir Area Utilities

A majority of the infrastructure adjacent to Millerton Lake above RM 274 is located in the Temperance Flat area off Wellbarn Road, and PG&E and BLM facilities off Smalley Road. Utilities in the area include potable water, power distribution, telecommunications, and wastewater facilities. If utilities are impacted by inundation, they would be demolished and relocated (if an associated facility is relocated or required to maintain distribution).

CVP and SWP Operations Criteria

The operations modeling of the alternative plans is based on the Reclamation March 2012 CalSim II Benchmark, which represents operations of the CVP and SWP in accordance with the 2008/2009 BOs. The operations and requirements under the 2008/2009 BOs are described in further detail in the Modeling Appendix.

Millerton Lake and Friant Dam Operations

The target water surface elevation for Millerton Lake for all alternative plans is elevation 550 (carryover storage target of 340 TAF). Analyses in the feasibility phase alternatives refinement process demonstrated that, with significant additional storage in Temperance Flat RM 274 Reservoir, water supply and flood storage operations for Friant Dam and Millerton Lake would not be dependent on the historical variable operation to fill and drain the reservoir, and would not be hindered by holding Millerton Lake at a target elevation of 550 feet (340 TAF).

The steady storage level would also support recreation and cold water management better than variable storage or low carryover storage in Millerton Lake. Less fluctuation in Millerton Lake also supports stable tailwater levels for hydropower generation facilities associated with Temperance Flat RM 274 Reservoir. Millerton Lake could still fill all the way to the top-of-active storage capacity at elevation 580.6 (520 TAF) when needed in wet years and when Temperance Flat RM 274 Reservoir would also be full. Millerton Lake and Temperance Flat RM 274 Reservoir could be operated jointly and changes in Millerton Lake operations would not affect the ability to manage the joint Millerton Lake Temperance Flat RM 274 Reservoir system for water supply (including providing Restoration Flows) and flood damage reduction.

Flood Storage Operations

The existing flood control rule curve at Friant Dam specifies that flood space increases from zero on October 1 to 170 TAF on November 1, and decreases from 170 TAF on February 1 to zero on April 1 (USACE 1980). From November 1 to February 1, flood space in excess of 85 TAF may be replaced by an equal amount of space in Mammoth Pool.

The required total available flood control storage and operation rules at Millerton Lake were used for the combined Temperance Flat Reservoir and Millerton Lake analysis to maintain the same level of regulatory flood control. The assumption was made that the available flood control storage could be in either reservoir, provided the required flood control storage space was always available between the two reservoirs.

With Millerton Lake operated at elevation 550 (340 TAF) in the alternative plans, the flood space requirement of 170 TAF would generally be maintained in Millerton Lake (operated in conjunction with Mammoth Pool). Temperance Flat RM 274 Reservoir could provide significant additional flood storage space if needed in very wet years, as the larger total storage volume increases the probability that the total storage in Millerton and Temperance Flat RM 274 reservoirs would be less than the regulatory flood control limit.

Temperance Flat RM 274 Reservoir would reduce flood flow releases from Millerton Lake compared to the No-Action Alternative. Based on CalSim II simulations, long-term average annual flood releases from Friant Dam in the No-Action Alternative would be 152 TAF and would range from 45 to 53 TAF for the alternative plans. Figure 4-2 shows the estimated annual volumes of Friant Dam flood releases for Alternative Plan 4 as well as reductions from the No-Action Alternative based on CalSim II simulations.

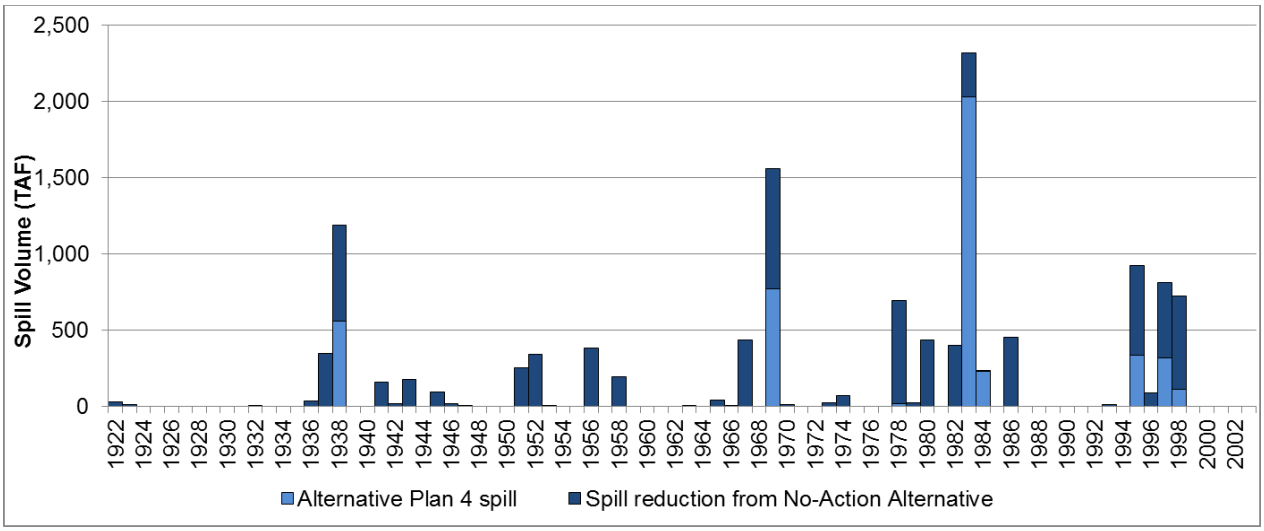

Figure 4-2. Simulated Friant Dam Flood Releases for Alternative Plan 4

Existing and Foreseeable Conveyance Facilities Operations

The alternative plans include existing and foreseeable available cross-valley conveyance capacity in the Cross Valley Canal, Shafter Wasco-Semitropic Water Storage District Connection, and Arvin Edison Canal. Total capacity is shown in the conveyance schematic in Figure 4-3. Further details on available conveyance capacity and modeling assumptions are described in Attachment B to the Modeling Appendix.

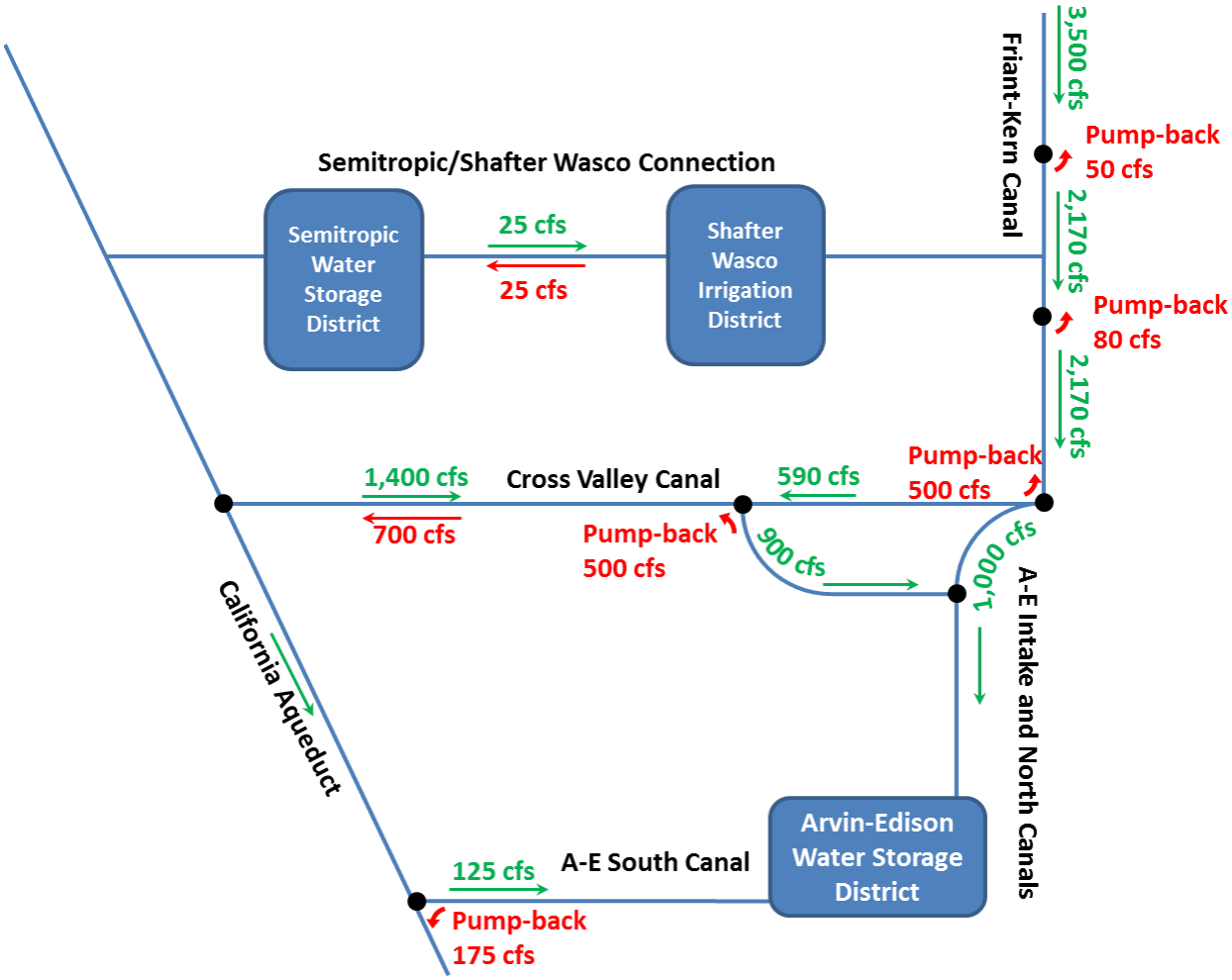

Figure 4-3. Schematic of Major Cross-Valley Conveyance Capacities

Features and Operations Varying Between Alternative Plans

The alternative plans mainly differ in four ways: minimum carryover storage target for Temperance Flat RM 274 Reservoir, beneficiaries of new water supply, routing of new water supply, and type of intake structure.

Minimum Carryover Storage Target for Temperance Flat RM 274 Reservoir

The minimum carryover storage target for Temperance Flat RM 274 Reservoir is 200 TAF for Alternative Plans 1, 2, and 3 and 325 TAF for Alternative Plan 4. The higher carryover in Alternative Plan 4 would slightly decrease water supply, but increase emergency water supply, recreation, cold-water pool, and hydropower. The modeling performed to date includes operating Temperance Flat RM 274 Reservoir to always be at or above the carryover storage target, but other carryover options such as variable carryover targets depending on the forecasted water supply may be considered for the Final Feasibility Report. Figure 4-4 illustrates simulated storage volumes for Millerton Lake and Temperance Flat RM 274 Reservoir for alternative plans 1 and 4, and shows the effects of the carryover storage targets on the minimum storage levels.

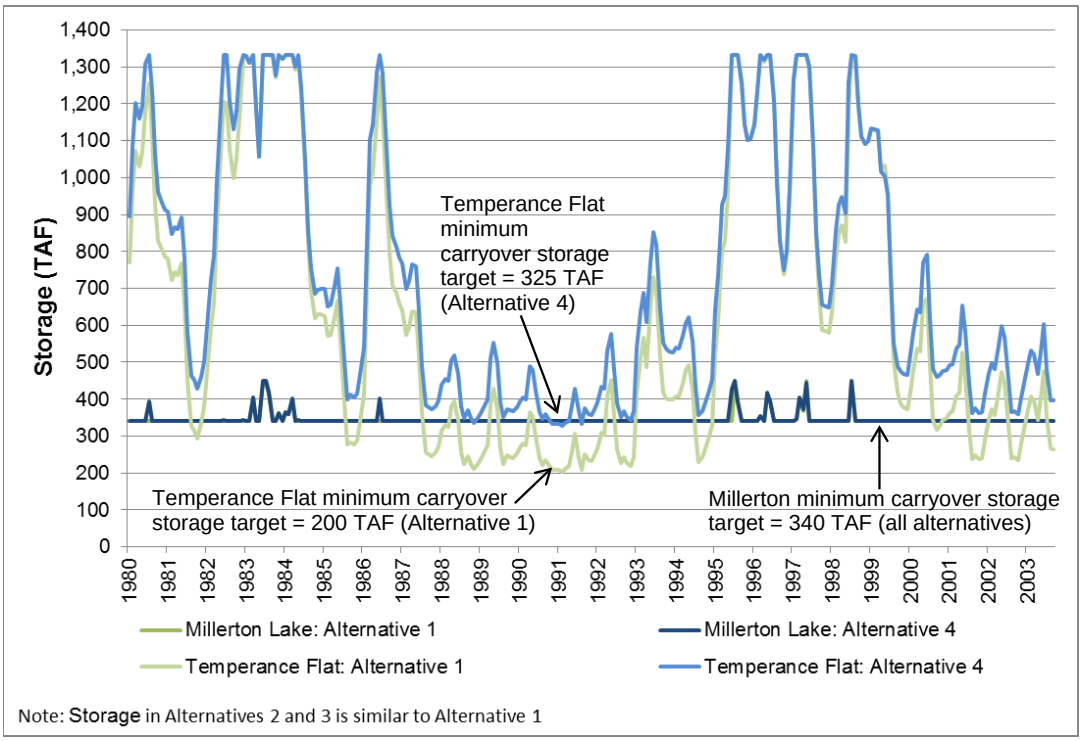

Figure 4-4. Simulated Millerton Lake and Temperance Flat Reservoir Storage

Beneficiaries of New Water Supply

Temperance Flat RM 274 Reservoir could provide water supply to a range of beneficiaries. The alternative plans illustrate some representative combinations of anticipated beneficiaries based on the strategic location of Temperance Flat RM 274 Reservoir and the Investigation problems, needs, and objectives. The Friant Division of the CVP, other CVP SOD contractors, and SWP M&I contractors are considered as beneficiaries in the alternative plans. All alternative plans would deliver some portion of the new water supply from Temperance Flat RM 274 Reservoir to the Friant Division and SWP M&I. Alternative Plans 2, 3 and 4 would also deliver new supply to CVP SOD contractors. Details of the new water supply allocated to each beneficiary could be revisited for the Final Feasibility Report.

Routing of New Water Supply

In some cases water deliveries could be routed to the beneficiaries in different ways. New supplies to the Friant Division would be conveyed via the Friant-Kern and Madera canals. New water supply to CVP SOD contractors would be delivered via the San Joaquin River to Mendota Pool, where it would be exchanged with DMC deliveries of Delta supply to Mendota Pool, freeing the Delta supply for delivery to CVP SOD contractors. New water supply would be delivered to CVP SOD contractors in Alternative Plans 3 and 4.

In Alternative Plans 1, 2, and 4, new water supply to SWP M&I beneficiaries would be routed via the San Joaquin River, and exchanged for Delta supplies at Mendota Pool, allowing an equivalent amount of Delta water supply to be delivered to SWP M&I via the California Aqueduct through another exchange at the San Luis Reservoir Forebay. In Alternative Plan 3, new water supply to SWP M&I beneficiaries would be delivered through the Friant-Kern Canal and cross-valley conveyance to the California Aqueduct. Water delivered via the San Joaquin River for CVP SOD or SWP M&I exchange with Delta supplies would create flexibility and source diversification for any contractors with access to Mendota Pool (wildlife refuges, CVP SOD contractors, Exchange Contractors).

Intake Structure Configuration

While Alternative Plans 1, 2, and 3 include an LLIS, an SLIS is included in Alternative Plan 4 to provide additional flexibility for cold-water pool and Temperance Flat RM 274 Reservoir release temperature management.

Summary of Alternative Plans Features and Operations

Features, assumptions, and operations variables were combined and incorporated into the four alternative plans through the feasibility-phase plan refinement processes described in Chapter 3. The four alternative plans are intended to achieve the planning objectives by balancing water supply reliability and ecosystem enhancement, provide a wide range of potential physical accomplishments and economic benefits related to the planning objectives, and provide benefits to a wide range of potential beneficiaries.

Alternative Plan	1	2	3	4
Millerton Lake Minimum Carryover Storage Target	340 TAF			
Temperance Flat Minimum Carryover Storage Target	200 TAF			325 TAF
Beneficiaries	Friant Division, SWP M&I	Friant Division, SWP M&I, CVP SOD		
Conveyance Routing: Friant Division	Friant-Kern and Madera canals			
CVP SOD	N/A	San Joaquin River Exchanges at Mendota Pool		
SWP M&I	San Joaquin River Exchanges at Mendota Pool		Friant-Kern, cross-valley conveyance, CA Aqueduct	San Joaquin River Exchanges at Mendota Pool
Intake Structure Type	Low-level intake structure			Selective-level intake structure

Alternative plans vary in four ways: minimum carryover storage target for Temperance Flat RM 274 Reservoir, beneficiaries of new water supply, routing of new water supply, and intake structure type.

Features of the alternative plans are summarized in Table 4-2 and operations of the alternative plans are summarized in Table 4-3. A schematic of SOD systemwide operations of the alternative plans is shown in Figure 4-5.

Table 4-2. Summary of Physical Features of Alternative Plans

Alternative Plan	1	2	3	4
Dam and Reservoir				
Temperance Flat RM 274 Dam	RCC gravity arch dam.	Same as 1.	Same as 1.	Same as 1.
Dam Height (feet)	665	Same as 1.	Same as 1.	Same as 1.
Elevation of Dam Crest (feet)[2]	1,005	Same as 1.	Same as 1.	Same as 1.
Elevation of Top of Active Storage (feet)[2]	985	Same as 1.	Same as 1.	Same as 1.
Capacity (TAF)	1,331	Same as 1.	Same as 1.	Same as 1.
Net Capacity Increase (TAF)	1,260	Same as 1.	Same as 1.	Same as 1.
Spillway	665-foot-wide uncontrolled ogee crest spillway.	Same as 1.	Same as 1.	Same as 1.
Diversion Works				
Diversion and Outlet Works Tunnel	30-foot-diameter, concrete-lined tunnel through left abutment.	Same as 1.	Same as 1.	Same as 1.
Upstream and Downstream Cofferdams	Embankment cofferdams to divert stream flows around dam construction site.	Same as 1.	Same as 1.	Same as 1.
Height (feet)	240	Same as 1.	Same as 1.	Same as 1.
Elevation of Cofferdam Crest (feet)[1]	580	Same as 1.	Same as 1.	Same as 1.
Intake Structure				
Low-Level Intake Structure	Inclined reinforced-concrete structure with two low-level fixed-wheel gates.	Same as 1.	Same as 1.	None.
Selective-Level Intake Structure	None.	None.	None.	Inclined reinforced-concrete structure with two low-level fixed-wheel gates and three upper-level fixed-wheel gates.
Powerhouse, Valve House, and Transmission Facilities				
Powerhouse	160 MW powerhouse and tailrace.	Same as 1.	Same as 1.	Same as 1.
Transmission	Transmission line approximately 5 miles southeast to the existing Kerckhoff–Sanger line.	Same as 1.	Same as 1.	Same as 1.
Valve House	At-grade reinforced-concrete structure connected to diversion tunnel and powerhouse.	Same as 1.	Same as 1.	Same as 1.

Table 4-2. Summary of Physical Features of Alternative Plans (contd.)

Alternative Plan	1	2	3	4
Other Construction Areas				
Access and Haul Roads	3 permanent access roads (approx. 3.5 miles) and 5 temporary haul roads (approx. 9.6 miles).	Same as 1.	Same as 1.	Same as 1.
Aggregate Quarry	92-acre quarry.	Same as 1.	Same as 1.	Same as 1.
Batch Plant	19-acre plant.	Same as 1.	Same as 1.	Same as 1.
Staging Area	21-acre staging area.	Same as 1.	Same as 1.	Same as 1.
Waste Area	21.5-acre area for waste rock from diversion tunnel and powerhouse excavation.	Same as 1.	Same as 1.	Same as 1.
Affected Existing Facilities				
Kerckhoff Hydroelectric Project Powerhouses	Demolish Kerckhoff Powerhouse and Kerckhoff No. 2 Powerhouse and restore to near-natural conditions.	Same as 1.	Same as 1.	Same as 1.
Kerckhoff Dam	Raise deck to elevation 1,005 and replace mechanical equipment for gate operations.	Same as 1.	Same as 1.	Same as 1.
Existing Transmission	Relocate inundated portions of Kerckhoff–Le Grand and Kerckhoff–Sanger lines.	Same as 1.	Same as 1.	Same as 1.
Recreational Facilities	Relocate inundated BLM and State Parks facilities. Construct new boat ramp.	Same as 1.	Same as 1.	Same as 1.
Reservoir Area Utilities	Relocate inundated utilities if associated facilities are also relocated.	Same as 1.	Same as 1.	Same as 1.

Notes:
[1] Based on the North American Vertical Datum of 1988.

Key:
BLM = U.S. Department of the Interior, Bureau of Land Management
MW = megawatt
RCC = roller-compacted concrete
RM = river mile
State Parks = California Department of Parks and Recreation
TAF = thousand acre-feet

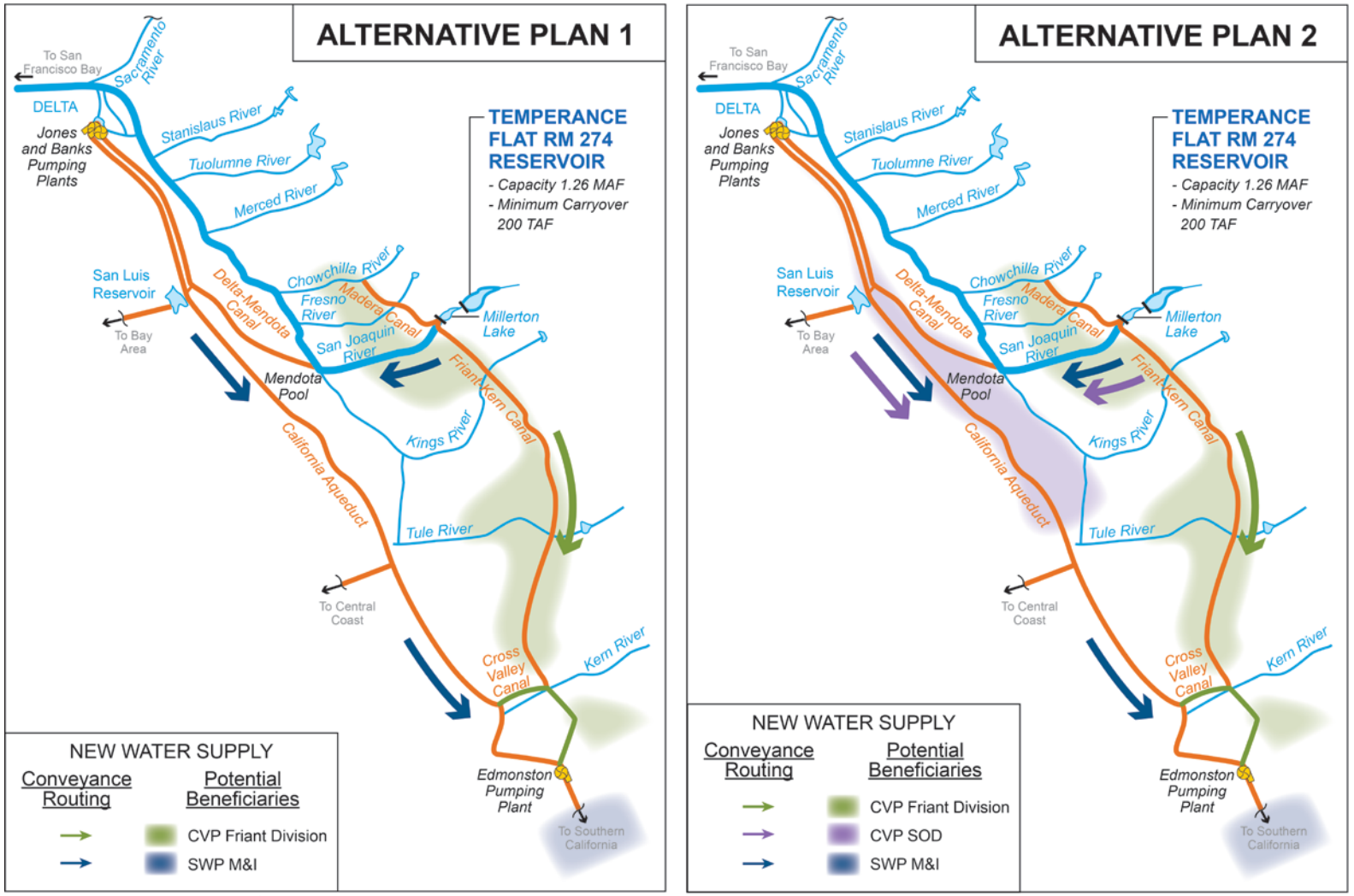

Figure 4-5. South-of-Delta Systemwide Operations of Alternative Plans

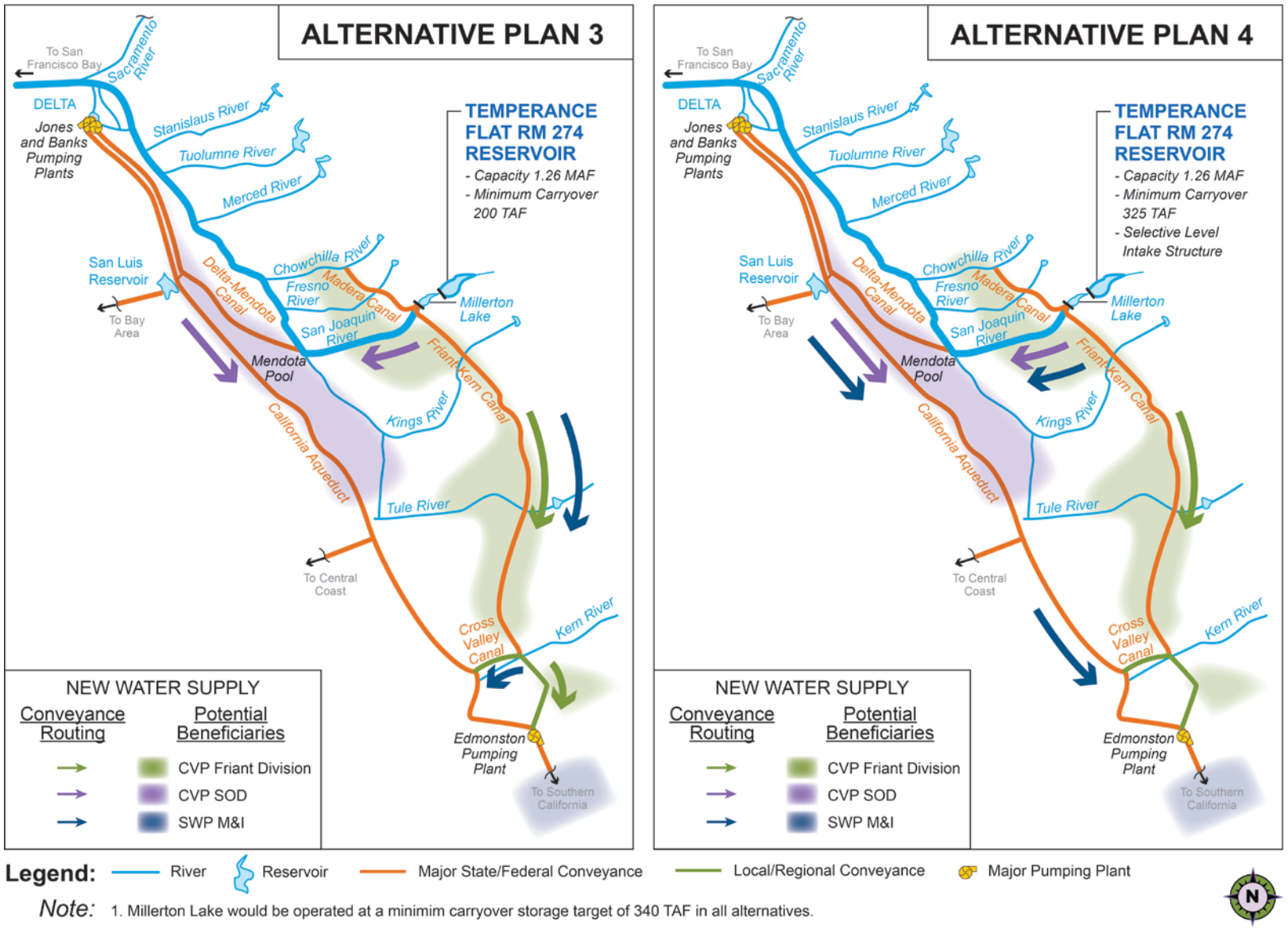

Figure 4-5. South-of-Delta Systemwide Operations of Alternative Plans (contd.)

Table 4-3. Summary of Operations of Alternative Plans

Alternative Plan	New Water Supply Beneficiaries/Deliveries			Millerton Lake Minimum Carryover Storage Target (TAF)	Temperance Flat Minimum Carryover Storage Target (TAF)	Intake Structure Type [1]
	CVP Friant Division	CVP South-of-Delta	SWP Municipal & Industrial			
	Conveyance Route					
1	Friant-Kern/ Madera Canals	N/A	San Joaquin River [2]	340 TAF	200 TAF	LLIS
2		San Joaquin River [2, 3]				LLIS
3			Friant-Kern Canal			LLIS
4			San Joaquin River [2]		325 TAF	SLIS

Notes:
[1] SLIS may be used for water temperature management.
[2] Water supply delivered via the San Joaquin River to Mendota Pool could be available for exchange with CVP SOD contractors, CVPIA Level 2 refuge supplies, or San Joaquin River Exchange Contractor supplies.
[3] Alternative Plan 2 would exchange Temperance Flat RM 274 Reservoir water supply for Level 2 refuges supplies delivered from the Delta, diversifying the CVPIA Level 2 water supply, and freeing up Delta supplies to be delivered to CVP SOD contractors.
Key:
CVP = Central Valley Project
CVPIA = Central Valley Project Improvement Act
LLIS = low level intake structure
N/A = not applicable
SLIS = selective level intake structure
SWP = State Water Project
TAF = thousand acre-feet

Alternative Plan 1

In addition to the features common to all of the alternative plans (dam and reservoir, diversion works, powerhouse, valve house, transmission facilities, other construction areas, and affected existing facilities), Alternative Plan 1 includes a fixed LLIS on Temperance Flat RM 274 Reservoir. The LLIS would be an inclined reinforced-concrete structure, located approximately 7,200 feet upstream from the dam and adjacent to and upstream from the outlet works entrance. The LLIS would consist of two, low-level fixed-wheel gates sized in combination to pass 20,000 cfs during high-flow conditions. Water through each gate would flow directly into the outlet works tunnel. Because the lower gates would also function to release higher flood flows, both are necessary, but only one would be opened, as necessary, for normal releases; the other would remain closed.

Alternative Plan 1 would provide new water supply to the Friant Division and SWP M&I contractors. New supply to SWP M&I contractors would be delivered via the San Joaquin River, and exchanged for Delta supplies at Mendota Pool, where an equivalent amount of Delta water supply could be delivered to SWP M&I via the California Aqueduct.

Alternative Plan 1 would include minimum carryover storage targets of 340 TAF in Millerton Lake and 200 TAF in Temperance Flat RM 274 Reservoir, for a total minimum carryover storage target of 540 TAF.

Alternative Plan 2

Alternative Plan 2 would include constructing the same physical features described in Alternative Plan 1. Alternative Plan 2 would provide new water supply to the Friant Division, SWP M&I contractors, and CVP SOD contractors. The new supply to SWP M&I contractors would be delivered via the San Joaquin River and exchanged for Delta supplies at Mendota Pool, where an equivalent amount of Delta water supply would be delivered to SWP M&I via the California Aqueduct. The new water supply to CVP SOD would be developed by delivering water supplies to serve CVPIA Level 2 refuge water demands from Temperance Flat RM 274 Reservoir. The water would be released to the San Joaquin River for refuge delivery from Mendota Pool. This water would be released to the San Joaquin River and delivered to Mendota Pool, allowing direct access or exchange with Delta supplies for delivery to CVP SOD contractors.

Alternative Plan 2 would have minimum carryover storage targets of 340 TAF in Millerton Lake and 200 TAF in Temperance Flat RM 274 Reservoir, for a total minimum carryover storage target of 540 TAF. Alternative Plan 2 would include a fixed LLIS on Temperance Flat RM 274 Reservoir, as described for Alternative Plan 1.

Alternative Plan 3

Alternative Plan 3 would include constructing the same physical features described in Alternative Plan 1. Alternative Plan 3 would provide new water supply to the Friant Division, SWP M&I contractors, and CVP SOD contractors. New supply to SWP M&I contractors would be delivered via the Friant-Kern Canal, cross-valley conveyance, and the California Aqueduct. New water supply to CVP SOD contractors would be delivered via the San Joaquin River to Mendota Pool for direct access or exchange with Delta supplies.

Alternative Plan 3 would have minimum carryover storage targets of 340 TAF in Millerton Lake and 200 TAF in Temperance Flat RM 274 Reservoir, for a total minimum carryover storage target of 540 TAF. Alternative Plan 3 would include a fixed LLIS on Temperance Flat RM 274 Reservoir, as described for Alternative Plan 1.

Alternative Plan 4

Alternative Plan 4 would include constructing the same physical features common to all of the alternative plans, and would also include an SLIS on Temperance Flat RM 274 Reservoir. The SLIS would be an inclined reinforced-concrete structure, located approximately 7,200 feet upstream from the dam and adjacent to and upstream from the outlet works entrance. The SLIS would consist of two low-level fixed-wheel gates sized in combination to pass 20,000 cfs during high-flow conditions and three 6,000 cfs upper-level fixed-wheel gates to allow selective withdrawal from different temperature zones in the reservoir. Water through each lower gate would flow directly into the outlet works tunnel. Because the lower gates would also function to release higher flood flows, both are necessary, but only one would be opened, when necessary, for low-elevation releases as driven by temperature objectives; the other would remain closed.

Alternative Plan 4 would provide new water supply to the Friant Division, SWP M&I contractors, and CVP SOD contractors. New supply to SWP M&I and CVP SOD contractors would be delivered via the San Joaquin River, and exchanged for Delta supplies at Mendota Pool, where an equivalent amount of Delta water supply could be delivered to SWP M&I contractors via the California Aqueduct. New water supply to CVP SOD contractors would be delivered via the San Joaquin River to Mendota Pool for direct access or exchange with Delta supplies.

Alternative Plan 4 would have minimum carryover storage targets of 340 TAF in Millerton Lake and 325 TAF in Temperance Flat RM 274 Reservoir, for a total minimum carryover storage target of 665 TAF.

Physical Accomplishments of Alternative Plans

This section summarizes accomplishments and comparative metrics for all alternative plans for the primary planning objectives of increased water supply reliability and system operational flexibility, and enhancement of water temperature and flow conditions in the San Joaquin River; and for the secondary planning objectives of improved flood management, hydropower generation, recreation, San Joaquin River water quality, and urban water quality. Model simulations completed to assess the physical accomplishments are described in detail in the Modeling Appendix. Project costs are further described in the Engineering Summary Appendix, and economic analysis and benefits are further described in the Economic Analysis Appendix.

Increase Water Supply Reliability and System Operational Flexibility

The planning objective to increase water supply reliability and system operational flexibility could address water supply and demand for agricultural and M&I CVP and SWP water contractors. In addition to providing long-term average or dry-year water supply reliability, Temperance Flat RM 274 Reservoir could provide emergency water supply to SOD water users in cases of Delta pumping outages. Both water supply reliability and emergency water supply are considered to meet this planning objective.

Water Supply Reliability

Analyses of Temperance Flat RM 274 Reservoir alternative plans in the draft feasibility phase with operating conditions under the 2008/2009 BOs are focused on developing new water supply by storing wet year water supplies from the San Joaquin River that would otherwise be flood releases from Friant Dam. This operation would provide water supply reliability and operational flexibility to the Friant Division and the CVP and SWP system. The alternative plans were analyzed for water supply to the Friant Division contractors, SWP M&I contractors, CVP SOD contractors, and CVP San Joaquin Valley wildlife refuges, based on CalSim II simulations. Table 4-4 summarizes the long-term average annual change in delivery to the potential beneficiaries in each alternative plan compared to the No-Action Alternative. Table 4-5 lists the long-term average annual change in deliveries systemwide for all water year types for all alternative plans compared to the

No-Action Alternative. The long-term average annual change in systemwide deliveries accounts for reduced Delta pumping to SWP and CVP SOD contractors due to the reduction in Delta inflows during wet years (flood flows) from the San Joaquin River. On average, the alternative plans would provide between 61 to 76 TAF per year of additional CVP and SWP systemwide water deliveries, depending on operations.

In addition to carryover storage targets, the magnitude of long-term average water supply reliability accomplishments is strongly influenced by CVP and SWP operating conditions. Evaluation of Temperance Flat RM 274 Reservoir integrated with the broader CVP and SWP SOD export and storage system under potential future conditions with increased flexibility for CVP and SWP Delta export operations would likely result in significantly greater estimates of water supply reliability by capturing additional Delta water supply in wet years through exchange. The sensitivity of the alternative plans' accomplishments and benefits to changes in CVP and SWP operating conditions will be further evaluated in the Final Feasibility Report.

Table 4-4. Long-Term Average Annual Change in Deliveries for Temperance Flat RM 274 Reservoir

Alternative Plan	1	2	3	4
Average Annual Change in Deliveries (TAF) [1]				
Friant Division	43	36	38	27
CVP South-of Delta Ag [2]	-10	16	16	16
SWP M&I SOD	40	22	25	21
Total CVP and SWP Change In Delivery [3]	**70**	**71**	**76**	**61**

Notes:

[1] Alternative Plans are compared to No-Action Alternative.

[2] Because Temperance Flat RM 274 Reservoir would increase the capacity to capture San Joaquin River flood flows, Delta inflows from the San Joaquin River would be reduced; therefore, reducing CVP and SWP deliveries from the Delta. In some alternative plans, the long-term annual average delivery to CVP SOD would be slightly less than the No-Action Alternative. Further refinements are anticipated for the Final Feasibility Report.

[3] Total CVP and SWP delivery includes SWP Ag and CVP M&I, which are not included as water supply beneficiaries, so line items may not sum to totals.

Key:
Ag = agricultural contractors
CVP = Central Valley Project
M&I = municipal and industrial
RM = River Mile
SOD = South of Delta
SWP = State Water Project
TAF = thousand acre-feet

Table 4-5. Long-Term Average Annual Change in Deliveries for Temperance Flat RM 274 Reservoir Alternative Plans[1]

Alternative Plan	WY Type San Joaquin Index [2]	Change in System-wide Delivery [3]	Total Friant Ag	Class 1	Class 2	Section 215	Total SWP SOD	SWP Ag SOD	SWP M&I SOD	Total CVP SOD[2]	CVP Ag SOD	CVP M&I SOD
1	Wet	112	102	(1)	239	(137)	33	(10)	44	(23)	(22)	(1)
	Above Normal	152	82	2	133	(53)	79	(3)	82	(9)	(9)	0
	Below Normal	1	(49)	(3)	(14)	(32)	53	7	46	(3)	(3)	0
	Dry and Critical	19	12	4	23	(15)	13	0	13	(5)	(5)	(1)
	All Years	**70**	**43**	**1**	**103**	**(61)**	**38**	**(3)**	**40**	**(11)**	**(10)**	**0**
2	Wet	115	99	(1)	237	(137)	0	(10)	10	16	17	(1)
	Above Normal	145	65	1	117	(53)	43	(3)	46	36	37	0
	Below Normal	(4)	(65)	(3)	(30)	(32)	42	7	35	19	19	0
	Dry and Critical	24	8	6	18	(15)	15	1	13	1	1	(1)
	All Years	**71**	**36**	**1**	**95**	**(61)**	**20**	**(2)**	**22**	**16**	**16**	**0**
3	Wet	116	86	(1)	224	(138)	22	(10)	33	9	10	0
	Above Normal	152	62	1	113	(53)	48	(3)	51	42	43	0
	Below Normal	7	(38)	(3)	(2)	(32)	21	6	15	23	23	0
	Dry and Critical	30	18	7	27	(15)	8	1	7	3	3	(1)
	All Years	**76**	**38**	**2**	**98**	**(62)**	**22**	**(2)**	**25**	**15**	**16**	**0**
4	Wet	99	91	(1)	220	(128)	(2)	(10)	8	10	11	0
	Above Normal	122	39	2	90	(53)	40	(3)	43	42	42	0
	Below Normal	2	(62)	(3)	(27)	(32)	40	6	34	23	23	0
	Dry and Critical	21	6	6	15	(15)	14	1	12	2	3	0
	All Years	**61**	**27**	**2**	**85**	**(59)**	**18**	**(2)**	**21**	**16**	**16**	**0**

Note:

[3] Changes in deliveries as simulated with CalSim II March 2012 Benchmark with future (2030) level of development and 82 year hydrologic period of record from October 1921 to September 2003.

[2] San Joaquin Year Type or 60-20-20 Year Type – This classification system is based on the historical and forecasted unimpaired inflows of the Stanislaus, Tuolumne, Merced, and San Joaquin rivers to the San Joaquin River Basin, as defined in State Water Board Decision D-1641. The classification consists of five year types: wet, above normal, below normal, dry, and critical. Average for all years is weighted average based on proportion of each year type out of 82-year period of record.

[3] Alternative plans are compared to No-Action Alternative.

Key:
Ag = agricultural
CVP = Central Valley Project
M&I = municipal and industrial
RM = river mile
SOD = south-of-Delta
SWP = State Water Project
WY = water year

Emergency Water Supply

Temperance Flat RM 274 Reservoir storage could provide greater water supply reliability to SOD M&I water users in an emergency event and disruption of Delta exports. The Delta Risk Management Strategy (DRMS) Water Acquisitions Model (WAM) was used to estimate average emergency supply from alternative plans that could be provided in the potential event of Delta levee breaches causing varying durations of pumping outages and consequent SOD deficits. Table 4-6 lists the average emergency water supply available under alternative plans for levee breach scenarios with 1, 3, 10, 20, and 30 islands.

Table 4-6. Temperance Flat RM 274 Reservoir Average Water Supply Available for Delta Export After Disruption by Seismic Event

Alternative Plan	1	2	3	4
Levees Breached – 1 Island Scenario (TAF) [1]	28	28	28	28
Levees Breached – 3 Islands Scenario (TAF) [1]	47	47	47	47
Levees Breached – 10 Islands Scenario (TAF) [1]	194	195	195	203
Levees Breached – 20 Islands Scenario (TAF) [1]	368	369	365	361
Levees Breached – 30 Islands Scenario (TAF) [1]	442	443	437	534

Note:

[1] Alternative plans are compared to No-Action Alternative.

Key:

RM = River Mile

TAF = thousand acre-feet

Enhance Water Temperature and Flow Conditions

The planning objective to enhance water temperature and flow conditions in the San Joaquin River considers physical accomplishments for management of reservoir cold-water pool and Friant Dam river release temperatures to improve conditions for San Joaquin River anadromous fish in general, as well as potential to improve habitat for spring-run Chinook salmon in particular.

Ecosystem – Cold-Water Pool and River Release Temperature

The alternative plans could improve the capability, reliability, and flexibility to release water at suitable temperatures for anadromous fish downstream from Friant Dam. Reservoir and river water temperature simulations were performed for all alternative plans. Alternative Plan 4 also includes an SLIS to better manage reservoir cold-water pool and San Joaquin River release temperatures for anadromous fish. All the alternative plans would increase the total volume of cold water in Millerton Lake and Temperance Flat RM 274 Reservoir, with larger available cold-water pools in alternative plans with higher carryover storage. The SLIS included in Alternative Plan 4 would also allow for better management of the cold-water pool, resulting in improved water temperature conditions for anadromous fish in the San Joaquin River.

The alternative plans would improve San Joaquin River release temperatures from September through December, as shown in Figure 4-6, at the cost of slightly warmer winter releases than in the No-Action. However, in the winter months, release temperatures would still be cooler than needed for anadromous fish (see Modeling Appendix for further detail on reservoir and river temperatures). Inclusion of an SLIS in Alternative Plan 4 reduced modeled release temperatures by up to 5°F more than without the SLIS during falls months. The colder release temperatures would also slightly extend the distance downstream from Friant Dam where mean daily river temperatures stay below 55°F, a critical temperature for anadromous fish (Figure 4-7).

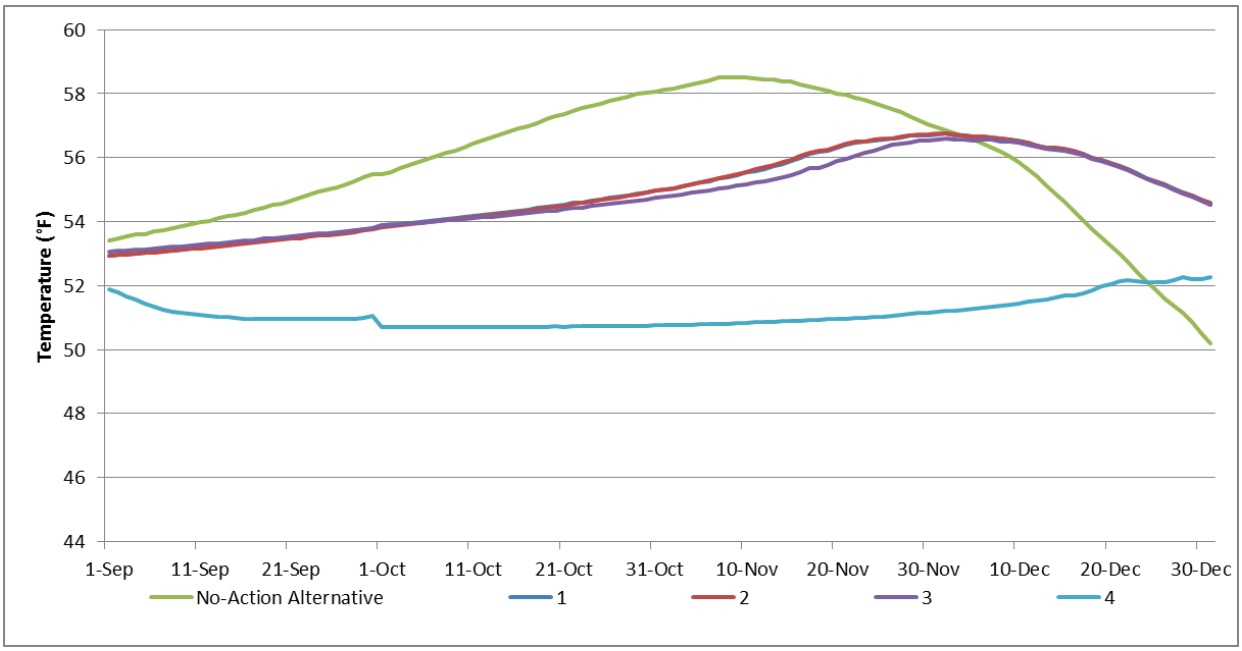

Figure 4-6. Mean Daily September – December Temperature (°F) of Friant Dam Release to San Joaquin River – All Years

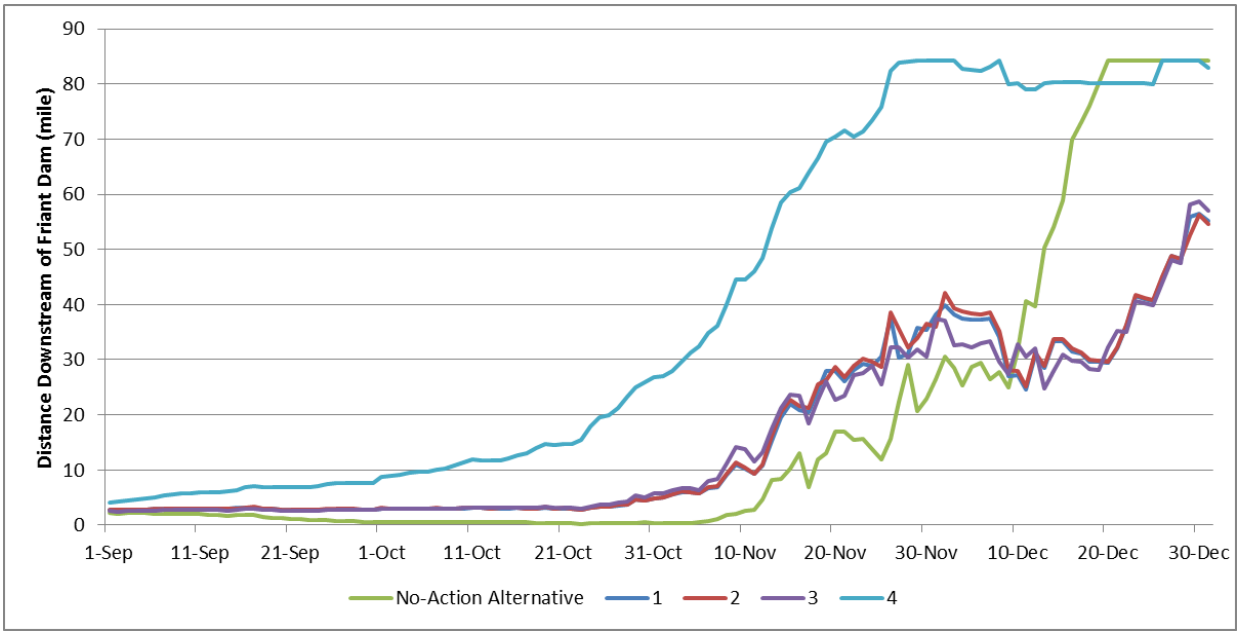

Figure 4-7. September – December Distance Downstream Where Mean Daily River Temperature Less Than or Equal to 55° F – All Years

Ecosystem – Improvement in Spring-Run Chinook Salmon Abundance

The Ecosystem Diagnosis and Treatment (EDT) model was used to estimate potential improvements to San Joaquin River spring-run Chinook salmon habitat that could be achieved by alternative plans. EDT output includes variables describing the productivity and capacity of fish habitat that could develop under flow and water temperature regimes for each alternative plan. Productivity and capacity are both represented in the abundance metric estimated by the EDT model, representing the number of spawning fish the habitat could sustain. Due to uncertainty and limited data regarding the survival of salmon as they migrate below the Merced River to the ocean and then return to spawn, results were developed to demonstrate a range of potential results for a low and high potential smolt-to-adult return rate (SAR). EDT modeling is described in further detail in the Modeling Appendix Attachment A.

Major EDT model outputs:

Productivity represents habitat quality and is based on the density-independent survival rate (i.e. survival without competition) and is a function of temperature, water quality, and food.

Capacity is the maximum abundance that could be supported by the quantity of suitable habitat and the density of fish in that habitat. It is a function of the quantity of habitat, productivity, and food.

Abundance is the best estimate for maximum number of returning/ spawning adult fish that could be supported considering both habitat quantity and quality.

The potential improvements for spring-run Chinook salmon habitat were measured by comparing the abundance for each alternative to that of the No-Action Alternative as a percent improvement in equilibrium abundance. Table 4-7 shows the increase in abundance of spring-run Chinook salmon habitat in the San Joaquin River due to improvements in flow and water temperature for weighted long-term average annual and dry year types. Alternative Plan 4, which includes an SLIS, would provide the highest long-term average annual improvement in equilibrium abundance. Improvements in abundance due to the alternative plans are related to a combination of water temperature improvements from additional flow or cold-water pool management through carryover storage and/or an SLIS, and additional flow in the San Joaquin River from Friant Dam to Mendota Pool (for water supply exchanges).

Table 4-7. Alternative Plans Improvement in Abundance of Spring-Run Chinook Salmon

Alternative Plan	1	2	3	4
Percent Improvement in Long-Term Average Annual Abundance– High SAR [1]	2.8%	2.8%	0.6%	4.9%
Percent Improvement in Dry Year Abundance– High SAR [1]	15.9%	13.2%	14.6%	13.1%
Percent Improvement in Long-Term Average Annual Abundance– Low SAR [1]	0.6%	-0.7%	-0.1%	2.8%
Percent Improvement in Dry Year Abundance– Low SAR [1]	14.0%	9.2%	13.3%	11.1%

Notes: Further details are presented in the Modeling Appendix Attachment A.
[1] Alternative plans are compared to the No-Action Alternative, which varies depending on the SAR.
Key: SAR = smolt-to-adult return rate

Flood Damage Reduction, Hydropower, Recreation, San Joaquin River Water Quality, Urban Water Quality

Secondary planning objectives include improving flood management, maintaining hydropower attributes value, increasing recreational opportunities, improving lower San Joaquin River water quality, and improving urban water quality. Physical accomplishments of the alternative plans regarding flood management, hydropower, recreation, and urban water quality are described below. San Joaquin River water quality improvements would be negligible.

Increase in Incidental Flood Space

Incidental flood storage was evaluated as the total storage between Millerton Lake and Temperance Flat RM 274 Reservoir available 90 percent of the time on a monthly basis. Increased storage with Temperance Flat RM 274 Reservoir would allow greater ability to capture flood flows. Figure 4-8 shows the 90 percent exceedence flood storage availability for alternative plans compared to the No-Action Alternative. Available storage in November through March also assumes that up to 85 TAF of flood storage would be available above Temperance Flat RM 274 Reservoir in Mammoth Pool. Alternative plans with lower carryover storage (1, 2, 3) would have more active storage available for flood damage reduction, but all alternative plans, including 4, would have at least 200 TAF more flood storage availability in the flood control period from November to March compared to the No-Action Alternative.

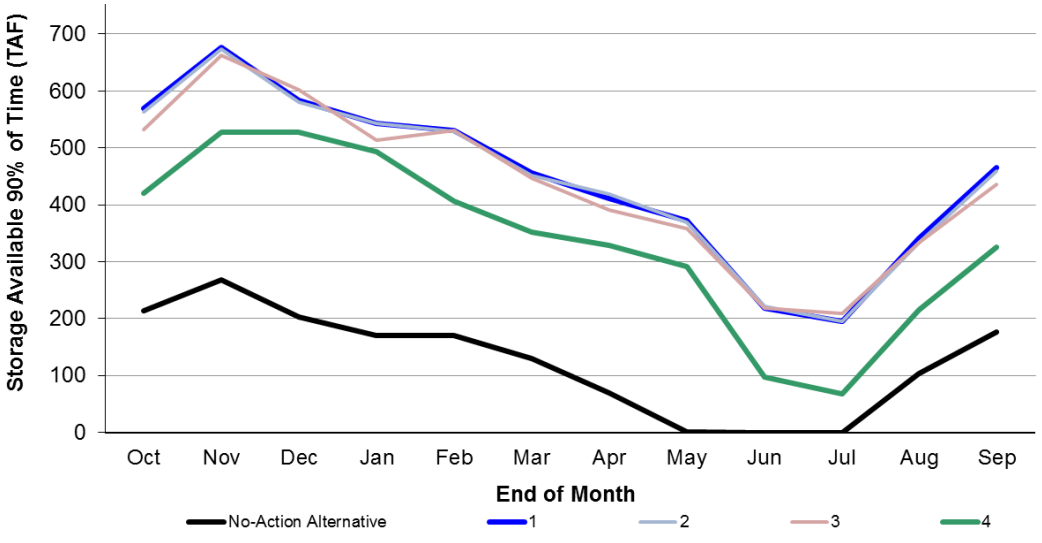

Figure 4-8. 90 Percent Exceedance Flood Storage Availability by Month for All Alternative Plans

Hydropower and Replacement of Impacted Hydropower Value

The ability of alternative plans to replace the value of the Kerckhoff Hydroelectric Project powerhouses would vary greatly, depending on how carryover storage in Temperance Flat RM 274 Reservoir is managed. Alternative Plans 1, 2, and 3 could replace all but 100 GWh/year (83.5 percent to 83.9 percent) of impacted Kerckhoff Hydroelectric Project generation using onsite hydropower mitigation. Alternative 4 could replace all but 57 GWh/year (90.8 percent) of impacted Kerckhoff Hydroelectric Project generation using onsite hydropower mitigation because of higher carryover storage in Alternative Plan 4 allowing for higher head for power generation. Table 4-8 shows the simulated long-term average hydropower generation change from the No-Action Alternative. All alternative plans would operate Millerton Lake with a fixed water surface at elevation 550 (carryover storage of 340 TAF). The fixed elevation would allow Friant Dam powerhouses to generate an average of 15.7 to 15.8 GWh/year greater than the No-Action Alternative.

Table 4-8. Friant Dam Hydropower Generation and Kerckhoff Hydroelectric Project Onsite Mitigation

Alternative Plan	1	2	3	4
Kerckhoff Hydroelectric Project Onsite Mitigation				
Change in Hydropower Generation from No-Action Alternative (GWh/year)[1]	-102.5	-100.6	-100.3	-57.1
Percent Generation Replacement of Kerckhoff Hydroelectric Project[1]	83.5	83.8	83.9	90.8
Friant Dam Hydropower Generation				
Change in Hydropower Generation from No-Action Alternative (GWh/year) [1]	15.8	15.7	15.7	15.8

Note: [1] Alternative plans are compared to No-Action Alternative. Change in Hydropower Generation = Kerckhoff Hydroelectric Project generation minus Temperance Flat RM 274 Powerhouse generation. Remaining mitigation requirements for Kerckhoff Hydroelectric Project are addressed in project costs.
Key: GWh = Gigawatt-hour
RM = River Mile

Recreational Opportunities

Opportunities for recreational development vary, depending on balancing of reservoir storage levels between Millerton Lake and Temperance Flat RM 274 Reservoir and water supply beneficiaries. Operating the reservoir balancing to generally keep Millerton Lake at a fixed elevation could improve early- and late-season boating opportunities in Millerton Lake, but at

lower elevations, could allow vehicular access that would degrade shoreline use conditions. Operating Millerton Lake with a fixed elevation between elevation 540 to 560 feet would allow the best balance of shoreline and reservoir use. All alternative plans would be operated with a fixed Millerton Lake elevation of 550 feet. Boating and waterskiing activities generate the highest economic value for Millerton Lake, followed by picnicking.

Temperance Flat RM 274 Reservoir could also support recreation, particularly boating activities. Recreational visitation at Temperance Flat RM 274 Reservoir is estimated as proportionate to Millerton Lake average historical visitation, considering the 50 percent exceedence reservoir surface areas. As a much larger reservoir, Temperance Flat RM 274 Reservoir could support 96,400 new visitor-days. Potential Temperance Flat RM 274 Reservoir recreational visitation may be understated because only peak recreation season boating activity participation was estimated, no land-based activity or camping participation was estimated, and no off-season participation was considered. Table 4-9 summarizes the increase in recreational visitor-days for alternative plans, considering recreation at Millerton Lake and Temperance Flat RM 274 Reservoir. Estimates in annual increase in recreational visitor-days range from 113,600 to 130,400.

Table 4-9. Estimated Increase in Recreational Visitor-Days Compared to No-Action Alternative

Alternative Plans	1	2	3	4
Potential Annual Increase in Visitation at Millerton Lake [1] (visitor-days/year)	34,000	34,000	34,000	34,000
Potential Annual Visitation at Temperance Flat RM 274 Reservoir [1,2] (visitor-days/year)	82,200	83,000	79,600	96,400
Total Potential Annual Increase in Recreational Visitation (visitor-days/year)	**116,200**	**117,000**	**113,600**	**130,400**

Notes:

[1] Alternative plans are compared to No-Action Alternative.

[2] Potential annual visitation at Temperance Flat RM 274 Reservoir is based solely on boating activities and peak recreational season Temperance Flat RM 274 Reservoir surface acres. Boating activities include waterskiing/wakeboarding, personal water craft, boat fishing, and general boating. This is considered a conservative estimate because with creation of Temperance Flat RM 274 Reservoir it is expected that new land-based recreational and camping facilities would be developed and support these recreational activities.

[2] Annual benefits are considered a conservative estimate because only peak recreational season boating activities economic value was estimated. Land-based recreational and camping activities are also expected at the new Temperance Flat RM 274 Reservoir and this has not been analyzed.

Key:
RM = River Mile

Municipal and Industrial Water Quality

Delivery of San Joaquin River water from Temperance Flat RM 274 Reservoir to SWP M&I water users could improve total water quality of SWP M&I deliveries. Water quality improves by diluting TDS and other water quality constituents in California Aqueduct deliveries with high-quality water from Temperance Flat RM 274 Reservoir. Table 4-10 shows the simulated average annual TDS concentration at the Edmonston Pumping Plant, as well as the change in concentration compared to the No-Action Alternative. Alternative Plan 3 is the only alternative that would deliver water from Temperance Flat RM 274 Reservoir directly to SWP M&I contractors via the Friant-Kern Canal and cross-valley conveyance, providing a positive dilution effect near the Edmonston Pumping Plant. Other alternative plans would deliver SWP M&I supplies from Temperance Flat RM 274 Reservoir via the San Joaquin River and Mendota Pool exchanges, increasing SWP M&I supplies but without any dilution effects in California Aqueduct deliveries.

Table 4-10. Simulated California Aqueduct Average Annual Total Dissolved Solids Concentrations at Edmonston Pumping Plant

Alternative Plan	3
Annual Average California Aqueduct Water Quality at Edmonston Pumping Plant (mg/L TDS)	266.8
Change in California Aqueduct water quality at Edmonston Pumping Plant Compared to No-Action Alternative (mg/L TDS) [1]	-1.7

Note: [1] Alternative Plans are compared to No-Action Alternative. Alternative Plans 1, 2, and 4 were not evaluated for water quality improvements.

Key:
mg/L = milligrams per liter
TDS = total dissolved solids

Summary of Potential Accomplishments

Table 4-11 summarizes the physical accomplishments of alternative plans. Alternative Plan 3 would provide the greatest water supply improvement, both in dry and critical years, as well as over the long term. However, because of the proportion of supply to new beneficiaries, Alternative Plan 1 would provide the greatest long-term new water supply to SWP M&I, while Alternative Plan 3 would provide the greatest volume of new supply to agriculture. Alternative Plan 4 has the greatest potential to improve long-term average abundance of spring-run Chinook salmon, but Alternative Plan 1 has the greatest potential to improve abundance in dry and critical years.

The alternative plans would provide similar levels of emergency water supply and similar levels of increased hydropower energy generation at Friant Dam. Alternative Plan 4 could replace the most Kerckhoff Hydroelectric Project value (91 percent). Only Alternative Plan 3 would improve SWP M&I water quality, due to direct delivery of Temperance Flat RM 274 Reservoir water supply via the Friant-Kern Canal and cross-valley conveyance. Alternative Plan 4 has highest potential for increasing recreation, due to having higher carryover storage compared to other alternative plans. The alternative plans with lower carryover storage (Alternative Plans 1, 2, and 3) would have a greater increase in flood space, up to 361 TAF at 90 percent exceedence in Alternative Plan 1.

The alternatives description provided in this chapter will be further developed to meet NEPA/CEQA requirements for the Draft EIS/EIR. As required by NEPA/CEQA, further information for the project description will include:

- Purpose and need for action and project objectives
- Location of the alternative and project features
- Construction activities and schedule
- Operational changes from and modifications to existing facilities
- O&M of proposed facilities
- Features incorporated into the proposed action’s design to avoid or reduce adverse environmental impacts (environmental commitments)

Table 4-11. Physical Accomplishments for Temperance Flat RM 274 Reservoir[1]

Alternative Plan	1	2	3	4
Physical Characteristics				
Temperance Flat RM 274 Reservoir Net Additional Storage Capacity (TAF) [2]	1,260	1,260	1,260	1,260
Total Carryover Storage Capacity (Millerton and Temperance Flat RM 274) (TAF)	540	540	540	665
Temperance Flat Carryover Storage Capacity (TAF)	200	200	200	325
Millerton Lake Carryover Storage Capacity (TAF)	340	340	340	340
Powerhouse Tailrace Elevation and Millerton Lake Carryover Storage Elevation (feet) [3]	550	550	550	550
Potential Physical Accomplishments [4]				
Dry and Critical Year Increase in Total Delivery (TAF)	19	24	30	21
Long-Term Average Annual Increase in Agricultural Delivery (TAF) [5]	30	49	52	41
Long-Term Average Annual Increase in M&I Delivery (TAF)	40	22	24	20
Long-Term Average Annual Increase in Total Delivery (TAF)	70	71	76	61
Long-Term Average Annual Spring-Run Chinook Abundance Increase–High SAR (percent) [6]	2.8%	2.8%	0.6%	4.9%
Dry and Critical Year Spring-Run Chinook Abundance Increase–High SAR (percent) [6]	15.9%	13.2%	14.6%	13.1%
Long-Term Average Annual Spring-Run Chinook Abundance Increase–Low SAR (percent)[6]	0.6%	-0.7%	-0.1%	2.8%
Dry and Critical Year Spring-Run Chinook Abundance Increase–Low SAR (percent) [6]	14.0%	9.2%	13.3%	11.1%
Emergency Water Supply Available during Delta Export Disruption (TAF) [7]	194	195	195	203
Change in M&I Water Quality at Edmonston Pumping Plant (mg/L TDS)	NE	NE	-1.7	NE
Net Increase in Friant Dam Hydropower Generation (GWh/year)	15.8	15.7	15.7	15.8
Replacement of Kerckhoff Hydroelectric Project Value (percent) [8]	81.1%	81.1%	81.1%	91.4%
Increase in Recreation (thousands of visitor-days) [9]	116.2	117.0	113.6	130.4
Increase in Incidental Flood Space (TAF) [10]	361	360	343	236

Notes:
[1] Operations based on Reclamation March 2012 CalSim II Benchmark with 2008/2009 BOs.
[2] Total storage of Temperance Flat RM 274 Reservoir would be 1331 TAF, with 75 TAF overlapping existing Millerton Lake.
[3] Elevation reported in NAVD 88.
[4] Accomplishments are reported as changes in comparison to No-Action Alternative.
[5] Simulated water demands in the Friant Division of the CVP are based on existing Class 1 and Class 2 contracts.
[6] Alternative plans are compared to the No-Action Alternative, which varies depending on the SAR.
[7] Emergency water supply represented by supply available for disruption due to 10-island levee breach.
[8] Impacts to Kerckhoff Hydroelectric Project will be mitigated. Costs include additional mitigation required after onsite replacement.
[9] Sum of potential annual visitor days at Millerton Lake and Temperance Flat RM 274 Reservoir.
[10] Incidental flood space is the flood space available during November through March at the 90 percent exceedance.

Key:
2008/2009 BOs = Formal ESA Consultation on the Proposed Coordinated Operations of the CVP and SWP (USFWS 2008a) and Biological Opinion and Conference Opinion on the Long-Term Operations of the CVP and SWP (NMFS 2009)
CVP = Central Valley Project
GWh/year = gigawatt hours per year
M&I = municipal and industrial
mg/L = milligrams per liter
NAVD = North American Vertical Datum
NE = not evaluated
SAR = smolt-to-adult return rate
RM = river mile
SWP = State Water Project
TAF = thousand acre feet
TDS = total dissolved solids

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