Chapter 5
Features and Potential Effects of Alternative Plans

This chapter provides an overview of the features and potential effects of the No-Action/No-Project Alternative and four groupings of alternative plans formulated for the Investigation. Major alternative components, accomplishments, primary effects, and economics of each of the four groupings of alternative plans are described.

Development of Alternative Plans

In addition to the No-Action/No-Project Alternative, the four groupings of alternative plans addressed in this chapter include the following:

- Temperance Flat RM 274 Reservoir
- Temperance Flat RM 274 Reservoir and Trans Valley Canal
- Temperance Flat RM 279 Reservoir
- Temperance Flat RM 279 Reservoir and Trans Valley Canal

The effects of the four groupings of action alternative plans are determined in comparison to the No-Action/No-Project Alternative. For each alternative plan grouping, several operational scenarios were formulated and evaluated to assess the sensitivity of accomplishments for the alternatives to varying operational strategies and assumptions reflecting various management measures.

As described in Chapter 4, alternative plans fundamentally consist of constructing new surface water storage facilities and operating them primarily to address the planning objectives of enhancing temperature and flow conditions in the San Joaquin River, and increasing water supply reliability. In addition to surface water storage measures (Temperance Flat RM 274 and RM 279 reservoirs), alternative plans consist of management measures retained in Chapter 4, as shown in Table 5-1. Many of these measures are included in all action alternative plans described in this chapter. Measures to increase transvalley conveyance capacity are included in two of the four groupings of alternative plans. Measures that were retained in concept only in Chapter 4 because of a lack of specific information (such as increasing groundwater storage) or because they are under study by others (such as enlarging Mammoth Pool Reservoir), are not explicitly defined for inclusion in alternative plans.

Table 5-1. Management Measures Retained for Alternative Plans

Management Measures Addressing Planning Objectives
Perform Reservoir Operations and Water Management
Balance water storage in Millerton Lake and new upstream reservoirs
Modify storage and release operations at Friant Dam
Integrate Friant Dam operations with SWP and/or CVP outside Friant Division
Increase Surface Water Storage in the Upper San Joaquin River Basin
Construct Temperance Flat RM 274 Reservoir
Construct Temperance Flat RM 279 Reservoir
Construct Water Temperature Management Devices
Construct temperature control devices on Friant Dam canal outlets
Construct temperature control device on Friant Dam river outlet
Construct selective level intake structures on new upstream dams
Management Measures Addressing Opportunities
Improve Management of Flood Flows at Friant Dam
Increase flood storage space in or upstream from Millerton Lake
Preserve and Increase Energy Generation and Improve Energy Generation Management
Construct new hydropower generation facilities on retained new surface water storage measures
Extend Kerckhoff No. 2 Powerhouse tunnel around new surface water storage measures
Preserve and Increase Recreation Opportunities in the Study Area
Replace or upgrade recreation facilities
Improve Quality of Water Supplies Delivered to Urban Areas
Integrate Friant Dam operations with SWP and/or CVP outside Friant Division

Key:
CALFED = CALFED Bay-Delta Program
CVP = Central Valley Project
RM = river mile
SWP = State Water Project

Evaluation Methods

This section describes evaluation methods used to assess the features and effects of alternative plans. Evaluation methods are described for engineering and cost estimates, reservoir water supply operations modeling, reservoir water temperature modeling, hydropower generation modeling, flood damage reduction modeling, recreation opportunities assessment, biological resources evaluations, recreation resources evaluations, cultural resources review, and economic assessments.

Engineering and Cost Estimates

Appraisal-level designs and cost estimates were prepared for features in each of the alternative plans, including dams and appurtenant features, pumping plants and/or powerhouses, TCDs, and affected facilities. The cost estimates were prepared at September 2006 price levels and are consistent with Reclamation cost-estimating guidance for appraisal-level cost estimates. Appraisal-level estimates are intended to be used to compare alternative plan features such as dam types, dam sites, and powerhouses or pumping plant capacities. Appraisal-level designs are based on standard practice with limited specific analysis, design optimization or estimated cost minimization.

Allowances for unlisted items and contingencies are included in the estimates of field costs to account for minor components not included in the estimates and for uncertainties, respectively. The allowance for unlisted items or design contingencies involved in constructing project components is estimated to be about 15 percent of the subtotal of feature line items and mobilization. The allowance for construction contingencies is estimated to be about 25 percent of the estimated contract cost (subtotal of feature line items with mobilization and unlisted items).

Estimated construction costs represent the sum of field costs and non-contract costs. Estimated non-contract costs include work or services provided by agency personnel, or acquisitions to facilitate project development, such as land acquisition, recreation facility replacement, environmental mitigation, and distributive costs for planning, engineering, design, and construction management. The allowance for planning, engineering, design, and construction management is estimated to be about 10 percent of the estimated field cost.

The total estimated capital cost (estimated construction cost and interest during construction) was annualized, and estimated annual costs were also included for O&M and power replacement, where applicable, to obtain the estimated annual cost for each alternative configuration. Cost estimates are presented in the economics section of this chapter for each alternative.

Reservoir Water Supply Operations Modeling

The effects of the alternative plans were simulated with CALSIM II (CALSIM), which is the joint DWR/Reclamation planning simulation model used to evaluate statewide water operations on a monthly time step. CALSIM includes an 82-year simulation period based on 1922 through 2003 hydrology. CALSIM encompasses the operations of major Sacramento River basin reservoirs, including Trinity, Shasta, Oroville, and Folsom; operations of major San Joaquin Basin reservoirs, including New Melones, Don Pedro, McClure, and Millerton; and operations of numerous smaller reservoirs. Current flow and regulatory standards throughout the water system are included as constraints in the model, including Delta salinity standards.

CALSIM's representation of the Friant Division was revised to incorporate operations that include Settlement Restoration Flow releases from Friant Dam. Canal diversions vary from year to year based on an annually varying water supply. The baseline CALSIM representation used in the analysis of system effects is the Future (2030) No-Action condition assumption in the Common Model Package.

CALSIM simulations were used to characterize the system effects of new storage, and provide a perspective on the level of magnitude of those effects. Complex water operations models such as CALSIM use operating rules and criteria to simulate water systems. The existing CALSIM operating rules were

developed and tuned to simulate the existing system. Inherently, these rules may not properly simulate how the system would operate with additional storage on the San Joaquin River. Many unknowns exist concerning the changes in institutional and regulatory commitments and requirements that may result from the effects of additional storage. To avoid speculation within the PFR analyses, the existing CALSIM rules and operational protocols were not adjusted. Therefore, the CALSIM model results should not be considered absolute, but instead used to provide general trends for comparing alternative plans.

Results from the CALSIM model are used as input to several other technical studies, including reservoir water temperature, hydropower generation, flood management, reservoir fisheries, and recreation evaluations. Because some of these assessments required operations data on a shorter time step, a procedure was developed to disaggregate monthly simulation results into daily output. Daily inflow, outflow, and reservoir storage were used for water temperature and reservoir fisheries analyses to provide insight on relative potential benefits and effects of alternatives. Refinements were made to CALSIM to represent operations of Friant Dam and upstream surface water storage measures integrated with operations of the CVP and SWP systems.

Reservoir Water Temperature Modeling

The CE-QUAL-W2 (W2) model was used to evaluate water temperature in simulated reservoirs. W2 is a two-dimensional (longitudinal and vertical) water quality and hydrodynamic model for rivers, estuaries, lakes, reservoirs, and river basin systems. W2 consists of directly coupled hydrodynamic and water quality transport models to represent basic eutrophication processes, such as temperature-nutrient-algae-dissolved oxygen (DO)-organic matter and sediment relationships. Inputs to the W2 model included inflow rates, inflow water temperature, meteorological data, bathymetry, and topography.

The W2 model for the Investigation was calibrated for 2004, 2005, and 2006 conditions in Millerton Lake. After calibration, river outlet releases at Friant Dam matched actual data with an error of less than 1 degree Celsius (ºC). Temperature profiles simulated with the Investigation model also agreed with measurements with an error of less than 1ºC. Inflow and outflow for the reservoirs in the W2 model are based on daily (disaggregated) output from the water supply operations model for a 20-year period of record, water years 1984 to 2003. This period is considered long enough to represent multiple water year-types, and short enough to allow the model to run in a reasonable time frame. The W2 model was applied to a variety of operational scenarios included in the alternative plans.

Because temperature dynamics for the San Joaquin River are not being simulated as part of the PFR, water temperature performance for alternative plans was evaluated based on cold water management flexibility as represented by the monthly multipliers (alternative divided by without-project condition) of

volume of cold water at specific target temperatures. All alternatives were simulated with SLISs for the Temperance Flat Reservoir alternatives and TCDs on Friant Dam river outlet and canal outlets.

Hydropower Generation Modeling

Preliminary energy estimates for generation at Friant Dam and Temperance Flat RM 274 and RM 279 dams were made using a spreadsheet approach based on output from the water operations models developed for the Investigation. Key features of the hydropower generation analyses include the following:

- Monthly time step calculations based on head and flow
- Generation unit capacity consistent with engineering assumptions
- Assumed peak and off-peak energy prices, as described in the economics section below
- Calculated peak and off-peak power use, generation, and values

The hydropower model also has a pumped-storage module which can simulate management of weekly water volume in a manner to maximize peak generation with off-peak pump back to upper reservoirs. Effects of the alternative plans on system-wide energy generation and usage for CVP and SWP facilities were evaluated using the LongTermGen and SWP Power California models.

Flood Damage Reduction Modeling

Flood damage reduction evaluations were completed using analytical tools and data developed by USACE and the Reclamation Board of the State of California (The Reclamation Board) for the Comprehensive Study (2002). Analytical tools developed for the Comprehensive Study were designed to support evaluations of flood management actions for the entire San Joaquin River basin. Hydrologic data include inflows to all major reservoirs operated for flood management, from Pine Flat Reservoir on the Kings River to New Hogan Reservoir on the Calaveras River. The USACE UNET hydraulic model used for evaluations represents all floodways, including river channels (leveed and nonleveed reaches) and bypasses. The Hydrologic Engineering Center's Flood Damage Analysis (HEC-FDA) flood benefits model used to evaluate economics represents damageable property in all areas subject to flooding from major flood management and conveyance systems in the entire San Joaquin River basin.

A series of evaluations was completed to estimate potential flood damage reduction benefits that would result from dedicating a range of additional flood storage space at or upstream from Millerton Lake. Evaluations also were performed to estimate potential incidental flood benefits that would accrue from alternative plans that do not include additional dedicated flood storage space. For the incidental flood benefit analysis, the monthly storage capacity that would be available at a 90 percent exceedence was identified for the without-

project condition and for all alternative plans. The minimum increase in available storage space between the without-project conditions and the alternative plans was identified, and the corresponding flood damage reduction benefit that would result from that amount of additional dedicated available space was identified as the potential incidental flood damage reduction benefit.

Biological Resources Evaluations

Biological resources evaluations during plan formulation were conducted for aquatic, plant, and wildlife species, including threatened, endangered, and sensitive species. Evaluations focused on effects of alternative plans on habitat and species in the primary study area.

Aquatic Biological Resources

The following sections describe evaluation methods for aquatic biological resources.

Habitat Evaluation Shallow water habitat analyses were conducted for centrarchid game species (black basses and sunfishes), which reside predominately in the shallow water margins of reservoirs. Mean surface areas between the reservoir surface and the 15-foot depth contour, the approximate lower depth of the principal spawning and rearing habitat of all the centrarchid species, were computed for each of several representative reservoir operations scenarios. Means were computed only for the months of April through September, because most spawning for these species occurs from April through June, and April through September are the most critical months for successful rearing. A 24-year period of record was used to calculate the mean values.

Effects of the alternatives on lotic (i.e., riverine or stream) habitat were evaluated by calculating how much stream habitat exists under current conditions with Millerton Lake at the top of active storage and how much would be inundated with each alternative at the top of active storage. These physical effects were expressed as lengths of stream habitat affected. Streambed gradient (i.e., stream slopes) of all lotic reaches was estimated from contour maps and digital elevation models. Certain species are less likely to use lotic habitat with slopes greater than 3 percent; therefore, length of stream habitat with slopes less than and greater than 3 percent was estimated. The numbers generated for the length of stream under each gradient category are approximations and are meant to be used for comparing the alternative plans only.

Species Evaluation Methods for evaluating effects of alternative plans on aquatic and fish species are described below.

Reservoir Species Results of the reservoir habitat analyses were combined with the known habitat requirements of the target reservoir species to assess species-specific effects of the alternative plans. For striped bass and American shad, analyses of effects were based on general information about projected reservoir

volumes and inundation zones of the alternative plans, including inundation of spawning habitat. For the two principal black bass game species, largemouth and spotted bass, life history-habitat spreadsheet models were developed using quantitative data on shallow water surface areas and reservoir surface elevations for each alternative. The models simulate spawning production of these species under the selected alternatives scenarios. The model outputs an index of total reservoir production rather than a true production estimate. Results of the model for largemouth and spotted bass were also used to determine likely effects of the alternatives on the other target centrarchids species, smallmouth bass, bluegill, and black crappie. Potential differences in the habitat requirements of the different species were considered in applying the model results to assess effects on the two sunfishes and smallmouth bass.

The largemouth and spotted bass spawning models were developed to simulate effects of changes in water level, shallow water surface area, and water temperature on production of these species. Only 21 years of production are simulated in the model because an initial 3 years of operations data are required to simulate effects of changes in reservoir elevations on habitat quality. The model was used to simulate production for several representative operations scenarios.

Lotic Species Species evaluations for the alternatives relative to lotic habitat were considered with regard to their effects on critical habitat elements of fish species and their life stage requirements. The length of useable habitat affected for each of the lotic species was calculated as the total length of lotic habitat affected by the alternative, multiplied by the percent of that habitat suitable for the species. For example, hardhead are less likely to use lotic habitat with slopes of greater than 3 percent; therefore, the total length of stream with slope of less than 3 percent was considered useable hardhead habitat. Streams considered for the lotic habitat analyses include the San Joaquin River and Big Sandy Creek.

The lotic habitat evaluation for rainbow trout was based on the assumption that this species occupies stream habitat with a gradient both greater and less than 3 percent, and potentially occurs in Big Sandy Creek and the San Joaquin River. Hardhead and Kern brook lamprey habitat analyses assumed these species mostly use habitat with a gradient of less than 3 percent. Although a 3-percent gradient is not a barrier to hardhead or to the Kern brook lamprey, these fishes are not likely present on a regular basis in higher gradient habitats. Therefore, the higher reach gradients were not included as useable habitat. Hardhead are known to occur in the San Joaquin River, but for purposes of the evaluation, it was assumed that they are also present where stream gradient is less than 3 percent in Big Sandy Creek. Within the primary study area, Kern brook lamprey were assumed to occur only in the San Joaquin River, and not in Big Sandy Creek. Hitch were captured within the primary study area, but outside the stream considered for lotic habitat analyses, in Fine Gold and Little Fine Gold creeks (Moyle et al., 1996). Hitch are not likely to be present within the

primary study area because green sunfish, a predator of hitch and other fish species, were captured in the lower reaches of Fine Gold Creek (Blumenshine, 2006). However, because no data exist proving or disproving their presence, hitch were included as a species present throughout the Fine Gold Creek watershed.

Terrestrial Biological Resources

Alternatives evaluations provided in this section for terrestrial biological resources are based on vegetation and wildlife studies conducted from February through July 2007 for the Investigation within the area inundated by the Temperance Flat RM 274 and RM 279 reservoir alternatives. Studies were conducted to describe baseline vegetation, habitat conditions, and plant and wildlife species occurrence, with an emphasis on special-status species. The comparative analysis presented in this chapter is limited to special-status species actually observed by biologists, and for which adequate data are available during plan formulation. For purposes of this analysis, special-status species refer to those that are legally protected or are otherwise considered sensitive by Federal, State, or local resource conservation agencies and organizations. Special-status taxa are species, subspecies, or varieties that fall into one or more of the following categories, regardless of their legal or protection status:

- Officially listed or proposed for listing by California or the Federal Government as endangered, threatened, or rare
- Candidate for Federal or State listing as endangered, threatened, or rare
- Taxa that meet the criteria for listing, even if not currently included on any list, as described in Section 15380 of the CEQA Guidelines
- Taxa designated as a special-status, sensitive, or declining species by other Federal or State agencies or nongovernmental organizations (including species classified as sensitive by BLM)
- Taxa considered by the California Native Plant Society (CNPS) to be "rare, threatened, or endangered in California" (Lists 1B and 2)
- Species identified by DFG as California species of special concern
- Animals fully protected under the California Fish and Game Code

Biologists mapped habitat in the field onto 1:2,400-scale (1 inch = 200 feet) rectified aerial photograph base maps. In addition, plant species composition data were collected in representative stands of each plant community type within the study area. Botanical surveys were conducted during April and May 2007 by walking meandering transects on public lands throughout the study area; the locations of rare plant species individuals and populations were recorded and mapped. Habitats were mapped using the Holland classification,

and the area of each habitat was calculated for each alternative plan. The resulting "ground-verified" geographic information system (GIS) layer is suitable for use in determining the extent of inundation-related effects of Investigation alternative plans on plant communities and potential habitat for plant and wildlife species, including special-status species.

Biologists also performed general wildlife surveys between February and July 2007, recording and mapping any special-status species observed. Habitat suitability was modeled for several species, including foothill yellow-legged frog, California tiger salamander, and western pond turtle. Modeled habitats were applied toward focused surveys for foothill yellow-legged frog and western pond turtle.

Special-status plant and wildlife species, identified through existing biological reports, literature, the California Natural Diversity Database (CNDDB), and discussions with local authorities and other biologists knowledgeable on the area's terrestrial resources, are summarized in tables that list species' habitat preferences and the likelihood of species occurring in the primary study area. Potential wildlife species distribution and potential occurrence of unmapped plant species are generally indistinguishable between the alternatives, and are not addressed in this PFR. Evaluations in this chapter summarize identifiable differences between the Temperance Flat RM 274 Reservoir and Temperance Flat RM 279 Reservoir alternative plans, based on data collected during plan formulation. General results for botanical and wildlife resources in both alternative plan areas are also summarized.

Habitat effects for alternative plans were compared using GIS. GIS was also used to summarize special-status botanical and wildlife species information for each alternative where geographical locations were recorded during data collection. Species-specific comparisons were reviewed where a species and its requisite habitat can be discerned between the Temperance Flat RM 274 Reservoir and Temperance Flat RM 279 Reservoir measures of alternative plans.

Recreation Opportunities Assessment

During plan formulation, analysis of the effects of fluctuating reservoir levels focused on the pool elevation of Millerton Lake, or a smaller Millerton Lake resulting from a dam located upstream at either of the Temperance Flat dam sites. This was because the majority of existing recreation opportunities that could be impacted by reservoir operations are on Millerton Lake, particularly in association with the facilities on the north and south shore at the lower end of the lake. More specifically, pool elevations for Millerton Lake during the key May-through-September peak water-based recreation season, under baseline conditions, were compared with the range most desirable for current use and the range that would occur under the alternatives. Reservoir operations would also influence the recreation opportunities available at the new Temperance Flat reservoirs created under the alternatives. Recreation opportunities and facilities

that could be developed at the new reservoirs would be influenced by operations, particularly by the pool elevations that are most likely to exist during the summer water-based recreation season, and seasonal fluctuation in pool elevation.

Recreation opportunities for the alternative plans were assessed using these reservoir pool elevations, and suitable characteristics for recreation site development and recreation development constraints. Suitable characteristics included favorable slope for development, road access, existing recreation sites for potential infill or expansion, and proximity to proposed shorelines. Recreation development constraints analyses included slopes unfavorable for development, inundated areas, sensitive species buffers, and several sensitive fish and plant habitat areas.

Recreation Resources Evaluations

Methods used during plan formulation for evaluating effects of Investigation alternatives on recreation resources are described below. Categories of effects to recreation resources include direct effects, indirect effects, and effects of reservoir balancing scenarios for alternatives on recreation resources.

Direct Effects

The direct effects of the alternative plans on recreation are those effects that result from inundation of recreation facilities, access roads, and undeveloped shoreline use areas due to increased maximum pool levels and new reservoirs. Direct effects to recreation facilities resulting from Investigation alternatives were estimated through mapping the maximum reservoir pool and identifying facilities affected by the alternative plans.

Indirect Effects

The indirect effects of the alternatives on recreation opportunities are those effects that result from the direct effects listed above, such as potential reductions in recreation use of various types due to loss of the facilities and shoreline land areas that support use. Other indirect effects that may occur relate to changes in the types and quality of recreation opportunities under the alternative plans. Estimates of indirect effects of the Investigation alternative plans are based on information such as the number and types of recreation visitors (e.g., shore-based day users, boaters, campers) who use individual facilities. Assessment of indirect effects is also based on existing descriptions and field observations of the types of recreation opportunities and settings currently existing in the study area, and similar qualitative information.

Cultural Resources Review

Evaluation methods during plan formulation for archaeological and historical structural resources, and historic and modern Native American resources, are described in this section.

Archaeological and Historical Structural Resources

The extent of archaeological surveys previously conducted varies widely across the primary study area for the alternatives sites. Also, survey methods and recording procedures have changed over time and between resources categories. For example, few low-density prehistoric artifact scatters and no buried sites (sites that lack obvious surface indicators) have been recorded, and historic-era sites often were not recorded; it appears that only prehistoric residential settlements and bedrock milling localities have been systematically discovered and recorded. Therefore, the archaeological inventory of the primary study area is not fully representative of all resources categories; the number of known resources varies widely between project alternatives largely because of the scale and nature of archaeological investigations; and the existing inventory is not fully comparable across the alternatives.

Sensitivity Analyses for Unsurveyed Areas To predict the total number of sites present within each alternative plan area, it was not practical to create simple site-density values based on known site quantities, for the reasons outlined above. Sensitivity analyses were conducted for prehistoric and historic-era sites to address data gaps using methods tailored to each data set. Results of the prehistoric and historic-era sensitivity analyses were integrated to provide quantitative, comprehensive sensitivity and effects assessments that take into account both documented and undocumented cultural resources (both archaeological sites and historic-era structures).

Prehistoric Sensitivity Analysis The prehistoric sensitivity analysis used existing data on survey coverage and sites from a larger area, along with selected environmental variables, to construct a statistical model to predict total site numbers for each alternative plan. A weights-of-evidence quantitative analysis predicted the overall density and distribution of sites. The analysis comprised several major components:

- Development of evidential themes, including slope, hydrology, distance to water, and soil type
- Compilation of a training-point theme (site locations)
- Weights calculations and model building

A larger regional database of archaeological sites and survey coverage was compiled. This analysis was extrapolated to the primary study area and, using the evidential themes, a single response theme was calculated to predict the overall probability for sites. This provided a quantitative basis for estimating the total number of prehistoric sites within the areas for surface water storage measures of alternative plans.

Historic-Era Sensitivity Analysis In contrast, the historic-era sensitivity study gathered archival data within the primary study area to make predictions regarding the range and number of potential historic-era resources (both structures and sites) by alternative plan, given that prior archaeological surveys did not appear to have systematically recorded historic-era sites and structures. The historic-era study relied more heavily on qualitative and categorical analysis to assess sensitivity for each alternative plan.

Archival information was derived primarily from Federal land records. Information was found for localities identified by Federal land surveyors who subdivided townships adjacent to the San Joaquin River in the late nineteenth century, and records of Federal disposition of the public domain to private individuals for homesteading, stock raising, mining, and other purposes.

Potential historic-era sites or properties were counted whose locations had been identified in historical documentation, but their existence had not been verified by field investigation. Historic-era buildings, structures, mines, towns, roads, and other features were identified and plotted as they appeared on historical maps. Historic-era mining claims and patents on the public domain, locations of mines reported in State Mineralogist and State Mining Bureau reports, and homestead patents were also tabulated. These sites, claims, and patents provide a basis for identifying more sensitive areas of potential historic-era resources in the future. Information on patterns of land use within the study area in the more recent past was derived from historical literature and the cultural information depicted on historical USGS topographic maps from 1912 to 1945.

Historic-Era and Modern Native American Resources

During the plan formulation phase of the Investigation, identification of Native American issues and resource locations was limited. The California NAHC was contacted to identify whether any recorded sacred sites were situated within the primary study area, and to obtain a recommended list of Native Americans to contact regarding the Investigation. Federally recognized Native American tribes were invited to begin the consultation process at an information meeting, followed by additional telephone contact to learn of their concerns regarding the Investigation, and to gain an initial sense of where sensitive resource localities are situated within the primary study area. Unrecognized tribes and individuals were contacted who provided valuable information for the Investigation. Also, in-person visits were made to tribal members to collect information.

Economics Assessments

The P&G (WRC, 1983) established four accounts to facilitate evaluation and display of alternative water resource plans:

- NED – Effects on the national economy, expressed in monetary units. NED benefits are the increase in value of national output of goods and services expressed in dollars. NED figures measure benefits to the Nation, rather than to a particular region.

- Regional Economic Development (RED) – Regional incidence of economic effects, income transfers, and employment.

- Environmental Quality (EQ) – Effects on ecological, cultural, and aesthetic attributes of significant natural and cultural resources that cannot be measured in monetary terms.

- Other Social Effects (OSE) – Urban and community impacts and effects on life, health, and safety.

The categories identified in the Investigation for potential NED benefits include agricultural and M&I water supply reliability, ecosystem enhancement, M&I water quality, emergency water supply, hydropower, recreation, and flood damage reduction. Evaluation methods were developed for those categories in which direct quantitative information would be available from the technical studies completed during plan formulation. Regional economic analyses were performed for the RED account, and the EQ and OSE accounts were addressed more generally in this phase of the Investigation. All economics assessments are considered preliminary and will be refined as the feasibility study progresses.

National Economic Development Account

Potential NED benefit categories and the associated evaluation methods used are summarized in this section.

M&I Water Supply Reliability Benefits Potential M&I water supply reliability benefits were estimated based on changes in M&I deliveries to SOD SWP M&I contractors. Changes in M&I deliveries to Friant Division contractors and other CVP M&I contractors resulting from the alternative plans were very small, and were not considered in the economics analysis at this stage. Friant Division M&I contracts account for about 8 percent of total Class 1 contracts and CVP M&I contracts are less than 7 percent of total SOD CVP water service contracts. The potential benefits to M&I water users are measured according to the estimated cost of the most likely alternative water supply that would be pursued in the absence of development of the alternative plans. For potential water supply reliability benefits, the estimated cost of the most likely alternative plan represents the next unit of water supply the water user would purchase or develop if the additional storage were not in place. The

estimated cost of the most likely alternative plan assumes that if the preferred alternative plan is not implemented, the alternative action most likely to take place provides a relevant comparison. If the preferred alternative plan provides the same output as the most likely alternative plan at a lower estimated cost, the net potential benefit of the preferred alternative plan is equal to the difference in the estimated project costs.

The analysis performed relies in part on market prices paid to purchase water on an annual basis from willing sellers. The market prices are reported according to the payments made directly to the sellers. The buyers incur additional costs to convey the water to their M&I service areas. These estimated costs include both conveyance losses that diminish the volume of water delivered to end users as well as wheeling and power charges. The conveyance costs are estimated for M&I water users benefiting from the alternative plans and added to the estimated market prices to acquire the water to develop an estimate of the willingness to pay for additional water supply. Two equations were applied to estimate the potential economic benefits of increased M&I water supplies. The first equation was used to forecast prices when volume of water traded is an explanatory variable. The second equation was used to estimate the volume of water traded in the market. Quantity traded can be estimated to project the volume of water traded over a 100-year period. The model was estimated using data from 1990 to 2007.

Agricultural Water Supply Reliability Benefits Direct potential agricultural water supply reliability benefits associated with the alternative plans were estimated according to changes in net revenue to agricultural producers within the Central Valley resulting from changes in agricultural deliveries to Friant Division and other CVP and SWP contractors. Improvements in surface water supply reliability to agricultural producers would result in less temporary crop idling and avoidance of obtaining more costly alternative water supplies, among other effects. The additional farm income generated through increased production opportunities and avoided production costs would result in direct potential economic benefits to the region. In addition, improvements in surface water deliveries would reduce reliance on groundwater, thereby reducing aquifer drawdown over time.

Regional agricultural water deliveries from CALSIM are used as inputs to the agricultural production model (CVPM). In this analysis, changes in 2030 groundwater pumping lifts among project alternatives are estimated for the Friant Division as well as adjacent agricultural production regions, and incorporated into the CVPM. Key output from the CVPM includes irrigated acres, net revenue, and gross revenue.

Hydropower Benefits As explained previously, all alternative plans evaluated would affect energy generation and use in the upper San Joaquin River watershed and, to a limited extent, at CVP and SWP facilities. The value of the energy used or generated was calculated using 5-year average monthly Dow Jones South of Path 15 (SP15) wholesale energy prices.

For alternative plans that adversely affect hydropower generation, it is assumed that impacted energy would be recovered to the extent possible using hydropower measures included in the plans. Potential hydropower benefits are presented as net benefits. If the estimated value of energy generated by an alternative plan exceeds the value of lost energy generation from the without-project condition, the difference in value is recorded as a positive benefit. If the estimated value of energy generated by an alternative plan is less than the value of lost energy generation compared to the without-project condition, the difference in value is recorded as a negative benefit.

Flood Damage Reduction Benefits Increased dedicated flood storage space is not included in alternative plans. Evaluations completed in previous phases of the Investigation demonstrated that potential flood damage reduction benefits resulting from incidental availability of flood storage space would be similar to those that would result from the dedication of additional flood storage space.

Recreation Benefits Potential recreation benefits are estimated based on changes in consumer surplus for various activities, such as boating, picnicking, camping, swimming, and fishing. The valuation of potential benefits for recreation would abide by a willingness to pay framework, as required by the P&G. Recreation is primarily a nonmarket good, and nonmarket potential benefits quantification is often difficult and time consuming. The "benefits transfer" approach was used to derive an estimate of consumer surplus, by applying estimates of willingness to pay values for the same nonmarketed commodity to the Investigation alternatives.

To develop an estimate of recreation enhancement, a model was developed to incorporate available information on visitation and economic values, and an assessment of the relationship of lake level to activities. The results of the qualitative recreation assessment were incorporated into the visitation model according to the degree of change anticipated. The model then estimated the change in recreation by activity type on an annual basis. By applying recreation visitor-day values, the results of the analysis predict the potential net economic benefits of recreation. The economic user-day estimates of consumer surplus require refinement in the future to ensure that they properly reflect conditions at Millerton Lake. It is expected that there would be a large proportion of new visitors with potentially different expenditure patterns. These factors would lend uncertainty to the estimate such that the true economic value could be as much as 25 percent higher. The recreation benefits reported in the PFR are based on the recreation model estimates increased by 25 percent.

M&I Water Quality Benefits In general, potential economic benefits of water quality improvements are measured by changes in consumer and producer surplus, and defined as the willingness to pay for an environmental improvement. In this context, it is often measured in terms of damages (increased costs of production and decreased output).

Water quality improvements resulting from the alternative plans are valued in the Investigation using a combination of methods addressing both demand and supply of treated water. A least-cost alternative approach involves valuation of the reduction in treatment costs attributable to improvements in raw water quality facilitated by the exchange. An important assumption in the valuation of water quality benefits using this approach is that the urban water providers would attain the same level of finished water quality with or without an exchange. The approach also assumes that any reduction in finished water price resulting from the exchange would not measurably affect urban water demand.

A literature review of potential water quality benefits estimation methods was performed. In addition, an operations model developed previously by MWDSC and Reclamation was used with some simplifying adjustments. The model provides a means to estimate cost savings to consumers of water provided by MWDSC, identified in categories of residential, commercial, industrial, agricultural, and utilities. Cost savings are also measured to users of groundwater within the service area, and to purchasers of recycled water. The model was used to develop preliminary quantitative estimates on the net economic benefits associated with M&I water quality improvement, assuming that treatment cost savings to MWDSC are passed along to consumers.

While cost savings can provide a reliable measure of economic benefits to consumers, it may represent an underestimate of the total benefit. Economic theory indicates that if the willingness to pay by consumers exceeds the cost savings they would realize, the benefits may be higher than cost savings alone. In the case of water quality for customers of MWDSC, there is strong indication that this may be true: MWDSC and CALFED have developed focused efforts to resolve salinity problems in MWDSC's source water, and the salinity of Colorado River water is forecasted to continue to increase in concentration. For water quality benefits reported in the PFR, the cost savings modeling results were increased by 50 percent to capture possible willingness to pay. These estimates were reasonable compared to other findings in the literature.

Emergency Water Supply Benefits The alternative plans could provide one source of short-term emergency supplies to SOD water users in the event of a disruption in Delta water supplies from a levee failure from a seismic event in the Delta that would disrupt the ability to pump water south out of the Delta. In addition to natural events, future environmental constraints may periodically limit the amount of imported water that can be delivered through Delta pumping facilities. This analysis considers the emergency water supplies available to urban water users. A variety of factors may influence potential water supply

disruptions to SOD urban water users, including the vulnerability and availability of non-Delta water supplies and the timing and duration of the supply disruption. Water from the alternative plans could be immediately available to SOD water users (either directly or through exchange), since the water would already be stored south of the Delta.

Key considerations in estimating the economic cost of water supply disruptions include the probability that a supply disruption would occur; duration and timing of the supply disruption; and level of water supply shortage to urban water agencies. Supply disruptions could arise from a variety of human and natural conditions. Various estimates exist of the probability of levee failures from seismic and flood events. This analysis relies on estimates of levee failures due to seismic events only. Similarly, this analysis assumes that seismic events that result in a small number of levee breaches do not result in significant water shortages to urban water suppliers. This analysis is limited to longer disruptions, as characterized by a 20-Delta island levee breach scenario. Annual probability was used to estimate risk-adjusted annual emergency water supply benefits for the 20-Delta island levee breach scenario. Information regarding the probabilities of Delta levee failures, potential levee failure scenarios, and associated projected shortages south of the Delta, were based on information developed for the Delta Risk Management Strategy (DRMS) (DWR, USACE, and DFG, 2007). The estimated water supply deficit from SWP and CVP operations subsequent to the Delta island levee breach scenario was simulated with the Water Analysis Module (WAM).

This analysis does not consider water transfers and does not account for the availability of local supplies to alleviate urban water shortages. As a result, the economic benefits of emergency water supplies may be overstated. Additional research would be required to fully consider these factors. As a first approximation, 40 percent of the water supply deficit estimated in WAM is assumed to accrue to urban water agencies. Urban water shortages were then estimated by comparing the average monthly deficit to the average monthly urban water demand. The amount of water available for emergency purposes from the alternative plans was estimated as the amount of water in storage in Millerton Lake and Temperance Flat Reservoir (RM 274 or RM 279) above the Millerton Lake storage in the without-project conditions. In most cases, the water available from the alternative plans would be less than the urban water supply shortage.

Economic benefits from emergency water supplies are measured according to water users' willingness to pay to avoid interruptions in water deliveries. Estimated benefits were weighted according to the probability of a Delta water supply disruption. The emergency water supply benefits will be refined in the feasibility phase of the Investigation.

Ecosystem Benefits The alternative plans provide opportunities for enhancement of water temperature in the San Joaquin River as a means of improving habitat conditions for Chinook salmon restoration efforts. The economic benefits from temperature improvement are estimated based on the application of benefit transfer methods from applicable studies that addressed habitat improvements, combined with efforts to isolate the contribution from improvement to the temperature attributes. The ecosystem benefits are considered preliminary and will be refined in the feasibility phase of the Investigation.

One of the goals of the SJRRP is to restore and maintain populations of Chinook salmon and other fish in the San Joaquin River from Friant Dam to the Merced River. Although the SJRRP has not finalized an assessment of specific requirements for the fish species, a number of experts have identified features and physical and biological conditions that would be necessary for a naturally reproducing Chinook salmon population in the upper San Joaquin River, and the SJRRP Team developed some initial Chinook salmon temporal occurrence and environmental requirements (SJRRP, 2007b). These initial requirements focus on identifying primary habitat conditions and limiting factors related to the spawning and rearing life stages of both spring- and fall-run Chinook salmon. They include, for example, monthly minimum flow levels, optimal depths, presence and characteristics of gravels, and maximum water temperatures.

The preliminary temperature requirement tables developed for the SJRRP were considered in combination with simulated Friant Dam release temperature exceedence probability curves for the alternative plans to assess the extent to which additional storage and the use of temperature control devices could further enhance water temperature conditions in the San Joaquin River at Friant Dam compared to the assumed without-project conditions (restoration releases and no additional storage). River temperature modeling has not been performed during the plan formulation phase of the Investigation, but will be performed during the feasibility phase to determine the downstream extent of potential water temperature improvements compared to the without project conditions.

The economic benefit associated with temperature modification for salmon habitat is difficult to measure, and there are no known directly comparable studies that focus on the benefits of temperature improvements alone on which to draw for guidance. Nevertheless, if temperature modification can be shown to improve biological conditions and lead to increased survival of salmon populations, an economic benefit, at least in theory, can be attributed to the improved temperature conditions resulting from the TCDs, operations, and additional cold water volume. For the purposes of this PFR Investigation, a preliminary estimate was developed in order to assess a reasonable approximation of the quantity of this benefit. Extensive literature exists with efforts at valuing fisheries, including salmon. A benefits transfer estimate from the literature was developed using parameters of the region's population and number of households, both present and forecasted, in combination with

assumptions about the limiting factors for survival of salmon. Particular emphasis was placed on the spawning and incubation period occurring in the fall months of the year. Other ecosystem benefits that were not quantified are encompassed in the EQ account.

Regional Economic Development Account

A regional economic analysis of the direct effects of the alternative plans was performed to satisfy the requirements of the RED account. The analyses incorporate changes in agricultural output and recreation for the alternatives. The changes in hydroelectric power generation would affect statewide residents in terms of electricity rates; however, preliminary results indicate the changes would be very small at the statewide level, and were not included in the analysis. A regional analysis has not been conducted for other potential direct impacts, including changes in M&I water quality, flood damage reduction, or other areas potentially affected by the storage alternatives.

Two input-output (I-O) regional economics models, based on IMPLAN software, were developed for regional economic analyses specific to the Investigation. The models are used to measure the indirect impacts that changes in crop production and recreation-related expenditures (or other direct impacts) may have on the regional economy, in terms of changes in industry output, employment, and income. The first model incorporated economic activity in the six-county region surrounding the Friant Division; the six counties are Fresno, Kern, Kings, Madera, Merced, and Tulare.

A second regional economic impacts model was developed to address impacts at the California statewide level. This model is intended to capture effects of the alternative plans that transcend the Friant Division, affecting residents and businesses throughout the State. In general, even when a project is concentrated in a particular region and sector, economic activity (sales and purchases) typically extend beyond that area, both directly and indirectly. For example, agricultural inputs such as seed, fertilizer, insurance services, and fuel and transportation often originate outside the region of emphasis. After accounting for direct sales and purchases, the indirect and induced transactions that result from income changes and secondary impacts broaden the boundaries of the originally affected area. The multidisciplinary nature of the proposed alternative plans would result in categories of effects that are more likely to accrue outside the six-county Friant Division. These include M&I water quality benefits, M&I water supply, emergency water supply reliability, and ecosystem benefits. For this reason, a statewide model is best able to capture the economic effects on the larger scale.

Environmental Quality and Other Social Effects Accounts

Detailed information regarding the EQ and OSE accounts has not been developed at this stage of the feasibility study. Preliminary summary alternative comparison information for the EQ and OSE accounts is included in Chapter 6.

Unquantified Benefits The alternative plans would provide benefits that would accrue to the general public but could be difficult to quantify on a monetary scale. For the alternative plans, these "unquantified benefits" could include the following:

- Habitat function and services
- Biodiversity, including endangered species recovery
- Water management system operational flexibility
- Climate change adaptation

These benefits would not be included in the NED account under the P&G, but the State emphasizes the importance of these benefits in evaluating alternative plans. These public benefits could be considered relevant to the EQ and/or OSE accounts. While not explicitly quantified, they are discussed and recognized by economists as positive in value and essentially additive to the monetized annual benefits for the alternative plans.

Ecological functions provided by riverine ecosystems generate value either because they induce specific economic uses or because they themselves are valued. Not all values can be measured in the market, and not all values can or should reasonably be measured in quantitative terms. A commonly accepted framework that provides an organization to goods and services includes market and nonmarket values, with subcategories of use and non-use values. "Nonmarket use values" include recreation, flood damage reduction, and water quality improvement. These categories are difficult to measure and are being continually refined. "Non-use values" are more difficult to quantify, and the methods for doing so not as generally accepted. This category of benefits includes the following:

- Option value – Willingness to pay to retain the opportunity for future use of the resource
- Existence value – Willingness to pay to know that a resource continues to exist, whether the payer enjoys or uses the resources directly
- Bequest value – Willingness to pay to ensure that a resource is available for both current and future generations
- Philanthropic value – Willingness to pay to ensure that a resource may be enjoyed by others

Examples of additional benefits not directly related to ecosystem improvements that are difficult to quantify include water management flexibility and climate change adaptation. Additional surface storage provided by the alternative plans could provide flexibility to the State's constrained water management system that cannot be provided by other management actions. Flexibility created within the water management system would likely prove to be essential in developing solutions to Delta ecosystem challenges. Surface water storage could also be useful in mitigating lost snowpack storage due to climate change, and in responding to other unforeseen circumstances. While approaches may exist for quantifying these benefits categories, the P&G require reliance on generally accepted practices that may not be available.

No-Action/No-Project Alternative

This alternative represents future conditions that would occur if none of the action alternatives are implemented. The No-Action Alternative provides the basis for comparison with potential action alternatives, consistent with the P&G (WRC, 1983) and NEPA guidelines. The No-Project Alternative provides a basis for comparison with potential action alternatives, consistent with CEQA guidelines. CEQA also requires that the No-Project Alternative be compared to the existing conditions. For the Investigation, the No-Action Alternative and the No-Project Alternative are based on the same assumptions, and are defined by the same conditions. Under the No-Action/No-Project Alternative, the Federal Government and the State would take no additional action toward implementing a specific plan to enhance water temperature and flow conditions in the San Joaquin River, or to help address the growing water supply reliability issues in California.

The following section highlights the consequences of implementing the No-Action/No-Project Alternative as they relate to the planning objectives and opportunities of the Investigation. For feasibility studies of potential water resources projects, the No-Action/No-Project Alternative is intended to account for various resources conditions today and to show how those conditions are expected to change over the foreseeable future.

Water Temperature and Flow Conditions in the San Joaquin River

As described in Chapter 2, the ability to manage cold water, release water from Friant Dam at suitable temperatures, and to provide for Restoration Flows during critical-low years, may be challenges to fully meeting the Restoration Goal of the Settlement.

Water Supply Reliability

Under the No-Action/No-Project Alternative, more reliance would be placed on shifting water uses from such areas as agricultural production to urban uses. With continued and deepening shortages in available water supplies, it is likely that increasing adverse economic effects would occur over time in the Central Valley and elsewhere in California, including higher water costs resulting in a further shift in agricultural production to areas outside California and/or outside the United States. Groundwater basins in the eastern San Joaquin Valley would remain in a state of overdraft in most years, and substantial water supply reliability problems would remain in the Friant Division of the CVP. The continued downward trend in groundwater levels may also result in localized areas of impaired groundwater quality.

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

Residual risks to human life, health, and safety along the upper San Joaquin River remain. Development in flood-prone areas has exposed the public to the risk of flooding. Storms producing peak flows, and volumes greater than the existing system was designed for, can occur, and result in extensive flooding along the upper San Joaquin River. Under the No-Action/No-Project Alternative, the threat of flooding would continue.

California's demand for electricity is expected to substantially increase in the future. Under the No-Action/No-Project Alternative, no new hydropower facilities would be constructed to help meet this growing demand. As the population of the State continues to grow, demand would grow considerably for water-oriented recreation at and near the lakes, reservoirs, streams, and rivers of the Central Valley. This increase in demand would be especially pronounced at reservoirs near urban areas, such as Millerton Lake near Fresno. Water quality conditions in the San Joaquin River would likely improve through implementation of various projects and programs in the study area. The extent of San Joaquin River water quality improvements resulting from these activities is unknown.

Local water agencies would likely have more difficulty achieving their overall water quality objectives under the No-Action/No-Project Alternative compared to existing conditions. As local substitute supplies to Delta exports are relied on more heavily, and rising demands for water in the Central Valley continue to exert pressure on the Delta, it would become more difficult and costly for water agencies to provide high quality water in the future without actions to improve the quality of water supplies delivered to urban areas.

Temperance Flat RM 274 Reservoir Alternative Plans

This section describes the components, accomplishments, potential effects, and economics of the Temperance Flat RM 274 alternative plans.

Plan Components

Temperance Flat RM 274 Reservoir would be created through constructing a dam in the upstream portion of Millerton Lake at RM 274.

Surface Water Storage Measures

The Temperance Flat RM 274 Dam site is located approximately 6.8 miles upstream from Friant Dam and 1 mile upstream from the confluence of Fine Gold Creek and Millerton Lake. Permanent features would include a main dam with an uncontrolled spillway to pass flood flows, a powerhouse to generate electricity, and outlet works for other controlled releases. Upstream and downstream cofferdams would be required for river diversion, and to keep Millerton Lake out of the construction zone. Diversion tunnels to route river flows around the construction zone would be required during construction. Figure 5-1 shows the extent of Temperance Flat RM 274 Reservoir and power features, and affected features in the reservoir area.

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

RCC and embankment dam types have been recently considered for the RM 274 dam site, and a formal decision has not yet been made regarding which dam type would be selected. Embankment dam types were assumed for the designs and cost estimates in the PFR. The dam would be about 640 feet high, from about elevation 365 in the bottom of Millerton Lake (San Joaquin River channel) at the upstream face to the dam crest at elevation 1,005. No saddle dams would be required.

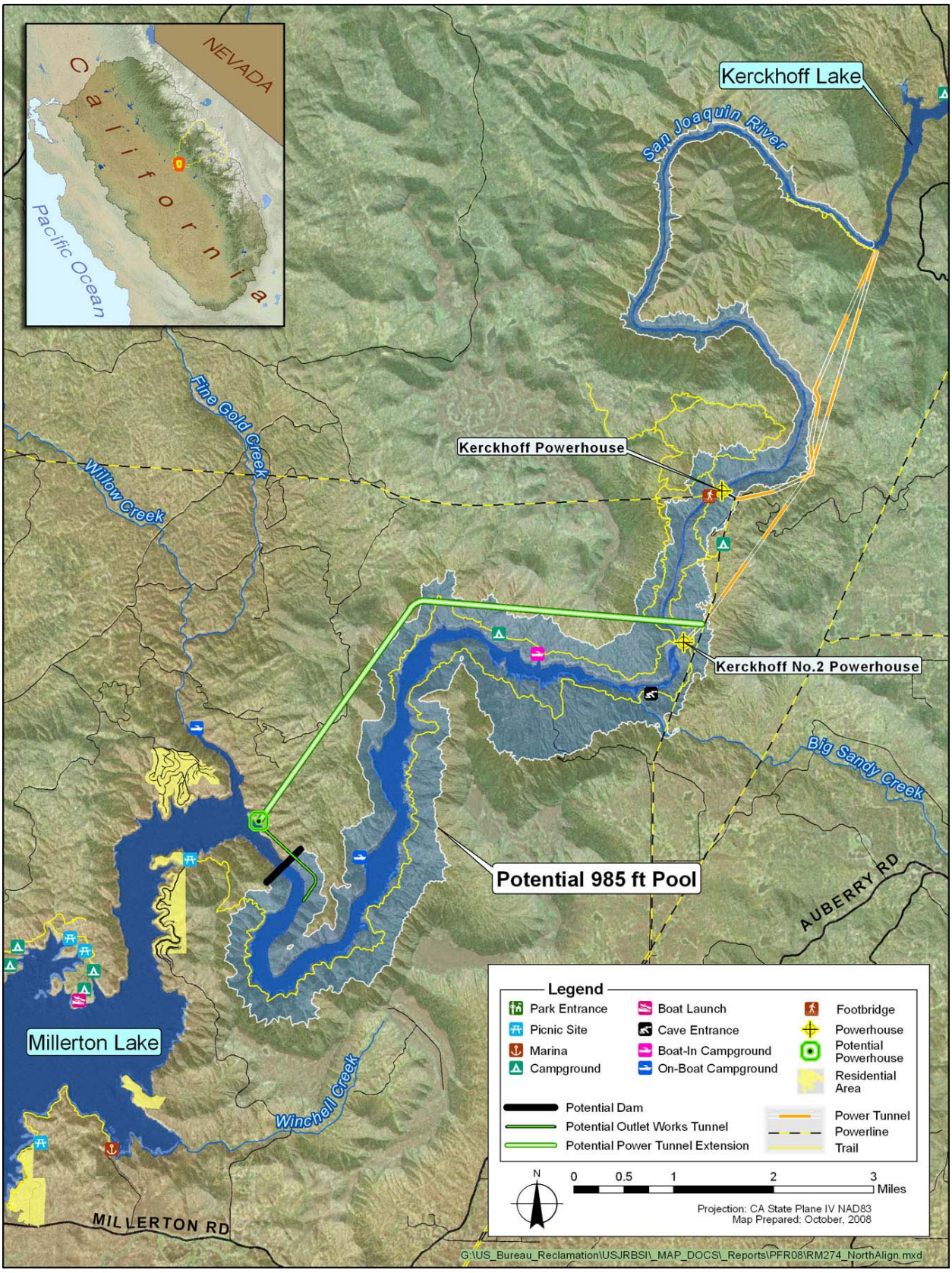

Figure 5-1. Potential Temperance Flat RM 274 Reservoir

Water Temperature Management Measures

Potential water temperature management measures include a SLIS on the main dam and TCDs on Friant Dam. A multiple-port SLIS could be constructed for Temperance Flat RM 274 Dam to improve management of the cold water pool in the reservoir for releases to Millerton Lake. The SLIS would be designed and operated to withdraw water from the highest level in the reservoir that would meet temperature targets, thereby preserving colder water at lower elevations in the reservoir. Without a SLIS, water would be drawn from the reservoir at the same elevation as the outlet works.

A steel TCD would be constructed for the Friant Dam river outlet and would be operated in a manner similar to above. TCDs also could be constructed on the canal outlets at Friant Dam to divert warmer water from the upper portion of the reservoir and preserve colder water for release to the river.

Energy Generation Measures

Temperance Flat RM 274 Reservoir would inundate the PG&E Kerckhoff and Kerckhoff No. 2 powerhouses. These facilities would be decommissioned and abandoned. Temperance Flat RM 274 Reservoir alternative plans include features to mitigate the loss of generation from the Kerckhoff Project powerhouses. These would involve modifying and extending the Kerckhoff No. 2 powerhouse tunnel to route water from Kerckhoff Lake to a new powerhouse and release valves downstream from Temperance Flat RM 274 Dam that would discharge into Millerton Lake, as shown in Figure 5-1. Tunnel extension alignments both north and south of the San Joaquin River have been considered; the northern alignment was assumed for the appraisal-level designs and cost estimates in the PFR. Water not routed through the extended tunnel would flow into Temperance Flat RM 274 Reservoir. This configuration would make use of the relatively constant head in Kerckhoff Lake to maximize power generation. The powerhouse would have a capacity of 135 MW, with 120 MW from three 40-MW units on the extended Kerckhoff No. 2 tunnel, and one 15-MW unit on the outlet works tunnel from Temperance Flat RM 274 Reservoir. The power features are subject to change as the feasibility study progresses.

During normal releases, all flows would pass through the turbines. During turbine outages, the outlet valves would be operated as necessary to maintain water operations flows. During periods of high inflow, the outlet works release valves could be used to supplement releases, in combination with the spillway, as necessary.

Reservoir Operations and Water Management Measures

Temperance Flat RM 274 Reservoir could be operated under a variety of scenarios that each could provide potential benefits to different purposes. For all operations scenarios, the primary focus would be increasing water supply reliability and enhancing water temperature conditions in the San Joaquin River. To the extent possible without impacting the primary purposes, the reservoir

also would be managed to improve opportunities for hydropower generation and recreation. Potential flood damage reduction benefits would be achieved through the incidental effect of additional available storage space.

Alternative plans for Temperance Flat RM 274 Reservoir were evaluated under six distinct operations scenarios associated with the reservoir operations and water management measures. These scenarios vary according to the options applied for the extent of operations integration, available transvalley conveyance, and reservoir balancing. These three options within the six operations scenarios are summarized in Table 5-2 and described in the following sections.

Table 5-2. Six Reservoir Operations Scenarios Simulated for Temperance Flat RM 274 Reservoir Alternative Plans

Alternative Plans	Operations Integration Options	Transvalley Conveyance Options	Reservoir Balancing Options
Temperance Flat RM 274 Reservoir	Friant Only	N/A	Millerton Baseline
	SWP/Friant	AE	Millerton Baseline
	SWP/Friant	SW/CVC/AE	Millerton Baseline
	CVP/Friant	SW/CVC/AE	Millerton Baseline
	SWP/CVP/Friant	SW/CVC/AE	Millerton Baseline
	SWP/CVP/Friant	SW/CVC/AE	Millerton High

Key:
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
N/A = not applicable
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project

Operations scenarios vary, in part, on the degree to which Friant Dam would be operated in a coordinated manner with other CVP and SWP facilities (operations integration). The level of operations integration, in combination with additional storage, has the potential to affect the geographic extent, type, and magnitude of potential water supply benefits that could be achieved with alternative plans for each reservoir site.

At the simplest level, operations with additional surface water storage would be integrated with Friant Division demands in the same manner as Friant Dam in the No-Action Alternative (Friant-only integration). Under this operations integration option, potential water supply benefits would be provided to the Friant Division only.

Operations integration with the SWP and/or CVP would include coordinated management of water supplies in Millerton Lake and new storage with project operations of SOD facilities. This would involve delivery of water supplies to the Friant Division in combination with water exchanges between the Friant Division and SWP and/or other CVP service areas. Some SWP or CVP Delta water supplies diverted to San Luis Reservoir would be delivered to water users in the Friant Division while San Joaquin River water would be stored in the new reservoir. This would provide additional available storage space in San Luis

Reservoir during wet periods, which would allow export of additional supplies from the Delta. Accumulated San Joaquin River water supplies would be provided through exchange to SWP and/or CVP SOD water users at a later time, depending on the operations scenario. Operations integration in this manner would result in additional water supply quantities compared to a Friant-only integration, and would expand the geographic extent, type, and magnitude of potential project benefits. Four distinct operations integration options were developed and applied to alternative plans involving Temperance Flat RM 274 Reservoir, as shown in Table 5-2.

The ability to accomplish the transvalley water exchanges that facilitate operations integration of surface water storage with the SWP and/or CVP systems depends on available conveyance capacity. Most of the simulations performed for the alternative plans assume available transvalley conveyance capacity in the Shafter-Wasco Pipeline (SW), Cross Valley Canal (CVC), and Arvin-Edison Canal (AE). Assumed capacity is 200 cfs for the SW, 800/500 cfs minus existing use for forward (west to east)/reverse (east to west) capacity of the CVC, and 200 cfs minus existing use for the AE. The Friant-Kern Canal and California Aqueduct are also necessary conveyance components for water exchanges. Unused capacity in the Friant-Kern Canal and California Aqueduct for operations of the alternative is assumed to be equivalent to current operations. Assumptions regarding transvalley conveyance routes and capacities are preliminary and will continue to be refined as the Investigation progresses.

Two reservoir balancing options were applied to represent a range of operations for balancing water storage levels between Millerton Lake and Temperance Flat RM 274 Reservoir. One balancing option would maintain Millerton Lake storage levels at the average monthly storage level from simulation of without-project conditions with the Settlement (Millerton Baseline). A second balancing option would set a priority for maintaining Millerton Lake levels higher during the recreation season (Millerton High).

Potential Accomplishments

This section summarizes the potential accomplishments of the Temperance Flat RM 274 Reservoir alternative plans, including water supply reliability, water temperature, energy generation, flood damage reduction, M&I water quality, recreation opportunities, emergency water supply, and ecosystem enhancement.

Water Supply Reliability

Table 5-3 summarizes average annual changes in water deliveries for the Temperance Flat RM 274 alternative plans, based on CALSIM simulations. The reservoir balancing options would have minimal effect on deliveries and are not shown. The operations scenario involving the SWP, CVP, and Friant Division would produce the largest increase in delivery, followed by CVP/Friant and SWP/Friant operations integration.

Table 5-3. Average Annual Change in Delivery for Temperance Flat RM 274 Reservoir Alternative Plans

Item	Operations Integration[1]				
	Friant Only	SWP/ CVP/ Friant	SWP/ Friant	CVP/ Friant	SWP/ Friant
		Transvalley Conveyance			
		SW/CVC/AE			AE
Total (TAF)					
Dry & Critical Years[2]	112	168	171	120	116
All Years	112	180	158	167	125
Friant Division (TAF)					
Dry & Critical Years[2]	112	106	106	109	107
All Years	113	107	107	110	109
CVP (TAF)					
Dry & Critical Years[2]	-4	21	-4	46	2
All Years	-4	38	-2	66	0
SWP (TAF)					
Dry & Critical Years[2]	4	41	68	-35	7
All Years	4	35	53	-10	16

Notes:

1 Reservoir balancing option has negligible effect on water deliveries and was not included in this table.

2 All dry & critical values are reported based on Sacramento River Index. Reporting of changes in Friant Division deliveries based on San Joaquin River Index would result in higher dry and critical year values.

Key:

AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project
TAF = thousand acre-feet

For operations integration beyond the Friant Division, the simulations showed minimal effect on Friant Division deliveries because the Friant Division was given priority over SWP and CVP to conveyance within the Friant-Kern Canal. SWP delivery also decreased when CVP was added to SWP/Friant integration. The decrease in simulated SWP delivery is due to SWP/CVP competition for limited storage and conveyance capacities, and the CVP is given priority over the SWP in the simulations. The last column in the table assumes transvalley conveyance capacity is only available in AE, and illustrates the sensitivity of delivery results to available conveyance for exchanges. For the SWP/Friant integration option, annual average SWP delivery decreased by about 50 TAF when conveyance capacity was assumed to be limited to AE.

On average, the Temperance Flat RM 274 Reservoir alternative plans would provide between 112 to 180 TAF per year of additional agricultural and M&I water deliveries, depending on operations scenario. In general, the CVP/Friant integration option was not carried forward from the water supply reliability assessment into the dependent analyses (temperature, power, water quality, emergency water supply, and economics).

Emergency Water Supply

Table 5-4 presents estimated annual emergency water supply benefits for the Temperance Flat RM 274 Reservoir grouping of alternative plans for the 20-Delta island levee breach scenario.

Table 5-4. Annual Emergency Water Supply Benefits for Temperance Flat RM 274 Reservoir Alternative Plans

Item	Operations Integration[1]			
	Friant Only	SWP/CVP/ Friant	SWP/ Friant	SWP/ Friant
		Transvalley Conveyance		
		SW/CVC/AE		AE
Avg. Emergency Water Supply, 20-Island Breach (TAF)	168	323	320	251
Annual Benefits, 20-Island Breach ($million)	8.0	14.6	14.5	11.2

Note:
1 Reservoir balancing option has negligible effect on water deliveries and was not included in this table.

Key:
AE = Arvin-Edison
Avg. = average
CVC = Cross Valley Canal
CVP = Central Valley Project
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project
TAF = thousand acre-feet

Ecosystem and Water Temperature

The Temperance Flat RM 274 Reservoir alternative plans could improve the capability, reliability, and flexibility to release water at suitable temperatures for anadromous fish downstream from Friant Dam. Several reservoir water temperature simulations were performed for Temperance Flat RM 274 Reservoir alternative plans for the various operations scenarios. All scenarios were effective in preserving the total volume of cold water in Millerton Lake and Temperance Flat RM 274 Reservoir. Scenarios that include Friant Division, CVP, and/or SWP operations integration developed larger total cold water volumes compared to scenarios integrated with the Friant Division only because of exchanges resulting in higher storage levels. Both reservoir balancing options for Temperance Flat RM 274 Reservoir alternative plans were effective in preserving the total volume of cold water in both reservoirs.

Figure 5-2 presents the relative changes in total cold water volume at or below 52ºF in Temperance Flat RM 274 Reservoir and Millerton Lake during dry and normal-dry years (based on Settlement year-types, which are equivalent to dry and below normal year-types in the San Joaquin Valley Index (DWR, 2005)). Changes in total cold water volume are based on cold water volume multipliers equal to the cold water developed by Temperance Flat RM 274 Reservoir alternative plans divided by the volume of cold water available under future without-project conditions. For example, if the total volume of cold water below 52ºF under the alternative is equal to 165.3 TAF, and the volume of cold water below 52ºF for without-project conditions during the same time period is

equal to 90.6 TAF, the cold water multiplier would equal 1.8, which corresponds to the light blue category of 1 to 2 cold water multiplier ranges in Figure 5-2. All operations scenarios evaluated for Temperance Flat RM 274 Reservoir alternative plans demonstrate substantial improvements in the volume of cold water that would be available for management and release to the San Joaquin River to support assumed restoration targets throughout the year.

Based on cold water multiplier ranges shown for the alternatives in Figure 5-2, operations integration and reservoir balancing options do not demonstrate substantial cold water volume differences between the Temperance Flat RM 274 Reservoir alternatives.

The simulated changes in Friant Dam release temperature were evaluated for the alternative plans and compared to the without-project conditions. In each case, an exceedence curve was developed that compared water temperature during the month with the probability of occurrence. These exceedence curves were further compared to the without-project conditions and the particular Chinook salmon temperature threshold for the month. The alternative plans would provide opportunity to improve the probability of meeting the temperature thresholds during the critical spawning and incubation periods for Chinook salmon of September through December.

While the results for the alternative plans indicated improvements during each of those months, the differences among alternatives were found to be small. In particular, there is uncertainty relating to both the temperature modeling and the economic estimation for temperature enhancement effects on salmon, such that the minor differences among the alternatives based on the release temperature information is not considered to be definitive at this phase of the Investigation. As such, results are developed as the average of the operation scenarios, and then applied uniformly to each of the alternative plans. The preliminary annual ecosystem benefits for Temperance Flat RM 274 Reservoir alternative plans are $24.5 million.

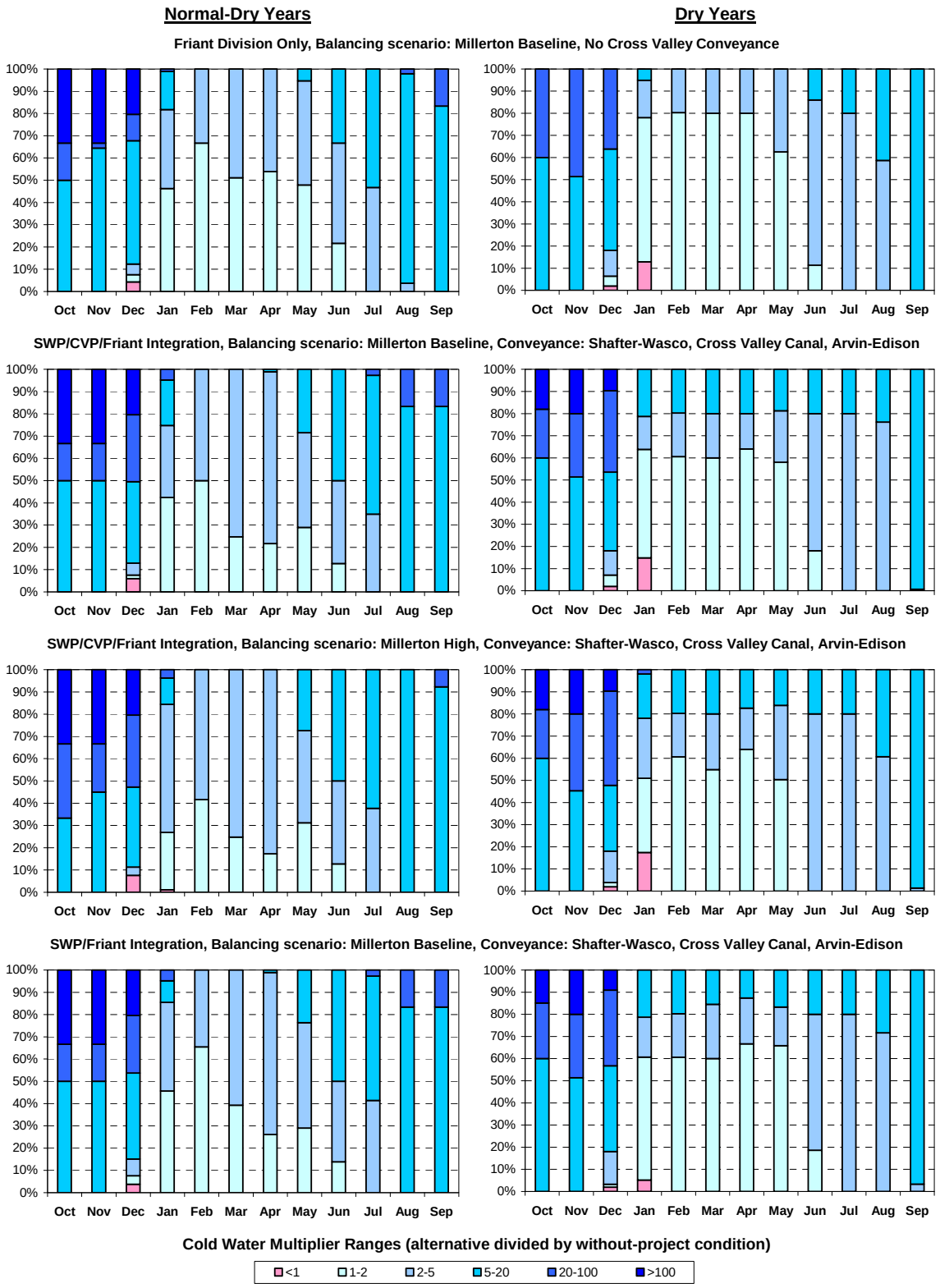

Figure 5-2. Changes in Cold Water Volume Below 52ºF for Temperance Flat RM 274 Reservoir Alternative Plans

Energy Generation

Most of the hydropower for the Temperance Flat RM 274 Reservoir alternative plans would be generated by diverting flow into the Kerckhoff No. 2 Powerhouse tunnel at Kerckhoff Lake and discharging flow through a new powerhouse just downstream from Temperance Flat RM 274 Dam into Millerton Lake. Releases from Temperance Flat RM 274 Reservoir would also be used for power generation. As shown in Table 5-5, power generation for this group of alternative plans would generate enough energy to replace all or most of the energy lost through inundation of the Kerckhoff Project powerhouses, on an average annual basis. Scenarios including Friant Division integration with SWP and/or CVP would result in less power generation because of reduced available head. The lower heads with operations integration options would occur as storage increases in both Millerton Lake and Temperance Flat because Delta supplies are delivered to Friant Division users and water levels increase in Millerton Lake and Temperance Flat RM 274 Reservoir. The Millerton High balancing option would result in less hydropower generation than the Millerton Baseline option, also due to reduced available head. For SWP/CVP operations integration with Millerton Baseline balancing, the power features could replace approximately 97 percent of the impacted Kerckhoff generation; therefore, even with system integration, the impacted generation would generally be replaced.

Table 5-5. Estimated Net Energy Generation for Temperance Flat RM 274 Reservoir Alternative Plans

Item	Operations Integration				
	Friant Only	SWP/CVP/Friant		SWP/Friant	SWP/Friant
		Millerton Baseline	Millerton High		
		Transvalley Conveyance			
		SW/CVC/AE			AE
Impacted Kerckhoff Project Generation (GWh/year)	-518	-518	-518	-518	-518
Temperance Flat RM 274 Generation (GWh/year)	515	490	445	492	497
Additional Friant Generation (GWh/year)	13	14	13	14	16
Net Power Generation (GWh/year)	10	-14	-60	-12	-4
Percent of Impacted Generation Replaced	102%	97%	88%	98%	99%

Key:
AE = Arvin-Edison
CVC= Cross Valley Canal
CVP = Central Valley Project
GWh = gigawatt-hour
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project

Table 5-6 demonstrates that system integration would have insignificant effects to CVP and SWP system-wide energy generation and use. The balancing options would not alter these effects.

Table 5-6. Estimated System-Wide Energy Generation and Use for Temperance Flat RM 274 Reservoir Alternative Plans

Item		Operations Integration					
		Friant Only		SWP/CVP/Friant			
				Millerton Baseline		Millerton High	
				Transvalley Conveyance			
				SW/CVC/AE			
System		CVP	SWP	CVP	SWP	CVP	SWP
Average Annual Energy Generation (MWh/year)	No-Action	4,881	5,081	4,881	5,081	4,881	5,081
	Change from No-Action	0	2	2	66	4	67
Average Annual Energy Use (MWh/year)	No-Action	1,328	9,943	1,328	9,943	1,328	9,943
	Change from No-Action	7	8	33	255	38	267

Key:
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
MWh = megawatt-hour
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project

Flood Damage Reduction

Potential annual flood damage reduction benefits accomplished through the Temperance Flat RM 274 Reservoir alternative plans are listed in Table 5-7. Potential flood benefits range from $2.1 million to $4.2 million. Potential flood damage reduction benefits decrease with integration and conveyance as more water is stored in Temperance Flat Reservoir and Millerton Lake.

Table 5-7. Annual Flood Damage Reduction for Temperance Flat RM 274 Reservoir Alternative Plans (90 percent exceedence)

Item	Operations Integration			
	Friant Only	SWP/CVP/ Friant	SWP/ Friant	SWP/ Friant
		Transvalley Conveyance		
		SW/CVC/AE		AE
90% Exceedence Flood Space (TAF)	660	301	285	457
Annual Flood Damage Reduction ($million)	$4.2	$2.3	$2.1	$3.4

Key:
AE = Arvin-Edison Canal
CVC = Cross Valley Canal
CVP = Central Valley Project
RM = river mile
SW = Shafter-Wasco Pipeline
SWP = State Water Project
TAF = thousand acre-feet

M&I Water Quality

Temperance Flat RM 274 Reservoir alternative plans that include exchanges to support operations integration could improve water quality in the California Aqueduct. Refinements to CALSIM operations modeling were used to quantify monthly changes in bromides, TDS, and organic carbon in the California Aqueduct resulting from the alternative plans. The monthly changes in constituent concentrations measured at the Edmonston Pumping Plant were then used to quantify the physical change in water quality from the alternative plans. These measures were then combined with an economic model of salinity management to estimate monetary benefits. The cost savings modeling results were increased by 50 percent to estimate potential benefits based on willingness to pay.

M&I water quality benefits accruing to customers of MWDSC that would be achieved through the Temperance Flat RM 274 alternative plans are listed in Table 5-8. Water quality benefits in terms of willingness to pay range from $0 million to $8.2 million. Water quality benefits increase with integration and conveyance as more water is stored in Temperance Flat RM 274 Reservoir and Millerton Lake.

Table 5-8. Annual M&I Water Quality WTP Benefits from Temperance Flat RM 274 Reservoir Alternative Plans

Item	Operations Integration			
	Friant Only	SWP/CVP/ Friant	SWP/ Friant	SWP/ Friant
		Transvalley Conveyance		
		SW/CVC/AE		AE
Average Change in TDS (mg/L)	0.2	-5.5	-5.0	-1.9
Annual M&I Water Quality WTP Benefit ($million)	$0.0	$8.2	$7.4	$2.8

Key:
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
M&I = municipal and industrial
Mg/L = milligrams per liter
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project
TAF = thousand acre-feet
TDS = total dissolved solids
WTP = willingness to pay

Recreation Opportunities

Opportunities for recreation development vary depending on operations integration and reservoir balancing options. Simulation results of recreation opportunities for Temperance Flat RM 274 Reservoir alternative plans that generally maintain Millerton Lake water levels at baseline average monthly storage levels would improve recreation opportunities in the primary study area. Millerton Lake levels would be slightly higher than the baseline pool elevation during April through July, and moderately higher through August. The higher pool elevations under the baseline average monthly storage level option would

provide a minor potential benefit to boaters while maintaining good shoreline use conditions. However, changing the reservoir balancing option to generally keep Millerton Lake higher than its average monthly baseline storage levels would improve early and late season boating opportunities in Millerton Lake, but degrade shoreline use conditions. Operations integration options do not demonstrate substantial differences in recreation opportunities for alternative plans.

Few areas near the Millerton Lake SRA were determined to have high or intermediate suitability for recreation development, and are on private property. Steep slopes, lack of road access, and remoteness from existing developed areas limit opportunities for recreation development within the SJRGMA. However, there is a large area of high suitability immediately upslope from existing recreation facilities within the SJRGMA.

Table 5-9 summarizes the recreation benefit results for Temperance Flat RM 274 Reservoir alternative plans, with estimates ranging from $6.7 million to $8.1 million. The recreation benefits are based on the recreation model estimates increased by 25 percent to account for uncertainty with respect to future visitor expenditure patterns and value of recreation activities at Millerton Lake. Boating and waterskiing activities generate the highest economic value, and represent more than 50 percent of the value in each scenario. This is followed by picnicking, which is also the second highest recreation activity by visitors.

Table 5-9. Estimates of Recreation Benefits for Temperance Flat RM 274 Reservoir Alternative Plans

Item	Operations Integration			
	Friant Only	SWP/Friant	SWP/CVP/ Friant	SWP/CVP/ Friant
			Millerton Baseline	Millerton High
Total ($million)	$6.7	$7.3	$7.3	$8.1

Key:
BL = Millerton baseline reservoir balancing option
CVP = Central Valley Project
High = Millerton high reservoir balancing option
RM = river mile
SWP = State Water Project

Primary Potential Effects

Primary potential effects are described below for aquatic biological resources, terrestrial biological resources, recreation resources, and cultural resources affected by the Temperance Flat RM 274 Reservoir alternative plans.

Aquatic Biological Resources

Potential effects on aquatic habitat conditions and species that may result from the Temperance Flat RM 274 Reservoir alternative plans are discussed below.

Habitat Conditions Temperance Flat RM 274 Reservoir alternative plans would produce a moderate increase in April-to-September shallow-water habitat over future without-project conditions in Millerton Lake. The Friant-only integration option for alternative plans would produce more shallow-water habitat than other reservoir operations options evaluated. The habitat increases would result from increased storage upstream from the Temperance Flat RM 274 Dam. The gains in shallow water would be substantial despite the relatively steep shoreline of this area of the basin.

The effects of the Temperance Flat RM 274 alternative plans on April-to-June quarter-month water level fluctuations would be generally similar for Temperance Flat RM 274 Reservoir and Millerton Lake. The mean reductions of water level in both reservoirs would be less than the magnitude of reductions under future without- project conditions. Centrarchid (black basses and sunfishes) spawning habitat would be more affected by water level reductions than increases because reductions may result in dewatered nests. Water level fluctuations in the Temperance Flat RM 274 Reservoir would likely have less effect on the shoreline spawning species than those in Millerton Lake because the Temperance Flat RM 274 Reservoir would have less shallow water surface area. Because of the greatly increased water surface elevation in the San Joaquin River portion of the primary study area, Temperance Flat RM 274 Reservoir would likely eliminate the American shad and striped bass spawning habitat downstream from the Kerckhoff and Kerckhoff No. 2 powerhouses. New spawning habitat for these species would potentially be created in the upper reach of the new reservoir, downstream from Kerckhoff Dam.

The Temperance Flat RM 274 alternatives would have a pronounced effect on water temperatures in the shallow depths of Millerton Lake. Water temperatures in Millerton Lake would be substantially cooler than under future without-project conditions. In contrast, water temperatures in the Temperance Flat RM 274 Reservoir would be warmer than in Millerton Lake under future without-project conditions. The changes in water temperatures would be somewhat greater in the 3- to 10-foot-depth interval, which corresponds to the optimal spawning depth range for largemouth bass, than nearer the surface. At greater depths, the changes in water temperatures would be comparable to those in the 3- to 10-foot interval.

At the top of active storage capacity (elevation 985), Temperance Flat RM 274 Reservoir alternative plans would inundate 49,919 feet of stream (lotic) habitat (Figure 5-1) in the San Joaquin River (between Kerckhoff Dam and Millerton Lake) and Big Sandy Creek, which is 46.5 percent of the total stream length for streams affected. The San Joaquin River from Millerton Lake up to Kerckhoff Dam would be completely inundated (46,488 feet) at the top of Temperance Flat RM 274 Reservoir active storage, while 3,431 feet (5.6 percent) of Big Sandy Creek would be inundated (Table 5-10). Within the inundation area for Temperance Flat RM 274 Reservoir alternative plans, Big Sandy Creek would have 400 feet (11.7 percent) of stream with gradients of less than 3 percent, while the San Joaquin River would have 32,200 feet under 3 percent (69 percent).

Table 5-10. Stream Inundation Effects of Temperance Flat RM 274 Reservoir and Temperance Flat RM 279 Reservoir Alternative Plans at Top of Active Storage

Stream	Total Stream Length (feet)	Total Stream Length Inundated (feet)	Percent of Total Stream Length Inundated	Stream Length Less Than 3% Gradient (feet)	Stream Length Less Than 3% Gradient Inundated (feet)	Percent of Total Inundated Stream Length Less Than 3% Gradient
Big Sandy Creek	60,801	3,431	5.6%	35,850	400	11.7%
San Joaquin River	46,488	46,488	100.0%	32,200	32,200	69.3%

Key: RM = river mile

Species The following sections describe potential effects to evaluated fish species for Temperance Flat RM 274 Reservoir alternative plans.

Largemouth and Spotted Bass Largemouth and spotted bass spawning and rearing production in Millerton Lake would be substantially reduced in the Temperance Flat RM 274 alternative plans. This reduction results from (1) the loss of warm, shallow water habitat in Millerton Lake upstream from RM 274, and (2) remaining shallow water habitat in Millerton Lake being cooler than without-project conditions. The loss of spawning production in Millerton Lake, however, would be substantially offset by a gain in production in warm, shallow water habitat created in Temperance Flat RM 274 Reservoir. The increase in spawning production upstream from RM 274 is particularly large for spotted bass.

Smallmouth Bass, Bluegill, and Black Crappie Effects of Temperance Flat RM 274 Reservoir alternative plans on production of smallmouth bass, bluegill, and black crappie are expected to be similar to described those for largemouth and spotted bass. Smallmouth bass, in particular, have very similar reservoir habitat requirements to those of largemouth bass, except they prefer cooler water temperatures relative to largemouth bass. As described earlier, remaining shallow water habitat in Millerton Lake is expected to be cooler than without-project conditions.

Striped Bass and American Shad Both striped bass and American shad forage in open water and prefer cool water temperatures. The Temperance Flat RM 274 Reservoir alternative plans would substantially increase the volume of deep, open water habitat compared to that of the future without-project reservoir, therefore increasing overall foraging habitat of both species. Compared to Millerton Lake under future without-project conditions, water temperatures in the open water habitat would be lower in Millerton Lake, but would be higher in Temperance Flat RM 274 Reservoir.

The current spawning habitat of striped bass and American shad in the upper extent of Millerton Lake and the San Joaquin River near Kerckhoff No. 2 Powerhouse would be completely eliminated. The loss of spawning habitat would not substantially affect the striped bass population because this population is largely sustained by stocking. However, American shad are not stocked and the loss of spawning habitat would potentially eradicate its population. This alternative plan has the potential to create new spawning habitat for American shad in the upper portion of the new Temperance Flat RM 274 Reservoir within the San Joaquin River channel below Kerckhoff Dam. At maximum pool, the new reservoir would inundate the entire river channel, but at lower reservoir levels, a large reach of the river would remain free-flowing. Flows from Kerckhoff Dam into this reach of the river may potentially provide excellent spawning conditions. Even with a full reservoir, the constrained character of this reach of the river would likely produce relatively riverine conditions in the reservoir. Therefore, as long as flow releases from Kerckhoff Dam were sufficient, the reservoir would potentially sustain shad spawning over a broad range of reservoir levels. More detailed analyses would be required to fully evaluate the potential of Temperance Flat RM 274 Reservoir alternative plans to support American shad spawning.

Construction of a dam at RM 274 would separate populations of American shad within Millerton Lake from spawning habitat upstream, assuming American shad were able to spawn in Temperance Flat RM 274 Reservoir. Unless they are able to spawn in the outflow from the new Temperance Flat RM 274 Dam, or sufficient numbers are entrained in the outflow, the population would be extirpated from Millerton Lake. The size of the total population of American shad between the two reservoirs would likely be smaller than the current population if Temperance Flat RM 274 Reservoir is not able to support as large a shad population as Millerton Lake currently supports.

Lotic Species Temperance Flat RM 274 Reservoir would affect a large portion of usable habitat for riverine fish species (Table 5-11). Under the assumption that rainbow trout and hardhead occupy the San Joaquin River and its tributaries, only 46.5 percent of usable rainbow trout habitat within the primary study area would be affected, while 63.5 percent of usable hardhead habitat in the primary study area would be affected. Within the primary study area, assuming rainbow trout, hardhead, and Kern brook lamprey inhabit only the San Joaquin River, all lotic habitat for the three riverine species would be affected by the Temperance Flat RM 274 (and Temperance Flat RM 279) alternative plans.

Table 5-11. Fish Habitat in the Primary Study Area Affected by Temperance Flat RM 274 Reservoir and Temperance Flat RM 279 Reservoir Alternative Plans

Riverine Species Affected	Distance of Usable Habitat Potentially Affected (feet)	
	San Joaquin River Residence Only	All Streams Residence[1]
Rainbow trout	46,488	49,919
Hardhead	32,200	32,600
Kern brook lamprey[2]	32,200	32,200

Note:
[1] Usable habitat potentially affected for rainbow trout equals the total inundated stream length. For hardhead, it is inundated stream length with less than a 3% gradient, and for Kern brook lamprey it is inundated stream length with less than a 3% gradient for the San Joaquin River only.
[2] Presence of Kern brook lamprey is uncertain.
Key:
RM = river mile

Terrestrial Biological Resources

The tables and discussion in this section summarize effects to terrestrial habitats and species in the inundation area under the Temperance Flat RM 274 Reservoir alternative plans.

Habitat Table 5-12 shows acreages of habitat types that would be inundated by the Temperance Flat RM 274 Reservoir alternative plans; a total vegetated habitat loss of 4,756 acres would occur. In addition, 31 acres of developed and barren land would be inundated, along with 200 acres of riverine habitat. These alternative plans would have the greatest effects on foothill pine oak woodland and blue oak woodland habitats. Smaller areas of shrub, grassland, and riparian habitats would also be impacted.

Table 5-12. Habitat Effects Under the Temperance Flat RM 274 Reservoir Alternative Plans

Habitat Types	Temperance Flat RM 274 Reservoir (acres)
	Inundation Area
Upland Woodland Habitat	
Foothill Pine Oak Woodland	3,339.8
Blue Oak Woodland	921.7
Live Oak Woodland	28.8
Foothill Pine Woodland	9.2
Foothill Pine Chaparral Woodland	4.8
Subtotal	**4,304.2**
Upland Shrub Habitat	
Buckbrush Chaparral	20.8
Bush Lupine Scrub	3.2
Subtotal	**24.0**
Upland Herbaceous Habitat	
Annual Grassland	129.7
Subtotal	**129.7**
Riparian Habitat	
White Alder Riparian	25.2
Mixed Riparian	2.1
Fig - Willow Riparian	2.6
Willow Woodland	1.9
Fig Riparian	0.5
Spanish Broom Scrub	0.5
Sycamore Woodland	0.4
Buttonbush Scrub	0.3
Subtotal	**33.5**
Herbaceous Wetland Habitat	
Seasonal Wetland[1]	263.9
Freshwater Seep	0.9
Subtotal	**264.8**
Aquatic Habitat	
Lacustrine Unconsolidated Bottom	437.0
Lacustrine Unconsolidated Shoreline[1]	286.9
Riverine	200.0
Subtotal	**923.9**
Other	
Barren	24.7
Developed	6.0
Subtotal	**30.7**
Total	**5,710.8**

Note:

1 Habitat types that are periodically inundated, because they are below the ordinary high water mark of Millerton Lake.

Key: RM = river mile

Species Terrestrial species effects that may result from Temperance Flat RM 274 Reservoir alternative plans are discussed below. Because the species analyses areas for the Temperance Flat RM 274 Reservoir and RM 279 Reservoir alternative plans overlap, the potential for species occurrence could not be distinguished between the alternatives. Therefore, tables for describing potential species occurrences in the following sections are provided for all alternatives in summary. Differentiations between the alternatives are discussed in the text, when applicable.

Rare Plants Nineteen special-status plant species were identified as either present or potentially occurring within the Temperance Flat RM 274 Reservoir inundation area. Of these, seven were found in the Temperance Flat RM 274 Reservoir alternative plans area during 2007 field surveys (Table 5-13).

Table 5-14 summarizes the status, habitat, and likelihood of occurrence for the special-status plant species present or potentially occurring within the primary study area for both Temperance Flat RM 274 Reservoir and RM 279 Reservoir alternative plans.

Table 5-13. Special-Status Plant Species Found in the Temperance Flat RM 274 Reservoir Inundation Area

Species	Occurrences[1]	Individuals
Tree anemone	1	6
Ewan's larkspur	1	23
Madera leptosiphon	1	~5,000
Michael's piperia	1	1
Farnsworth jewelflower	3	~1,300
Hall's wyethia	4	~1,900
Small-flowered monkeyflower	12	~10,200

Note:

1 An occurrence, as defined by CNPS and CNDDB, is a group of rare plants located within 0.25 miles of each other. Occurrences may consist of a number of individuals and clumps of individuals (colonies), the distribution of which may or may not differ between inundation areas and/or buffers.

Key:
CNPS = California Native Plant Society
CNDDB = California Natural Diversity Database
RM = river mile

Table 5-14. Special-Status Plant Species Known to Occur or with Potential to Occur in the Primary Study Area

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Likelihood of Presence
Mariposa pussypaws *Calyptridium pulchellum*	T	--	CNPS 1B.1	Bare sandy, gravelly granitic substrates at elevations between 1,300 to 4,000 feet in chaparral and woodland	Unlikely • Known to occur at higher elevations near but outside the primary study area • Loose, bare granitic sands provide at least marginal habitat in the primary study area • Species was not found during 2007 surveys
Tree anemone *Carpenteria californica*	--	T	CNPS 1B.2, MSCSm	Species generally occurs at elevations between 1,500 to 3,000 feet; occurs on granitic soils in chaparral or forests with shrub layer	Present • One known occurrence in primary study area and several populations very near inundation line at higher elevations • Known occurrence was relocated during 2007 surveys
Succulent owl's clover *Castilleja campestris ssp. succulenta*	T	E	CNPS 1B.2, MSCSm	Northern basalt flow vernal pools on table tops in the region and northern hardpan vernal pools downstream from Friant Dam	Unlikely • Documented on table tops above Millerton Lake and below Friant Dam • Soil and terrain conditions conducive to vernal pool formation do not appear to be present in primary study area • Neither species nor its habitat were found during 2007 surveys
Ewan's larkspur *Delphinium hansenii ssp. ewanianum*	--	--	CNPS 4.2	Rocky soils, bluffs, often acidic soils associated with woodland and grassland at elevations between 200 to 2,000 feet.	Present • Abundant potential habitat in primary study area • Increasing discoveries of this taxon in the Sierra Nevada foothills • Species was found in the primary study area during 2007 surveys
Dwarf downingia *Downingia pusilla*	--	--	CNPS 2.2	Northern basalt flow vernal pools on tables tops in the region and northern hardpan vernal pools downstream from Friant Dam	Unlikely • Documented on table tops above Millerton Lake and below Friant Dam • Soil and terrain conditions conducive to vernal pool formation do not appear to be present • Species was not found during 2007 surveys
Spiny-sepaled button-celery *Eryngium spinosepalum*	--	--	CNPS 1B.2, MSCSm	Vernal pools, wet swales below 1,000 feet, Tulare to San Joaquin counties	Unlikely • Documented on table tops above Millerton Lake and below Friant Dam • Soil and terrain conditions conducive to vernal pool formation do not appear to be present • Species was not found during 2007 surveys
Boggs Lake hedge-hyssop *Gratiola heterosepala*	--	E	CNPS 1B.2, MSCSm	Found in shallow water margins of vernal pools, also margins of small lakes and ponds, wet meadows	Unlikely • Not known in primary study area but occurs in nearby vernal pools on table tops • Vernal pools not recorded in primary study area, but possible for species to occur in more marginal habitat • No suitable soils in the primary study area • Neither species nor its habitat were found during 2007 surveys

Table 5-14. Special-Status Plant Species Known to Occur or with Potential to Occur in the Primary Study Area (contd.)

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Likelihood of Presence
Madera leptosiphon *Leptosiphon serrulatus*	--	--	CNPS 1B.2, MSCSm, BLM Sensitive	Cismontane woodland, lower montane coniferous forest	Present • Previously documented occurrence in the primary study area was not relocated during 2007 surveys, but two new occurrences were found in the primary study area
Congdon's lewisia *Lewisia congdonii*	--	R	CNPS 1B.3	Occurs in mesic rocky/outcrop habitats in chaparral, woodland coniferous forest at elevations between 1,500 and 8,400 feet	Unlikely • Many potential habitats in the primary study area, but species was not found during 2007 surveys; primary study area is below typical elevation range • Occurs in Merced River and Tuolumne River canyons to north and south, respectively
Orange lupine *Lupinus citrinus var. citrinus*	--	--	CNPS 1B.2, BLM Sensitive	Often occurs on decomposed granite in chaparral, cismontane woodland, or lower montane coniferous forest	Unlikely • Known to occur at higher elevations near but outside the primary study area • Suitable habitat occurs in primary study area, but this species was not found during 2007 surveys
Small-flowered monkeyflower *Mimulus inconspicuus* (includes *M. acutidens* and *M. grayi*)	--	--	CNPS 4.3	Mesic sites in chaparral, cismontane woodland, lower montane coniferous forest above elevation 1,300 feet	Present • Twelve occurrences were documented in the primary study area during 2007 surveys
Slender-stalked monkeyflower *Mimulus gracilipes*	--	--	CNPS 1B.2	Decomposed granite, disturbed sites often following fire in chaparral, woodland, and coniferous forest at elevations between 1,500 and 3,900 feet	Possible • Known to occur in the vicinity of the primary study area • Loose, bare granitic sands provide at least marginal habitat in the primary study area; this species was not found during surveys • 2007 was a poor year for this species because of below-average precipitation
San Joaquin Orcutt grass *Orcuttia inequalis*	T	E	CNPS 1B.1, MSCSm	Known from northern basalt flow vernal pools on table tops in the region and northern hardpan vernal pools downstream from Friant Dam	Unlikely • Documented on table tops above Millerton Lake and below Friant Dam • Soil and terrain conditions conducive to vernal pool formation do not appear to be present in primary study area • Neither species nor its habitat were found during 2007 surveys
Michael's piperia *Piperia michaelii*	--	--	CNPS 4.2	Coastal bluff scrub, closed-cone coniferous forest, chaparral, cismontane woodland, coastal scrub, lower montane coniferous forest between 10 and 3,000 feet in elevation	Present • Two occurrences of this species were found in the primary study area during 2007 surveys
Hartweg's golden sunburst *Pseudobahia bahiifolia*	E	E	CNPS 1B.1, MSCSm	Species is limited to grasslands and open woodlands on clay soil	Unlikely • Suitable soils do not occur in primary study area; this species was not found during surveys

Table 5-14. Special-Status Plant Species Known to Occur or with Potential to Occur in the Primary Study Area (contd.)

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Likelihood of Presence
Sanford's arrowhead *Sagittaria sanfordii*	--	--	CNPS 1B.2, BLM Sensitive	Shallow freshwater marsh habitats on margins of small lakes and ponds, sluggish waters of sloughs, creeks, rivers, canals, and ditches between 0 and 2,000 feet in elevation	Unlikely • Streams in the area support periodic high velocity flows, making them unsuitable for this species • No suitable habitat was observed in stock ponds • This species was not found during surveys conducted in 2007
Farnsworth's jewelflower *Streptanthus farnsworthianus*	--	--	CNPS 4.3	Cismontane woodland at elevations between 1,300 and 4,600 feet in elevation	Present • Three occurrences of this species were found in the primary study area during 2007 surveys
Oval-leaved viburnum *Viburnum ellipticum*	--	--	CNPS 2.3	Chaparral, cismontane woodland, and lower montane coniferous forest	Possible • Known to occur in vicinity of the primary study area • Reported on Squaw Leap Trail above primary study area • Suitable habitat occurs in primary study area, but this species was not found during surveys; 2007 was not an optimal year because of below-average precipitation
Hall's Wyethia *Wyethia elata*	--	--	CNPS 4.3	Cismontane woodland and lower montane coniferous forest typically between 3,000 to 4,600 feet in elevation	Present • Four occurrences of this species were found in the primary study area during 2007 surveys

Key:
-- =
BLM = U.S. Department of the Interior, Bureau of Land Management
CNPS = California Native Plant Society
MSCS = CALFED Multi-Species Conservation Strategy
Elevation xxx = elevation in feet above mean sea level

[1]Federal Status
E = Endangered
T = Threatened

[2]State Status
CSC = California Species of Special Concern
E = Endangered
FP = Fully Protected
R = Rare
T = Threatened

[3]Other Status
CNPS 1B.1: Rare, threatened, or endangered in California and elsewhere; seriously endangered in California
CNPS 1B.2: Rare, threatened, or endangered in California and elsewhere; fairly endangered in California
CNPS 1B.3: Rare, threatened, or endangered in California and elsewhere; not very endangered in California
CNPS 2.2: Rare, threatened, or endangered in California, but more common elsewhere; fairly endangered in California
CNPS 2.3: Rare, threatened, or endangered in California, but more common elsewhere; not very endangered in California
CNPS 4.2: Plants of limited distribution; fairly threatened in California
CNPS 4.3: Plants of limited distribution; not very threatened in California
MSCSm: CALFED Multi-Species Conservation Strategy goal=maintain
BLM Sensitive: BLM Sensitive Species

Wildlife Resources The following sections summarize the likelihood of special-status wildlife species to occur within the inundation area for the Temperance Flat RM 274 Reservoir alternative plans. The potential for special-status wildlife species to occur in general within the primary study area is summarized in Table 5-15.

Invertebrates The pipevine swallowtail is a butterfly species of management concern in the primary study area, because it is one of only two known nonmigratory populations. The California pipevine is the obligate host plant for this species; therefore, populations of this plant are of interest in the primary study area. Ten California pipevine populations were identified in the inundation area for Temperance Flat RM 274 Reservoir alternative plans during 2007 field surveys.

The elderberry (*Sambucus* sp.) shrub is the host plant of the valley elderberry longhorn beetle, Federally listed as threatened. During the grub stage, valley elderberry longhorn beetle lives in elderberry stems greater than 1 inch in diameter and chews an exit hole in the stem as it metamorphoses to an adult beetle. Shrubs with visible exit holes may, therefore, be occupied by valley elderberry longhorn beetle. Within the inundation area for Temperance Flat RM 274 Reservoir alternative plans, 139 elderberry shrubs with stems greater than 1 inch in diameter were identified. Four of these were observed to have exit holes. Although the valley elderberry longhorn beetle has not been documented in the primary study area, it is known to occur nearby (within approximately 1 mile) and is assumed to be present within the primary study area. In 2006, USFWS conducted a 5-year status review for valley elderberry longhorn beetle and recommended delisting.

Table 5-15. Special-Status Wildlife Species Known or with Potential to Occur in the Primary Study Area

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Potential to Occur
Invertebrates					
Dutchman's pipe / Pipevine swallowtail *Battus philenor*	--	--	BLM	Plants from the pipevine family are hosts (e.g., Dutchman's pipe); found in mesic habitat in forest understory or with shrubs	Present • Multiple populations and host plant locations detected in primary study area • Suitable habitat occurs in riparian habitat throughout primary study area
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	T	--	MSCSm	Elderberry shrubs are host; generally found in riparian areas, also open hillsides and rocky outcroppings	Likely • Species not documented in primary study area but known to occur in region; documented population east of Table Mountain • Many elderberry shrubs present; some older shrubs with evidence of exit holes; species presence suspected but not confirmed
Amphibians					
California tiger salamander *Ambystoma californiense*	T	CSC	MSCSm	Breeds in vernal pools or other temporary pools; spends most of life cycle in burrows	Possible • One undocumented report in San Joaquin River Gorge; occurs below Friant Dam and may use vernal pools on table tops; also documented in Auberry • No vernal pools in primary study area; potential movement corridors exist from table tops to Millerton Lake • Suitable habitat in primary study area, but may be absent in drier years
Relictual slender salamander *Batrachoseps relictus*	--	CSC	--	Preferred habitat is small mesic areas with tree canopy, shrubs, abundant rock, litter, woody debris	Likely • Has not been recorded in or near primary study area • Potential habitat is present in primary study area
California red-legged frog *Rana aurora draytonii*	T	CSC	MSCSm	Riparian, slow-water rivers, and lakes with emergent aquatic vegetation	Unlikely • Presence of bullfrogs and centrarchids restricts already limited habitat suitability
Foothill yellow-legged frog *Rana boylii*	--	CSC	BLM-S, MSCSm	Slow-moving water with sandy or gravelly substrate and various upland habitats, including valley foothill riparian, blue oak woodland, blue oak– foothill pine, mixed chaparral, and wet meadows	Possible • No recent records of occurrence in primary study area • Potential habitat is present, but bullfrogs and centrarchids present and greatly reduce potential of occurrence • Unlikely because of abundant predator populations in permanent water sources and lack of perennial stream habitat

Table 5-15. Special-Status Wildlife Species Known or with Potential to Occur in the Primary Study Area (contd.)

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Potential to Occur
Western spadefoot toad *Spea (=Scaphiopus) hammondi*	--	CSC	BLM-S, MSCSm	Preferred habitat is grasslands with temporary water pools, but does breed in permanent pools; occurs in foothills to elevation 4,400 feet	Likely • Known occurrences near but outside primary study area • Suitable habitat available • Likely to occur in the primary study area based on species range, and availability of potentially suitable habitat
Reptiles					
Western pond turtle *Clemmys marmorata*	--	CSC	BLM-S (SW pond turtle), MSCSm	Riparian areas, shallow, slow-moving water bodies with emergent aquatic vegetation and available basking areas	Present • Present in natural pools and stock ponds in Big Sandy Creek and along Patterson Bend Reach • Habitat conditions are marginal because of controlled water flows, extensive bedrock substrate
California (coast) horned lizard *Phrynosoma coronatum frontale*	--	CSC	BLM-S	Various, includes areas of gravelly, sandy soils in open shrublands, riparian woodlands, dry chamise chaparral, annual grasslands	Likely • No records of occurrence in or near primary study area; species may be present in low numbers • Likely to occur in the primary study area based on species range and availability of potentially suitable habitat
Birds					
Cooper's hawk *Accipiter cooperi*	--	CSC (nesting)	MSCSm	Typically inhabits oak savanna, woodlands, and open grassland habitats	Present • Present throughout the primary study area • Likely more common in denser canopied habitats, including riparian
Sharp-shinned hawk *Accipiter striatus*	--	CSC (nesting)	--	Nests and forages in woodlands, but may occur in the more open savanna woodland type habitats, such as blue oak woodland and blue oak–foothill pine	Present • Present in certain areas of the primary study area with relatively higher quality breeding habitat • Likely more common in denser forest and woodland canopied habitats, including riparian
Grasshopper sparrow *Ammodramus savannarum*	--	--	MSCSm	Inhabits grasslands, grassland-shrub areas, and ruderal areas	Unlikely • No recent records of occurrence in primary study area • Habitat in primary study area is marginal
Golden eagle *Aquila chrysaetos*	--	CSC, FP	BGEPA, MSCSm	Forages over open shrub and grasslands; nests on cliffs or large rock outcrops	Likely • Known to occur in primary study area; nests in cliffs above reservoir • Suitable forage habitat throughout area
Long-eared owl *Asio otus*	--	CSC (nesting)	MSCSm	Wide distribution but uncommon in habitats consisting of dense trees and shrubs and riparian	Unlikely • No records of occurrence in primary study area • Habitat in primary study area is marginal

Table 5-15. Special-Status Wildlife Species Known or with Potential to Occur in the Primary Study Area (contd.)

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Potential to Occur
Western burrowing owl *Athene cunicularia hypugea (=Athene cunicularia)*	--	CSC	BLM-S, BCC, MSCSm	Open dry grasslands and desert habitat	Unlikely • No recent records of occurrence in primary study area • Habitat in primary study area is marginal
Lawrence's goldfinch *Carduelis lawrencei*	--	--	BCC	Breeds in open woodland and chaparral near water; preferentially nests in oaks; distribution erratic and localized	Present • Detected multiple times in Patterson Bend Reach • Suitable habitat exists in primary study area along watercourses
Northern harrier *Circus cyaneus*	--	CSC (nesting)	MSCSm	Prefers annual and perennial grasslands, open meadows from sea level to elevation 10,000 feet; breeds from sea level to elevation 5,700 feet	Unlikely • Predominant forested habitats in primary study area are not optimal
Yellow warbler *Dendroica petechia*	--	CSC (nesting)	MSCSr	Breeds in mesic, deciduous thickets, especially riparian; preferred habitat includes moist areas with dense insect prey populations	Present, but unlikely to breed in primary study area • Detected in primary study area at Big Sandy Creek, but nonbreeding; riparian habitat is limited size and has unsuitable structure for breeding purposes
White-tailed kite *Elanus leucurus*	--	FP	MSCSm	Prefers coastal and lowland valleys; often associated with farmlands, meadows with emergent vegetation, grasslands	Unlikely • Not commonly known in primary study area; may be occasional migrant • Preferred habitat not present
Willow flycatcher *Empidonax trailii brewsterii*	--	E	MSCSr	Requires contiguous patches of multilayered riparian habitat with moist soils and/or standing water	Unlikely • No confirmed recent sightings in primary study area; BLM indicates species may be present in San Joaquin River Gorge; incidental occurrence as migrant is possible • Riparian habitat marginal—too limited in size, distribution, and structure
California horned lark *Eremophila alpestris actia*	--	CSC	--	Open grasslands and pasture	Unlikely • Limited suitable habitat in primary study area
Merlin *Falco columbarius*	--	CSC (winter)	--	Prefers open grasslands, savannas, and woodlands below elevation 4,000 feet	Possible • Uncommon winter migrant • Suitable habitat is limited in primary study area
Prairie falcon *Falco mexicanus*	--	CSC (nesting)	BCC	Forages over large areas of open habitats, nests in cliffs	Likely • Reported as nesting in San Joaquin River Gorge; breeds on cliffs above Millerton Lake and San Joaquin • Suitable habitat is available

Table 5-15. Special-Status Wildlife Species Known or with Potential to Occur in the Primary Study Area (contd.)

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Potential to Occur
American peregrine falcon *Falco peregrinus anatum*	--	E, FP	MSCSm	Forages in open fields, especially near water (e.g., large wetland complexes); nests on cliffs, tall buildings, or bridges	Possible • Occurrence in the primary study area is unknown; reported as occasional over the San Joaquin River east of Friant • Suitable breeding habitat is available, but foraging habitat is limited
Bald eagle *Haliaeetus leucocephalus*	--	E, FP	BGEPA, MSCSm	Forages in open water, roosts in adjacent trees, nests in tall, sturdy trees	Present • Pair nesting at southwestern edge of primary study area near Millerton Lake
Yellow-breasted chat *Icteria virens*	--	CSC (nesting)	--	Riparian thickets of willow, blackberry, wild grape, and other brushy tangles near watercourses	Unlikely • Suitable riparian habitat is limited in primary study area
Loggerhead shrike *Lanius ludovicianus*	--	CSC	BCC	Common winter visitor and resident in open habitats with scattered trees and shrubs; prefers habitats with abundant perches	Possible • Known to occur in primary study area as winter migrant • Suitable habitat is available in primary study area
Lewis's woodpecker *Melanerpes lewis*	--	--	BCC	Uncommon winter resident in open oak, conifer, or riparian woodland	Likely • Known to occur in region, but primary study area occurrence unknown • Suitable habitat occurs in primary study area
Osprey *Pandion haliaetus*	--	CSC	MSCSm	Forages on large bodies of water and rivers that have abundant fish in ponderosa pine and mixed conifer habitats	Possible • Observed around Millerton Lake; breeds north of primary study area • Foraging opportunities in Millerton Lake; habitats in the primary study area provide low suitability for reproduction and cover
California spotted owl *Strix occidentalis occidentalis*	--	CSC (nesting)	BLM-S	In the Sierra Nevada foothills, nests in oak woodlands located in or near riparian areas in deep-sided canyons at elevations of 1,000 to 8,000 feet	Likely • Detected immediately southeast of Kerckhoff Dam • Suitable breeding habitat is available in primary study area
Least Bell's vireo *Vireo bellii pusillus*	E	E	MSCSr	Requires larger contiguous stands of riparian habitat with lush to moderate understory cover	Unlikely • Riparian habitat marginal—too limited in size, distribution, and structure

Table 5-15. Special-Status Wildlife Species Known or with Potential to Occur in the Primary Study Area (contd.)

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Potential to Occur
Mammals					
Pallid bat *Antrozous pallidus*	--	CSC	BLM-S	Forages over wide range of habitats, including grasslands, scrub, woodlands, and forests; most common in open, dry areas with rocky areas for roosting; also roosts in large oaks and on buildings	Likely • Occurs in or near primary study area; known to breed on cliffs above lake • Suitable habitat is available in primary study area
Ringtail *Bassariscus astutus*	--	FP	MSCSm	Prefers riparian, brush habitats and most forest habitats, areas with talus or rocky elements or snags for cover; occurs in low to midlevel elevations	Likely • Species is known to occur in or near primary study area • Suitable habitat available in primary study area
Townsend's big-eared bat *Corynorhinus townsendii*	--	CSC	BLM-S	Found throughout California in wide range of habitats; roosts in colonies in caves, mines, or buildings	Present • Detected in rock outcrop near Millerton Bottoms portion of primary study area • Suitable roosting habitat is available in primary study area
Spotted bat *Euderma maculatum*	--	CSC	BLM-S	Species biology not well known; distribution limited to approximately 40 small areas in California; may forage in foothills, desert; breeds and roosts in rock crevices	Possible • Not known to occur in the primary study area • Suitable habitat may occur in primary study area
Western (California) mastiff bat *Eumops perotic californicus*	--	CSC	BLM-S, MSCSm	Found throughout California in wide range of habitats; nests on cliffs; intolerant of human activity	Present • Known to nest in cliffs above Millerton Lake • Suitable foraging habitat may occur in primary study area
American pine marten *Martes americana*	--	CSC	--	Optimal habitat is mixed evergreen forests with >40% cover, large trees and snags, red fir, and lodgepole pines	Unlikely • Not known to occur in primary study area • Optimal habitat is limited in primary study area
Western small-footed myotis *Myotis ciliolabrum*	--	--	BLM-S	Occurs in wide range of dry upland habitats in the Sierra Nevada; prefers scrub and woodlands near open water where it feeds; ranges from sea level to elevation 9,000 feet	Likely • Occurrence in primary study area is unknown • Suitable habitat occurs in primary study area

Table 5-15. Special-Status Wildlife Species Known or with Potential to Occur in the Primary Study Area (contd.)

Species	Federal Status[1]	State Status[2]	Other Status[3]	Habitat	Potential to Occur
Long-eared myotis *Myotis evotis*	--	--	BLM-S	Widespread but uncommon; prefers brushy, woodland, and forest habitats; roosts on buildings, in caves, under tree bark, in snags and rock crevices; distribution from elevation 0 to 9,000 feet	Likely • Occurrence in primary study area is unknown • Suitable habitat occurs in primary study area
Fringed myotis *Myotis thysanodes*	--	--	BLM-S	Distribution is widespread, but its abundance is irregular; optimal habitat is pinyon-juniper, valley foothill hardwood, and hardwood-conifer between elevation 4,000 and 7,000 feet	Possible • Occurrence in primary study area is unknown • Suitable habitat is limited in primary study area; elevation is below general distribution
Yuma myotis *Myotis yumanensis*	--	--	BLM-S	Common and widespread in California; wide range of habitats used; roosts in caves, mines, in buildings; optimal habitat is open woodlands and forests near open water	Present • Known to occur in region • Suitable habitat occurs in primary study area
San Joaquin pocket mouse *Perognathus inornatus inornatus*	--	--	BLM-S	Occurs in dry, open grasslands with fine-textured soils in the Central and Salinas valleys from elevation 1,000 to 2,000 feet	Possible • Distribution in primary study area unknown • Suitable habitat is limited in primary study area
American badger *Taxidea taxus*	--	CSC	--	Drier open grassland, shrub, and forest habitats with friable soils	Possible • Species occurs in vicinity of primary study area • Suitable habitat is present in primary study area

Key:
BLM = U.S. Department of the Interior, Bureau of Land Management
Elevation xxx = elevation in feet above mean sea level
MSCS = CALFED Multi-Species Conservation Strategy
USFWS = U.S. Fish and Wildlife Service

[1]Federal Status
E = Endangered
T = Threatened

[2]State Status
CSC = California species of special concern
E = Endangered
FP = Fully Protected

[3]Other Status
BCC = USFWS Birds of Conservation Concern
BGEPA = Federal Bald and Golden Eagle Protection Act
BLM-S = BLM Sensitive Species
BLM = Species of management concern to BLM
MSCSm = CALFED Multi-Species Conservation Strategy goal=maintain.
MSCSr = CALFED Multi-Species Conservation Strategy goal=Contribute to recovery

Amphibians and Reptiles Four aquatic features were identified within the inundation area of the Temperance Flat RM 274 Reservoir alternative plans during 2007 surveys that may provide potential breeding habitat for California tiger salamander. Each feature was evaluated during surveys for potential suitability, and classified as either suitable or marginal. Two of the features were considered to be marginal and two were classified as suitable habitat. The determination of potential suitability of these features is conservative; bullfrogs were observed in at least one pond, which is also known to permanently hold water.

Potentially suitable western pond turtle habitat was mapped and western pond turtle presence and habitat features were surveyed across the primary study area. Western pond turtle has been previously documented in the primary study area and was observed during 2007 Investigation surveys in Big Sandy Creek (three individuals outside the inundation area of Temperance Flat RM 274 Reservoir alternative plans) and the San Joaquin River (one individual in the inundation area of both Temperance Flat RM 274 and RM 279). Based on surveys in 2007, 437.4 acres of potential western pond turtle habitat were identified in the Temperance Flat RM 274 Reservoir area. The most suitable habitat (providing more suitable basking sites, aquatic vegetation, and food sources) was identified along the San Joaquin River.

During 2007 surveys, potentially suitable and marginal habitat for the foothill yellow-legged frog was identified. Approximately 12,105 linear feet of potentially suitable and marginal stream habitat would be affected by Temperance Flat RM 274 Reservoir alternative plans. While potentially suitable habitat was identified within the primary study area, no recent sightings of foothill yellow-legged frogs have been documented near the area. Based on the presence of nonnative predators (bullfrogs and centrarchids) in the San Joaquin River and adjacent streams, foothill yellow-legged frog are unlikely to be found within the inundation area for Temperance Flat RM 274 Reservoir alternative plans.

Birds Several raptor species (American kestrel, Cooper's hawk, red-tailed hawk, sharp-shinned hawk) were incidentally observed in the primary study area during 2007 field surveys. Existing information and data collected during 2007 surveys suggest that raptors and other special-status bird species may nest in the area. These species are most vulnerable to human intrusions into their habitats when nesting. A bald eagle nest was identified near the Temperance Flat RM 274 Dam site, but is located outside the inundation area of both Temperance Flat RM 274 and RM 279.

Mammals A number of special-status bat species have potential to occur within the area that would be inundated under Temperance Flat RM 274 Reservoir alternative plans. Suitable roost sites occur throughout the primary study area. One Townsend's big-eared bat was observed in a rock outcrop within an area potentially affected by Temperance Flat RM 274 Reservoir alternative plans during 2007 surveys. Western mastiff bats are known to breed on the cliffs above the primary study area and are likely to occupy portions of the primary study area during most behavioral activities.

Recreation Resources

Temperance Flat RM 274 Reservoir alternative plans would create a relatively narrow and winding lake extending about 18.5 miles up the San Joaquin River to Kerckhoff Dam, with 4,680 surface acres at the top of active storage (elevation 985). The reservoir would be more than 1.25 miles wide at its widest extent, but would be quite narrow in the upstream third of the pool, within the San Joaquin River Gorge. The most remote, undeveloped, and scenic portion of the Millerton Lake SRA would be substantially affected, as would the full length of the SJRGMA along the San Joaquin River.

The Temperance Flat RM 274 Reservoir would inundate an on-boat campground, a boat-in campground, and other campgrounds in the Millerton Lake SRA, and impact portions of the San Joaquin River trail. Facilities within the BLM SJRGMA would also be affected, such as an extension of the San Joaquin River Trail, a footbridge, a primitive campground, and a reproduction Native American village. Recreation facilities affected by this alternative plan are shown in Figure 5-1.

With a 275- to 600-acre increase in reservoir surface area, the shoreline of Millerton Lake would be accessible less often for recreation with the Temperance Flat RM 274 Reservoir alternative plan. However, the increased surface area would somewhat improve boating conditions on Millerton Lake.

Cultural Resources

Prior archaeological surveys examined 26.4 percent of the Temperance Flat RM 274 Reservoir area, and a total of 36 archaeological sites were previously recorded. These include 27 prehistoric sites, five historic-era sites, and four sites with prehistoric and historic components. No historical structures were recorded. Local Native American tribes expressed opposition to the Temperance Flat RM 274 Reservoir alternative, indicating that the area is very sensitive, with 20 identified areas of concern, including village sites, gathering areas, and religious areas. Some Native American groups specified that some of the more sensitive and important locations are in the Temperance Flat and Squaw Leap areas, and that a new nearby dam would be very detrimental.

Sensitivity analyses were conducted for prehistoric and historic-era sites across the alternatives to address data gaps using methods tailored to each data set. The sensitivity analyses estimate the number of archaeological sites that may exist if the entire area were surveyed. Although the goal of the sensitivity analysis is to accurately estimate the actual number of existing archaeological sites, it is possible that the number of sites could be substantially less or greater than the number of sites estimated. Based on the sensitivity analyses, approximately 155 archaeological sites and historical resources are estimated within the Temperance Flat RM 274 Reservoir area, including 89 historic-era resources (mostly mining-related) and 66 prehistoric resources (Table 5-16).

Table 5-16. Estimated Number of Archaeological Sites Affected Under Temperance Flat RM 274 Reservoir Alternative Plans

Archaeological Sites	Temperance Flat RM 274 Reservoir (1,260 TAF)
Historic-Era Resources	***89***
Homestead-related sites	9
Sites associated with structures	5
Mines and mining patents	9
Sites within Big Bend Mining Claim concentration	21
Sites within Temperance Flat/Crook Mountain Mining Claim concentration	42
Roads	0
Hydroelectric/water engineering facilities	3
Recorded structures	0
Prehistoric Resources	***66***
Residential sites	24
All other sites	42
Total Resources	**155**

Key: RM = river mile TAF = thousand acre-feet

Economics

This section summarizes information for estimated costs and potential benefits of the Temperance Flat RM 274 Reservoir alternative plans.

Estimated Costs

Estimated costs for construction of Temperance Flat RM 274 Reservoir are presented in Table 5-17. This appraisal-level cost estimate for Temperance Flat RM 274 Reservoir is subject to change as the feasibility study progresses. The magnitude of contingencies would also decrease as the feasibility study progresses and uncertainties regarding site conditions decrease.

Table 5-17. Cost Estimate Summary for Temperance Flat RM 274 Reservoir Alternative Plans

Item	Estimated Cost[1,2] ($million)
Features	
Embankment Dam	$430
Diversion Structures	$510
Spillway	$400
Outlet Works	$100
Power Features	$990
Affected Infrastructure	$10
Temperature Control Device at Friant Dam	$155
TOTAL FIELD COST[3]	**$2,595**
Non-Contract Costs	
Planning, Engineering, Design and Construction Management (10%)	$260
Acquisition of Private Lands	$16
Replacement Recreation Facilities	$7
Environmental Mitigation	$17
Cultural Resources Mitigation	$6
TOTAL CONSTRUCTION COST	**$2,901**
Interest During Construction	$457
TOTAL CAPITAL COST	**$3,358**
Interest and Amortization	$165
Annual Operations and Maintenance	$4
Annual Replacement Power	$0
Annual Transvalley Exchange Power	NE
TOTAL ANNUAL COST[4]	**$169**

Notes:
General: This appraisal-level cost estimate is preliminary and subject to revision in the Feasibility Report.

[1] Costs are presented in 2006 dollars

[2] Values may not add to totals because of rounding.

[3] The embankment dam costs include the following allowances: 5 percent mobilization, 10 percent unlisted items, and 20 percent construction contingency. All other features include allowances of 5, 15, and 25 percent, respectively.

[4] Based on 4-7/8 discount rate and 100-year period of analysis.

Key:
NE = not estimated
RM = river mile

Potential Benefits

Estimated potential monetary benefits for the Temperance Flat RM 274 Reservoir alternative plans, developed for several categories using methods described previously in this chapter, are summarized in Tables 5-18.

Table 5-18. Potential Annual Benefits for Temperance Flat RM 274 Reservoir Alternative Plans

Item	Operations Integration				
	Friant Only	SWP/CVP/ Friant		SWP/ Friant	SWP/ Friant
		Transvalley Conveyance			
		SW/CVC/AE			AE
Potential Monetary Benefits ($million)					
Agricultural Water Supply Reliability	$46.1	$55.2		$50.4	$48.4
M&I Water Supply Reliability	$1.7	$57.3		$74.2	$38.4
M&I Water Quality	$0.0	$8.2		$7.4	$2.8
Flood Damage Reduction	$4.2	$2.3		$2.1	$3.4
Hydropower Generation	$0.6	-$0.4	-$2.6	-$0.3	$0.03
Recreation	$6.7	$7.3	$8.1	$7.3	$7.3
Emergency Water Supply	$8.0	$14.6		$14.5	$11.2
Ecosystem	$24.5	$24.5		$24.5	$24.5
Total Potential Monetary Benefits	**$91.8**	**$169.0**	**$167.6**	**$180.1**	**$136.0**

Note:

[1] Millerton Baseline reservoir balancing option listed on the left and Millerton High reservoir balancing option listed on the right.

Key:

AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
M&I = municipal and industrial
RM = river mile
SLIS = selective level intake structure
SWP = State Water Project
SW = Shafter-Wasco
TCD = temperature control device

Regional Economic Effects

Regional economic evaluations are discussed in the sections on Temperance Flat RM 274 Reservoir with Trans Valley Canal alternative plans and Temperance Flat RM 279 Reservoir alternative plans.

Temperance Flat RM 274 Reservoir with Trans Valley Canal Alternative Plans

This section describes the components, accomplishments, potential effects, and economics of the Temperance Flat RM 274 Reservoir with Trans Valley Canal alternative plans.

Plan Components

Surface water storage measures, water temperature management measures, and energy generation measures for this grouping of alternative plans are the same as described previously for the Temperance Flat RM 274 Reservoir alternative plans.

Increase Transvalley Conveyance Capacity Measures

The Trans Valley Canal would have a conveyance capacity of 1,000 cfs. A conceptual alignment for the canal is over 50 miles long, and includes a connection to the Friant-Kern Canal near Porterville at the Tulare Check Structure and a connection to the California Aqueduct south of the Tulare Lake bed. It is assumed that the Trans Valley Canal would be configured to flow both east-to-west and west-to-east, as needed, to facilitate exchanges. Primary components of this conveyance would be the penstock from the California Aqueduct to the valley floor, a canal across the valley floor, and a lift canal on the valley's eastern slope. The Trans Valley Canal could have several potential alternative configurations and alignments. This measure is also being studied by the FWUA-MWDSC Partnership and the SJRRP.

Reservoir Operations and Water Management Measures

Alternative plans for Temperance Flat RM 274 Reservoir with Trans Valley Canal were evaluated under four distinct operations scenarios associated with the reservoir operations and water management measures. These scenarios vary according to the options applied for the extent of operations integration, available transvalley conveyance, and reservoir balancing. These three options within the four operations scenarios are summarized in Table 5-19 and as described previously under water management measures for Temperance Flat RM 274 Reservoir alternative plans.

Table 5-19. Four Reservoir Operations Scenarios Simulated for Temperance Flat RM 274 with Trans Valley Canal Alternative Plans

Alternative Plans	Operations Integration Option	Transvalley Conveyance Option	Reservoir Balancing Option
Temperance Flat RM 274 Reservoir + Trans Valley Canal	CVP/Friant	TVC/SW/CVC/AE	Millerton Baseline
	SWP/Friant	TVC/SW/CVC/AE	Millerton Baseline
	SWP/CVP/Friant	TVC/SW/CVC/AE	Millerton Baseline
	SWP/CVP/Friant	TVC/AE	Millerton Baseline

Key:
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
N/A = not applicable
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project
TVC = Trans Valley Canal

Potential Accomplishments

This section summarizes the potential accomplishments of the Temperance Flat RM 274 Reservoir with Trans Valley Canal alternative plans, including water supply reliability, water temperature, energy generation, flood damage reduction, M&I water quality, recreation opportunities, emergency water supply, and ecosystem enhancement.

Water Supply Reliability

Table 5-20 summarizes average annual changes in water deliveries from without-project conditions for the Temperance Flat RM 274 Reservoir with Trans Valley Canal alternative plans, based on CALSIM simulations. Increasing conveyance capacity with the Trans Valley Canal would substantially increase deliveries compared to alternative plans without the canal, as indicated by the "TVC increment" column in the table. The operations scenario involving the SWP, CVP, and Friant Division would produce the largest average annual increase in delivery, but the SWP/Friant operations scenario would result in the greatest increase in M&I and dry year deliveries.

On average, the Temperance Flat RM 274 Reservoir with Trans Valley Canal alternative plans would provide between 177 to 240 TAF per year of additional agricultural and M&I water deliveries, depending on operations scenario.

Table 5-20. Average Annual Change in Delivery for Temperance Flat RM 274 Reservoir with Trans Valley Canal Alternative Plans

Item	Operations Integration							
	SWP/ CVP/Friant		SWP/Friant		CVP/Friant		SWP/CVP/Friant	
	Transvalley Conveyance							
	TVC/SW/CVC/AE						TVC/AE	
	Change in Delivery	TVC Increment	Change in Delivery	TVC Increment	Change in Delivery	TVC Increment	Change in Delivery	TVC Increment
Total (TAF)								
Dry & Critical Years	254	+86	230	+59	168	+48	206	+90
All Years	240	+60	177	+20	214	+47	211	+86
Friant Division (TAF)								
Dry & Critical Years	105	-1	107	+1	107	-1	104	-3
All Years	106	-2	107	0	109	-1	105	-4
CVP (TAF)								
Dry & Critical Years	47	+26	-1	+3	103	+57	38	+36
All Years	68	+30	-3	-1	112	+45	58	+58
SWP (TAF)								
Dry & Critical Years	102	+61	123	+55	-43	-8	64	+57
All Years	67	+31	74	+20	-7	+3	48	+32

Note:
All dry and critical year values are reported based on the Sacramento River Index. Reporting of changes in Friant Division deliveries based on the San Joaquin River Index would result in higher dry and critical year values.

Key:
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project
TAF = thousand acre-feet
TVC = Trans Valley Canal

Emergency Water Supply

Emergency water supply benefits to SOD urban water users that would be achieved through the Temperance Flat RM 274 alternative plans are listed in Table 5-21. Emergency water supply benefits range from $19.3 million to $23.8 million, depending on the operations scenario.

Table 5-21. Annual Emergency Water Supply Benefits from Temperance Flat RM 274 Reservoir with Trans Valley Canal Alternative Plans

Item	Operations Integration		
	SWP/CVP/Friant	SWP/Friant	SWP/CVP/Friant
	Transvalley Conveyance		
	TVC/SW/CVC/AE		TVC/AE
Avg. Emergency Water Supply, 20-Island Breach (TAF)	500	456	424
Annual Benefits, 20-Island Breach ($million)	$23.8	$22.0	$19.3

Key:
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project
TAF = thousand acre-feet
TVC = Trans Valley Canal

Ecosystem and Water Temperature

Water temperature evaluations for Temperance Flat RM 274 Reservoir with Trans Valley Canal alternative plans demonstrated improvements in ability to preserve and manage cold water compared to future without-project conditions. Relative improvements, or in some cases, decreases, in total cold water volume at or below 52ºF in Temperance Flat RM 274 Reservoir and Millerton Lake are shown in Figure 5-3. As described previously, changes in total cold water volume are based on cold water volume multipliers equal to cold water volume developed by alternatives divided by the volume of cold water available under future without-project conditions. Temperance Flat RM 274 Reservoir with Trans Valley Canal alternative plans improve the ability to preserve and manage cold water for releases to the San Joaquin River, especially during summer and fall months.

The Temperance Flat RM 274 Reservoir with Trans Valley Canal alternative plan was not specifically evaluated for monetary ecosystem benefits. The results of this alternative plan are expected to be similar to those for the Temperance Flat RM 274 alternative plans.

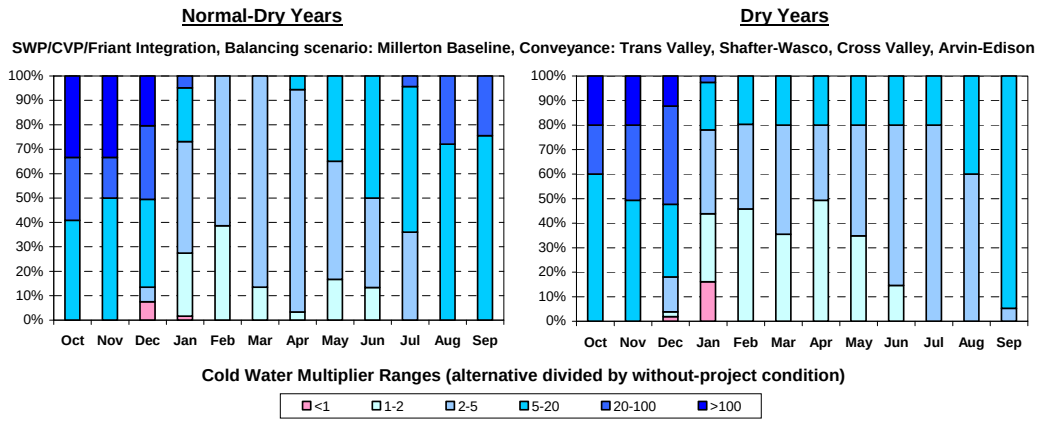

Figure 5-3. Changes in Cold Water Volume Below 52ºF for Temperance Flat RM 274 Reservoir with Trans Valley Canal Alternative Plans

Energy Generation

As shown in Table 5-22, energy generation for the Temperance Flat RM 274 Reservoir with Trans Valley Canal would replace about 94 percent of the average annual Kerckhoff Project generation impacted by the alternative plans. The differences in conveyance capacity between the operations scenarios evaluated had almost no effect on power generation. Changes to CVP and SWP system-wide energy generation and use were not simulated for this grouping of alternative plans.

Table 5-22. Estimated Net Energy Generation for Temperance Flat RM 274 Reservoir with Trans Valley Canal Alternative Plans

Item	Operations Integration	
	SWP/CVP/Friant	
	Transvalley Conveyance	
	TVC/SW/CVC/AE	TVC/AE
Impacted Kerckhoff Project Generation (GWh/year)	-518	-518
Temperance Flat RM 274 Generation (GWh/year)	473	474
Additional Friant Generation (GWh/year)	13	14
Net Power Generation (GWh/year)	-32	-30
Percent of Impacted Generation Replaced	94%	94%

Key:
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
GWh = gigawatt-hour
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project
TVC = Trans Valley Canal

Flood Damage Reduction

Potential annual flood damage reduction benefits accomplished through the Temperance Flat RM 274 Reservoir with Trans Valley Canal alternative plans are listed in Table 5-23. Potential flood damage reduction benefits range from $1.3 to almost $1.9 million.

Table 5-23. Annual Flood Damage Reduction for Temperance Flat RM 274 Reservoir with Trans Valley Canal Alternative Plans (90 percent exceedence)

Item	Operations Integration		
	SWP/CVP/Friant	SWP/Friant	SWP/CVP/Friant
	Transvalley Conveyance		
	TVC/SW/CVC/AE		TVC/AE
90% Exceedence Flood Space (TAF)	210	257	209
Annual Flood Damage Reduction ($million)	$1.4	$1.9	$1.3

Key:
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project
TAF = thousand acre-feet
TVC = Trans Valley Canal

M&I Water Quality

M&I water quality benefits that would be achieved through the Temperance Flat RM 274 alternative plans with Trans Valley Canal are listed in Table 5-24. Water quality benefits range from $11.1 million to $16.4 million.

Table 5-24. Annual M&I Water Quality WTP Benefits from Temperance Flat RM 274 Reservoir with Trans Valley Canal Alternative Plans

Item	Operations Integration		
	SWP/CVP/Friant	SWP/Friant	SWP/CVP/Friant
	Transvalley Conveyance		
	TVC/SW/CVC/AE		TVC/AE
Average Change in TDS (mg/L)	-15.4	-13.8	NE
Annual M&I Water Quality Benefit ($million)	$16.4	$15.2	$11.1

Key:
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
M&I = municipal and industrial
mg/L = milligrams per liter
NE = not estimated
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project
TAF = thousand acre-feet
TDS = total dissolved solids
TVC = Trans Valley Canal
WTP = willingness to pay

Recreation Opportunities

The Temperance Flat RM 274 Reservoir with Trans Valley Canal alternative plans were not specifically evaluated for effects on recreation opportunities. The results of these alternative plans are expected to be similar to those of the Temperance Flat RM 274 alternative plans.

Primary Potential Effects

Primary potential effects are described below for aquatic biological resources, terrestrial biological resources, recreation resources, and cultural resources that would be affected by the Temperance Flat RM 274 Reservoir with Trans Valley Canal alternative plans.

Aquatic Biological Resources

Temperance Flat RM 274 with Trans Valley Canal alternative plans are likely to have the same effects on aquatic resources in the primary study area as Temperance Flat RM 274 Reservoir alternative plans. Impact analyses for the Trans Valley Canal measure for this alternative have not yet been conducted, but will be completed for the Feasibility Report and EIS/EIR.

Terrestrial Biological Resources

Potential effects of Temperance Flat RM 274 Reservoir with Trans Valley Canal alternative plans on terrestrial biological resources within the inundation area for the alternatives would be the same as the effects described above for Temperance Flat RM 274 Reservoir alternative plans. Effects of the Trans Valley Canal measure for these alternative plans have not been evaluated, but will be completed for the Feasibility Report and EIS/EIR.

Recreation Resources

Temperance Flat RM 274 with Trans Valley Canal alternative plans are likely to have the same effects on recreation resources in the primary study area as Temperance Flat RM 274 Reservoir alternative plans. Impact analyses for the Trans Valley Canal measure for this alternative have not yet been conducted, but will be completed for the Feasibility Report and EIS/EIR.

Cultural Resources

Potential effects on cultural resources associated with the Temperance Flat RM 274 Reservoir for these alternative plans would be the same as the potential effects described above for the Temperance Flat RM 274 alternative plans. Impact analyses for the Trans Valley Canal measure for this alternative have not yet been conducted, but will be completed for the Feasibility Report and EIS/EIR.

Economics

This section summarizes information for estimated costs and potential benefits of the Temperance Flat RM 274 Reservoir with Trans Valley Canal alternative plans.

Estimated Costs

Estimated costs for construction of Temperance Flat RM 274 Reservoir and the Trans Valley Canal are presented in Table 5-25. The cost information for the Trans Valley Canal is based on pre-appraisal level cost estimates prepared on behalf of the FWUA-MWDSC Partnership. The potential benefits estimates and water operations modeling were both based on a bidirectional Trans Valley Canal. Unidirectional canal cost estimates were expanded to provide a preliminary indication of the relative magnitude of costs for a bidirectional Trans Valley Canal. This cost information was used to facilitate comparison to the incremental benefits provided by the Trans Valley Canal to determine whether more detailed study is warranted.

Table 5-25. Cost Estimate Summary for Temperance Flat RM 274 Reservoir with Trans Valley Canal Alternative Plans

Item	Estimated Cost[1,2] ($millions)
Features	
Embankment Dam	$430
Diversion Structures	$510
Spillway	$400
Outlet Works	$100
Power Features	$990
Affected Infrastructure	$10
Temperature Control Device at Friant Dam	$155
Trans Valley Canal	$490
TOTAL FIELD COST[3]	**$3,085**
Non-Contract Costs	
Planning, Engineering, Design and Construction Management[4]	$358
Acquisition of Private Lands	$19
Replacement Recreation Facilities	$7
Environmental Mitigation[5]	$17
Cultural Resources Mitigation	$8
TOTAL CONSTRUCTION COST	**$3,494**
Interest During Construction	$551
TOTAL CAPITAL COST	**$4,045**
Interest and Amortization	$199
Annual Operations and Maintenance	$5
Annual Replacement Power	$0
Annual Cross Valley Exchange Power	NE
TOTAL ANNUAL COST[6]	**$204**

Notes:

General: This appraisal-level cost estimate is preliminary and subject to revision in the Feasibility Report.

[1] Costs are presented in 2006 dollars.

[2] Values may not add to totals due to rounding.

[3] The embankment dam costs include the following allowances: 5 percent mobilization, 10 percent unlisted items, and 20 percent construction contingency. The Trans Valley Canal costs include allowances of 5, 20, and 30 percent, respectively. All other features include allowances of 5, 15, and 25 percent, respectively.

[4] The planning, engineering, design, and construction management cost for the dam features and Trans Valley Canal is 10 and 20 percent of each feature's field cost, respectively.

[5] Environmental mitigation has not been estimated for the Trans Valley Canal.

[6] Based on 4-7/8 discount rate and 100-year period of analysis.

Key:
NE = not estimated
RM = river mile

Potential Benefits

Estimated potential monetary benefits for the Temperance Flat RM 274 Reservoir with Trans Valley Canal alternative plans, developed for several categories using methods described previously in this chapter, are summarized in Table 5-26.

Table 5-26. Potential Annual Benefits for Temperance Flat RM 274 Reservoir with Trans Valley Canal Alternative Plans

Item	Operations Integration		
	SWP/CVP/ Friant	SWP/Friant	SWP/CVP/Friant
	Transvalley Conveyance		
	TVC/SW/CVC/AE		TVC/AE
Potential Monetary Benefits ($million)			
Agricultural Water Supply Reliability	$59.1	$50.4	$55.8
M&I Water Supply Reliability	$81.9	$93.2	$70.0
M&I Water Quality	$16.4	$15.2	$11.1
Flood Damage Reduction	$1.4	$1.9	$1.3
Hydropower Generation	-$1.2	-$0.3	-$1.1
Recreation	$7.3	$7.3	$7.3
Emergency Water Supply	$23.8	$22.0	$19.3
Ecosystem	$24.5	$24.5	$24.5
Total Potential Monetary Benefits	**$213.2**	**$214.2**	**$188.2**

Key:
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
M&I = municipal and industrial
RM = river mile
SLIS = selective level intake structure
SW = Shafter-Wasco
SWP = State Water Project
TCD = temperature control device
TVC = Trans Valley Canal

Regional Economic Effects

Table 5-27 presents the results of the Friant Division and Statewide regional economic model simulations for Temperance Flat Reservoir RM 274 Reservoir with Trans Valley Canal alternative plans.

Table 5-27. Regional Economic Impacts by Impact Area for Temperance Flat RM 274 with Trans Valley Canal Alternative Plans

Item	Output ($million)		Income ($million)		Employment (jobs)	
Impact Area	**Direct**	**Total**	**Direct**	**Total**	**Direct**	**Total**
Friant Division	$31.1	$42.9	$6.4	$10.1	190	290
Statewide	$45.5	$70.8	$12.7	$22.9	270	460

Key:
RM = river mile

For Temperance Flat RM 274 Reservoir with the Trans Valley Canal and SWP/CVP/Friant operations integration and SW/CVC/AE/TVC conveyance options scenario, the direct impact to industries would be $31.1 million within the Friant Division counties, and about $45.5 million in the State. These direct impacts would yield indirect and induced impacts throughout the region and the State, respectively. "Indirect impacts" accrue largely to input supply and support industries, but accrue to many other sectors as well. "Induced impacts" are the change in overall output throughout the region as a result of greater household spending. The combined total of direct, indirect, and induced impacts would result in a total economic impact of $42.9 million annually in the Friant Division and $70.8 million statewide.

The second measure of regional impacts is "Personal Income," the sum of employee compensation and proprietor income, and a measure of benefit for the RED account. The direct impact in the Friant Division would be $6.4 million; after accounting for indirect and induced impacts, the total impact on personal income in the Friant Division counties would be just over $10.1 million annually. In California, the direct impact on personal income would be $12.7 million, and the total impact would be $22.9 million.

Employment impacts are measured in total jobs, whether full- or part-time, of the businesses producing the output. In the Friant Division, the direct impact would be about 190 jobs, mostly to those involved in crop production. This leads to a total impact of about 290 jobs in those counties. Across the state, the direct impact would be 270 jobs, with a total impact of 460 jobs.

Temperance Flat RM 279 Reservoir Alternative Plans

This section describes the components, accomplishments, potential effects, and economics of the Temperance Flat RM 279 Reservoir alternative plans.

Plan Components

Temperance Flat RM 279 Reservoir would be created through construction of a dam in the upstream portion of Millerton Lake at RM 279.

Surface Water Storage Measures

The Temperance Flat RM 279 Dam site is located approximately 11.6 miles upstream from Friant Dam near the upstream extent of Millerton Lake. Permanent features would include a main dam with an uncontrolled spillway to pass flood flows, a powerhouse to generate electricity, and an outlet works for other controlled releases. Upstream and downstream cofferdams would be required for river diversion, and to keep Millerton Lake out of the construction zone. Diversion tunnels to route river flows around the construction zone would be required during construction. Figure 5-4 shows the extent of Temperance Flat RM 279 Reservoir and power features, and affected features in the reservoir area.

At the top of active storage capacity (elevation 985), Temperance Flat RM 279 Reservoir would provide about 690 TAF additional storage (705 TAF total storage, 17 TAF of which would overlap with Millerton Lake), and would have a surface area of about 3,490 acres. The reservoir would extend about 13.6 miles upstream from RM 279 to Kerckhoff Dam. At top of active storage capacity, the reservoir would reach about 12 feet below the crest of Kerckhoff Dam. Temperance Flat RM 279 Reservoir would reduce Millerton Lake storage volume and acreage at the top of active storage to 507 TAF and 4,540 acres, respectively.

RCC and embankment dam types have been recently considered for the RM 279 dam site, and a formal decision has not yet been made regarding which dam type would be selected. Embankment dam types were assumed for the designs and cost estimates in the PFR. The dam would be about 545 feet high, from about elevation 460 in the bottom of Millerton Lake (San Joaquin River channel) at the upstream face to the dam crest at elevation 1,005. No saddle dams would be required.

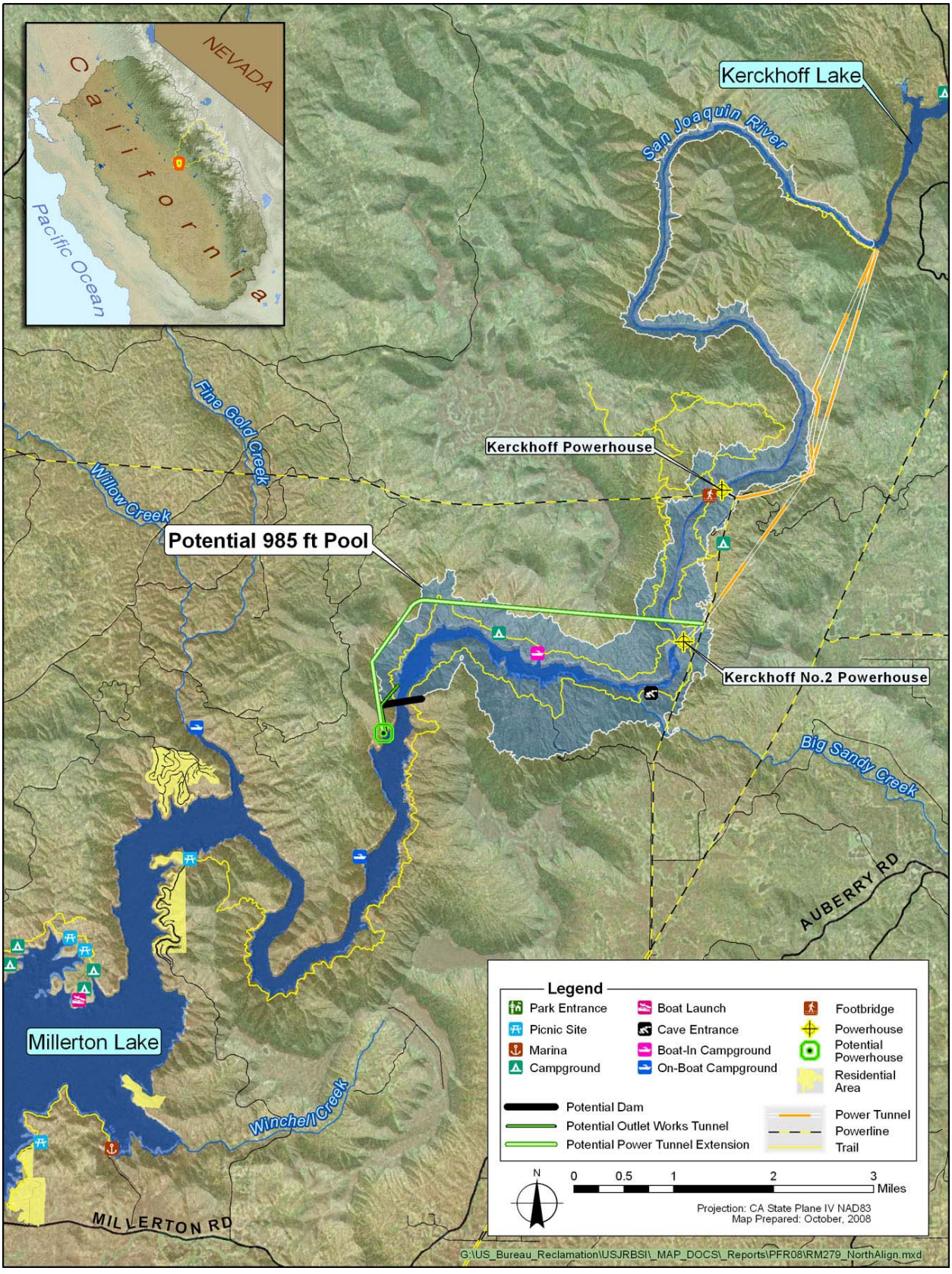

Figure 5-4. Potential Temperance Flat RM 279 Reservoir

Water Temperature Management Measures

Potential river restoration measures include a SLIS on the main dam and a TCD on Friant Dam. A multiple-port SLIS could be constructed for Temperance Flat RM 279 Dam to improve management of the cold water pool in the reservoir for releases to Millerton Lake. The SLIS would be designed and operated to withdraw water from the highest level in the reservoir that would meet temperature targets, thereby preserving colder water at lower elevations in the reservoir. Without a SLIS, water would be drawn from the reservoir at the same elevation as the outlet works.

A TCD on Friant Dam would be operated in a manner similar to above. TCDs also could be constructed on the canal and river outlets at Friant Dam to divert warmer water from the upper portion of the reservoir and preserve colder water for release to the river.

Energy Generation Measures

Temperance Flat RM 279 Reservoir would inundate the Kerckhoff and Kerckhoff No. 2 powerhouses. These facilities would be decommissioned and abandoned. Temperance Flat RM 279 Reservoir alternative plans include features to mitigate the loss of generation from the Kerckhoff Project powerhouses. These features would involve modifying and extending the Kerckhoff No. 2 Powerhouse tunnel to route water from Kerckhoff Lake to a new powerhouse and release valves downstream from Temperance Flat RM 279 Dam that would discharge into Millerton Lake, as shown in Figure 5-4. Tunnel extension alignments both north and south of the San Joaquin River have been considered; the northern alignment was assumed for the appraisal-level designs and cost estimates in the PFR. Water not routed through the extended tunnel would flow into Temperance Flat RM 279 Reservoir from Kerckhoff Lake. This configuration would make use of the relatively constant head in Kerckhoff Lake to maximize power generation. The powerhouse would have a capacity of 135 MW, with 120 MW from three 40-MW units on the extended Kerckhoff No. 2 Powerhouse tunnel, and one 15-MW unit on an outlet works tunnel from Temperance Flat RM 279 Reservoir. The configuration of power features is subject to change as the feasibility study progresses.

During normal releases, all flows would pass through the turbines. During turbine outages, the outlet valves would be operated as necessary to maintain water operations flows. During periods of high inflow, the outlet works release valves could be used to supplement releases, in combination with the spillway, as necessary.

Reservoir Operations and Water Management Measures

Alternative plans for Temperance Flat RM 279 Reservoir were evaluated under six distinct operations scenarios associated with the reservoir operations and water management measures. These scenarios vary according to the options applied for the extent of operations integration, available transvalley conveyance, and reservoir balancing. These three options within the six operations scenarios are summarized in Table 5-28 and described in the following sections and as described previously under water management measures for Temperance Flat RM 274 Reservoir alternative plans.

Table 5-28. Six Reservoir Operation Scenarios Simulated for Temperance Flat RM 279 Alternative Plans

Alternative Plans	Operations Integration Options	Transvalley Conveyance Options	Reservoir Balancing Options
Temperance Flat RM 279 Reservoir	Friant Only	N/A	Millerton Baseline
	SWP/Friant	AE	Millerton Baseline
	SWP/Friant	SW/CVC/AE	Millerton Baseline
	CVP/Friant	SW/CVC/AE	Millerton Baseline
	SWP/CVP/Friant	SW/CVC/AE	Millerton Baseline
	SWP/CVP/Friant	SW/CVC/AE	Millerton High

Key:
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
N/A = not applicable
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project

Potential Accomplishments

This section summarizes the potential accomplishments of the Temperance Flat RM 279 Reservoir alternative plans, including water supply reliability, water temperature, energy generation, flood damage reduction, M&I water quality, recreation opportunities, emergency water supply, and ecosystem enhancement.

Water Supply Reliability

Table 5-29 summarizes average annual changes in water deliveries for the Temperance Flat RM 279 operations scenarios, based on CALSIM simulations. The reservoir balancing options have a minimal effect on deliveries and are not shown. The operations scenario involving the SWP, CVP, and Friant Division would produce the largest average annual increase in delivery, but the SWP/Friant with full conveyance operations scenario would result in the greatest increase in M&I and dry year deliveries.

The last column in the table assumes transvalley conveyance capacity would only be available in AE, and illustrates the sensitivity of delivery results on available conveyance for exchanges. For the SWP/Friant operations integration options, annual average SWP delivery decreased by about 13 TAF when conveyance capacity was assumed to be limited to AE.

On average, the Temperance Flat RM 279 Reservoir alternative plans would provide between 83 to 132 TAF per year of additional agricultural and M&I water deliveries, depending on operations scenario.

Table 5-29. Average Annual Change in Delivery for Temperance Flat RM 279 Reservoir Alternative Plans

Item	Operations Integration				
	Friant Only	SWP/ CVP/Friant	SWP/Friant	CVP/Friant	SWP/Friant
		Transvalley Conveyance			
		SW/CVC/AE[1]			AE
Total (TAF)					
Dry & Critical Years	82	120	103	85	81
All Years	83	132	107	128	94
Friant Division (TAF)					
Dry & Critical Years[2]	84	81	81	83	81
All Years	86	83	83	85	83
CVP (TAF)					
Dry & Critical Years[2]	-4	20	1	31	-4
All Years	-5	32	1	53	-1
SWP (TAF)					
Dry & Critical Years[2]	2	19	21	-29	4
All Years	2	17	23	-9	12

Notes:

[1] Reservoir balancing option has negligible effect on water deliveries.

[2] All dry and critical values are reported based on the Sacramento River Index. Reporting changes in Friant Division deliveries based on the San Joaquin River Index would result in higher dry and critical year values.

Key:

AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project
TAF = thousand acre-feet

Emergency Water Supply

Alternatives to increase surface water storage in the upper San Joaquin River Basin offer the potential to provide emergency water supplies in the event of a disruption in the Delta. Emergency water supply benefits are the value of water supplies in upper San Joaquin River Basin storage facilities that can be used to increase supplies to urban water users in the event of a major levee failure in the Delta that would significantly degrade water quality. Table 5-30 presents the annual emergency water supply benefits for Temperance Flat RM 279 Reservoir. As shown, annual benefits range from $6.4 to $11.5 million, depending on operations scenario.

Table 5-30. Annual Emergency Water Supply Benefits from Temperance Flat RM 279 Reservoir Alternative Plans

Item	Operations Integration			
	Friant Only	SWP/CVP/ Friant	SWP/ Friant	SWP/ Friant
		Transvalley Conveyance		
		SW/CVC/AE		AE
Avg. Emergency Water Supply, 20-Island Breach (TAF)	131	246	235	209
Annual Benefits, 20-Island Breach ($million)	$6.4	$11.5	$11.1	$9.5

Key:
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project

Ecosystem and Water Temperature

Several reservoir water temperature simulations were performed for Temperance Flat RM 279 Reservoir alternative plans for the various operations scenarios. All scenarios evaluated for alternatives were effective in preserving the total volume of cold water in Millerton Lake and Temperance Flat RM 279 reservoirs, and improving the ability to manage cold water volumes for releases to the San Joaquin River. Results demonstrating the relative improvements, or in some cases, decreases, in total cold water volume at or below 52ºF in Temperance Flat RM 279 Reservoir and Millerton Lake for Temperance Flat RM 279 Reservoir alternative plans are shown in Figure 5-5. Reservoir balancing and operations integration options for the Temperance Flat RM 279 Reservoir alternative plans do not appear to have substantial differences in the ability to manage and release cold water to the San Joaquin River for support of assumed restoration temperature thresholds throughout the year.

The alternative plans would provide the opportunity to improve the probability of meeting temperature thresholds during the critical spawning and incubation periods for salmon of September through December. As noted above, the differences among operation scenarios were small relative to the limited precision of the applied temperature modeling and economic estimation. Therefore, the results were applied uniformly to each alternative plan. The preliminary annual ecosystem benefits for Temperance Flat RM 279 Reservoir alternative plans are $24.5 million.

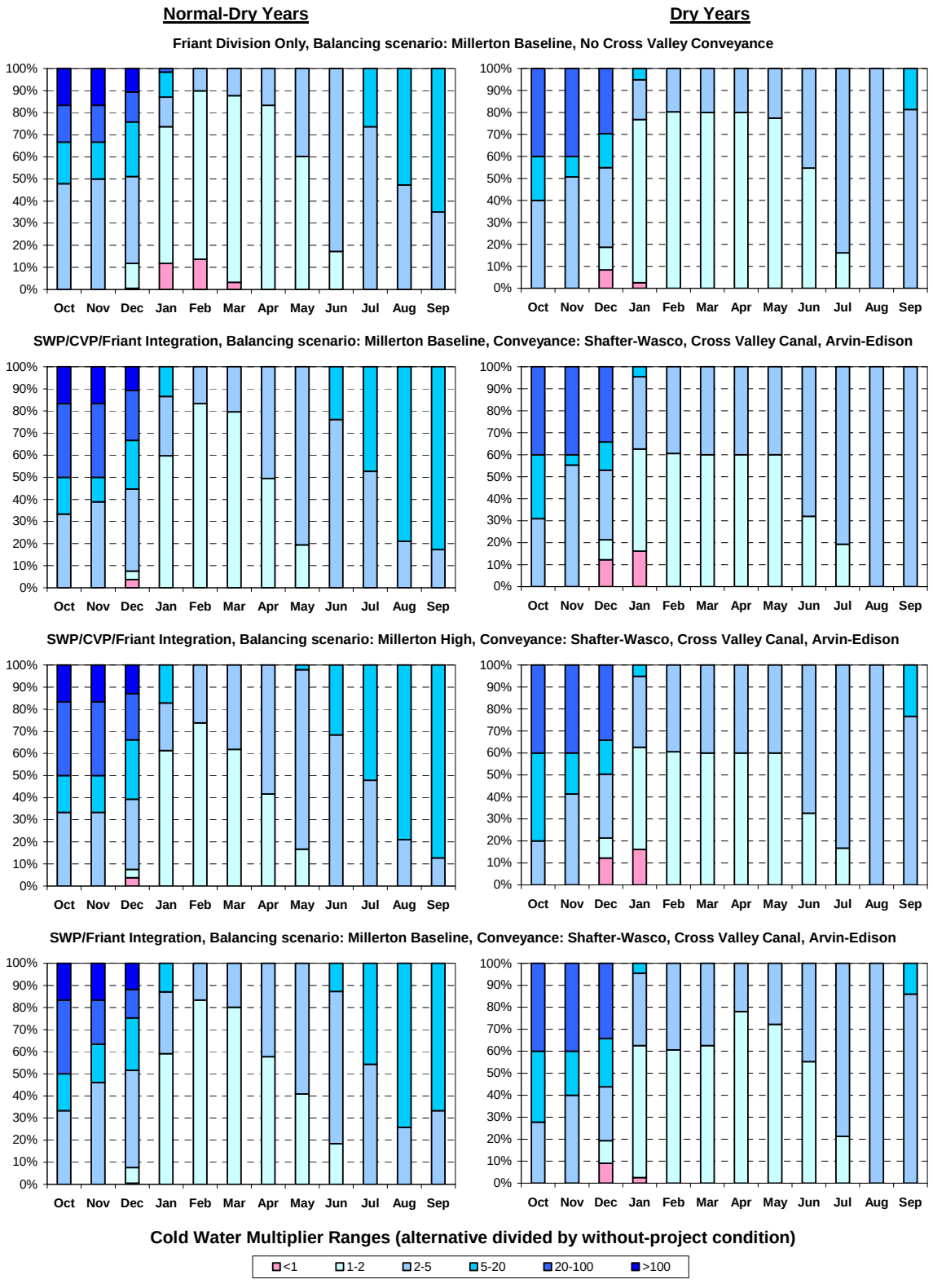

Figure 5-5. Changes in Cold Water Volume Below 52ºF for Temperance Flat RM 279 Reservoir Alternative Plans

Energy Generation

Most of the hydropower generation for the Temperance Flat RM 279 Reservoir alternatives would be accomplished by diverting flow into the Kerckhoff No. 2 Powerhouse tunnel at Kerckhoff Lake and discharging flow through a new powerhouse just downstream from Temperance Flat RM 279 Dam into Millerton Lake. Releases from Temperance Flat RM 279 Reservoir would also be used for power generation. As shown in Table 5-31, this grouping of alternative plans would generate enough energy to replace all or most of the energy lost through inundation of the Kerckhoff Project powerhouses, on an average annual basis.

Operations integration with SWP and/or CVP would result in slightly less power generation compared to the Friant Division only because of reduced available head. The lower heads with operations integration would occur as storage increases in both Millerton Lake and Temperance Flat as Delta supplies are delivered to Friant Division users and water levels increase in Millerton Lake and Temperance Flat RM 279 Reservoir. The Millerton High balancing option would result in less hydropower generation than the Millerton Baseline option, also due to reduced available head. For SWP/CVP integration with Millerton Baseline balancing, the power features could replace approximately 100 percent of the impacted Kerckhoff generation; therefore, even with operations integration, the impacted generation could generally be replaced.

Table 5-31. Estimated Energy Generation and Losses for Temperance Flat RM 279 Reservoir Alternative Plans

Item	Operations Integration				
	Friant Only	SWP/CVP/Friant		SWP/Friant	SWP/Friant
		Millerton Baseline	Millerton High		
		Transvalley Conveyance			
		SW/CVC/AE			AE
Impacted Kerckhoff Project Generation (GWh/year)	518	518	518	518	518
Temperance Flat Generation (GWh/year)	525	509	479	510	512
Additional Friant Generation (GWh/year)	8	11	18	10	11
Net Power Generation (GWh/year)	15	2	-21	2	5
Percent of Impacted Generation Replaced	103%	100%	96%	100%	101%

Key:
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
GWh = gigawatt-hour
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project

Table 5-32 demonstrates that operations integration would have insignificant effects to CVP and SWP system-wide energy generation and use. The balancing options would not have an effect on these impacts.

Table 5-32. Estimated System-Wide Energy Generation and Use for Temperance Flat RM 279 Reservoir Alternative Plans

Item		Operations Integration					
		Friant Only		SWP/CVP/Friant			
				Millerton Baseline		Millerton High	
				Transvalley Conveyance			
				SW/CVC/AE			
System		CVP	SWP	CVP	SWP	CVP	SWP
Average Annual Energy Generation (MWh)	Base	4,881	5,081	4,881	5,081	4,881	5,081
	Change from Base	0	1	3	54	3	41
Average Annual Energy Use (MWh)	Base	1,328	9,943	1,328	9,943	1,328	9,943
	Change from Base	5	4	0	209	30	162

Key:
CVP = Central Valley Project
MWh = megawatt-hour
RM = river mile
SWP = State Water Project

Flood Damage Reduction

Potential annual flood damage reduction benefits accomplished through the Temperance Flat RM 279 Reservoir alternative plans are listed in Table 5-33. Potential flood damage reduction benefits range from $0.7 to $2.3 million.

Table 5-33. Annual Flood Damage Reduction for Temperance Flat RM 279 Reservoir Alternative Plans (90 percent exceedence)

Item	Operations Integration			
	Friant Only	SWP/ CVP/Friant	SWP/Friant	SWP/Friant
		Transvalley Conveyance		
		SW/CVC/AE		AE
90% Exceedence Flood Space (TAF)	312	191	191	213
Annual Flood Damage Reduction ($million)	$2.3	$0.7	$0.7	$1.4

Key:
% = percent
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
RM = river mile
SW= Shafter-Wasco
SWP = State Water Project
TAF = thousand acre-feet

M&I Water Quality

M&I water quality benefits through the Temperance Flat RM 279 alternative plans are listed in Table 5-34. The estimated benefits based on willingness to pay range from $0.0 million to $7.5 million.

Table 5-34. Annual M&I Water Quality WTP Benefits from Temperance Flat RM 279 Reservoir Alternative Plans

Item	Operations Integration			
	Friant Only	SWP/CVP/ Friant	SWP/Friant	SWP/Friant
		Transvalley Conveyance		
		SW/CVC/AE		AE
Average Change in TDS (mg/L)	0.2	-5.0	-5.0	-2.0
Annual M&I Water Quality WTP Benefit ($million)	$0.0	$7.5	$7.4	$3.0

Key:
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
SW = Shafter-Wasco
SWP = State Water Project
TAF = thousand acre-feet

Recreation Opportunities

As described earlier, opportunities for recreation development vary depending on operations scenarios. Simulation results of recreation opportunities for Temperance Flat RM 279 Reservoir alternative plans that generally maintain Millerton Lake water levels at baseline average monthly storage levels would improve recreation opportunities in the primary study area. Millerton Lake levels would be slightly higher than the baseline pool elevation during April through July, and moderately higher through August. The higher pool elevations under the baseline average monthly storage level option would provide a minor potential benefit to boaters while maintaining good shoreline use conditions. However, changing the reservoir balancing option to generally keep Millerton Lake higher than its average monthly baseline storage levels would improve early and late season boating opportunities in Millerton Lake, but degrade shoreline use conditions. Operations integration options do not demonstrate substantial differences in recreation opportunities for alternative plans.

Highly suitable areas for recreation development are similar to those described above for Temperance Flat RM 274 Reservoir alternative plans. Few areas near the Millerton Lake SRA were determined to have high or intermediate suitability for recreation development, and are mostly on private property. Steep slopes, lack of road access, and remoteness from existing developed areas limit opportunities for recreation development within the SJRGMA. However, there is a large area of high suitability immediately upslope from existing recreation facilities within the SJRGMA.

Table 5-35 summarizes the recreation benefit results for Temperance Flat RM 279 Reservoir alternative plans, with estimates ranging from $4.0 million to $7.3 million.

Table 5-35. Estimates of Recreation Benefits for Temperance Flat RM 279 Reservoir Alternative Plans

Item	Operations Integration			
	Friant Only	SWP/Friant	SWP/CVP/ Friant	SWP/CVP/ Friant
			Millerton Baseline	Millerton High
Total ($million)	$5.4	$4.0	$4.0	$7.3

Key:
BL = Millerton baseline reservoir balancing option
CVP = Central Valley Project
High = Millerton high reservoir balancing option
RM = river mile
SWP= State Water Project

Primary Potential Effects

Primary potential effects are described below for aquatic biological resources, terrestrial biological resources, recreation resources, and cultural resources affected by the Temperance Flat RM 279 Reservoir alternative plans.

Aquatic Biological Resources

Potential effects that may result from Temperance Flat RM 279 Reservoir alternative plans to aquatic habitat conditions and species are discussed below.

Habitat Conditions The effects of Temperance Flat RM 279 Reservoir alternative plans on reservoir fish habitat would generally be similar to those described above for Temperance Flat RM 274 Reservoir alternative plans. These alternatives would produce a moderate increase in April-to-September shallow water habitat over future without-project conditions in Millerton Lake. The increase would result from increased storage upstream from Temperance Flat RM 279 Reservoir and Dam, although these alternative plans have less storage in the upstream reservoir than the Temperance Flat RM 274 Reservoir alternative plans.

April-to-June quarter-month water level fluctuations for the Temperance Flat RM 279 Reservoir alternative plans could be more variable than for Temperance Flat RM 274 Reservoir alternative plans. Both the mean reductions and increases of water level in Millerton Lake would be less than those under future without-project conditions. For the Temperance Flat RM 279 Reservoir, the increases and reductions in water level for two of the scenarios, the Friant-only integration and the SWP/CVP/Friant integration with SW/CVC/AE conveyance (Millerton Lake Baseline) scenarios, would be much

smaller than future without-project water level fluctuations in Millerton Lake, while for the SWP/CVP/Friant integration with SW/CVC/AE conveyance (Millerton Lake High) scenario, the water level increases and reductions would be slightly larger.

American shad and striped bass spawning habitat downstream from the Kerckhoff and Kerckhoff No. 2 powerhouses would be eliminated with the Temperance Flat RM 279 Reservoir alternative plans. New spawning habitat for these species would potentially be created in the upper reach of the new reservoir, downstream from Kerckhoff Dam, as described for the Temperance Flat RM 274 Reservoir alternative plans.

The loss of lotic habitat under the Temperance Flat RM 279 Reservoir alternative plans would be identical to the effects described above for the Temperance Flat RM 274 Reservoir alternative plans (Table 5-10).

Species The following sections describe potential effects to evaluated fish species for Temperance Flat RM 279 Reservoir alternative plans.

Largemouth and Spotted Bass Results of the largemouth and spotted bass model runs for Temperance Flat RM 279 Reservoir alternative plans are similar to the results described for Temperance Flat RM 274 Reservoir alternative plans. Spawning and rearing production in Millerton Lake would be reduced from that of the current reservoir under future without-project conditions, but offset by increased production in the reservoir created upstream from RM 279 for Temperance Flat RM 279 Reservoir alternative plans.

Smallmouth Bass, Bluegill, and Black Crappie Effects of Temperance Flat RM 279 Reservoir alternative plans on production of smallmouth bass, bluegill, and black crappie are expected to be similar to those described for the Temperance Flat RM 274 Reservoir alternative plans. Conditions for these species are expected to be degraded in Millerton Lake, and improved within the area of the reservoir upstream from RM 279.

Striped Bass and American Shad As described for the Temperance Flat RM 274 Reservoir alternative plans, these alternative plans would substantially increase the volume of deep, open water foraging habitat for striped bass and American shad, but would entirely eliminate the current spawning habitat of the species. The potential for creating new spawning habitat for American shad with these alternative plans, and the effects of the Temperance Flat dam on the new Millerton Lake, are likely to be much the same as those described for the Temperance Flat RM 274 Reservoir alternative plans.

Lotic Species Loss of useable fish habitat under Temperance Flat RM 279 Reservoir alternative plans would be the same as described earlier for the Temperance Flat RM 274 Reservoir alternative plans (Table 5-11).

Terrestrial Biological Resources

The following tables and discussion summarize effects to terrestrial habitats and species in the inundation area for the Temperance Flat RM 279 Reservoir alternative plans.

Habitat Table 5-36 shows acreages of habitat types that would be inundated by the Temperance Flat RM 279 Reservoir alternative plans. A total of 3,065 acres of vegetated habitat would be affected, along with 31 acres of developed and barren land, and 200 acres of riverine habitat. As is the case for Temperance Flat RM 274 Reservoir alternative plans, the greatest effect under these alternative plans would occur to foothill pine oak woodland and blue oak woodland habitats. Smaller areas of shrub, grassland, and riparian habitats would also be impacted.

Species Terrestrial species effects that may result from Temperance Flat RM 279 Reservoir alternative plans are discussed below. Species effects are similar to effects previously discussed for Temperance Flat RM 274 Reservoir alternative plans.

Rare Plants Of the 19 special-status plant species identified as either present or potentially occurring within the inundation area for Temperance Flat RM 274 Reservoir alternative plans, five were found within the inundation area for Temperance Flat RM 279 Reservoir alternative plans during 2007 field surveys (Table 5-37).

Table 5-14 summarizes the status, habitat, and likelihood of occurrence for the special-status plant species present or potentially occurring within the primary study area for both Temperance Flat RM 274 and RM 279 reservoir alternative plans.

Wildlife Resources The following sections summarize the likelihood of special-status wildlife species to occur within the inundation area for Temperance Flat RM 279 Reservoir alternative plans. As discussed above, potential wildlife species distribution is similar across the alternatives. The potential for special-status wildlife species to occur in the primary study area is summarized in Table 5-15. The following text highlights differences between the alternatives, when applicable.

Invertebrates As under the Temperance Flat RM 274 Reservoir alternatives, 10 California pipevine swallowtail butterfly populations were identified in the inundation area for the Temperance Flat RM 279 Reservoir alternative plans during 2007 field surveys.

Eighty-six elderberry shrubs with stems greater than 1 inch in diameter were identified within the inundation area for the Temperance Flat RM 279 Reservoir alternative plans. Four of these shrubs were observed to have valley elderberry longhorn beetle exit holes.

Table 5-36. Habitat Effects Under Temperance Flat RM 279 Reservoir Alternative Plans

Habitat Types	Temperance Flat RM 279 Reservoir (acres)
Foothill Pine Oak Woodland	2,152.4
Blue Oak Woodland	618.4
Live Oak Woodland	23.2
Foothill Pine Woodland	9.2
Foothill Pine Chaparral Woodland	4.8
Subtotal	**2,808.0**
Upland Shrub Habitat	
Buckbrush Chaparral	20.8
Bush Lupine Scrub	2.4
Subtotal	**23.2**
Upland Herbaceous Habitat	
Annual Grassland	47.7
Subtotal	**47.7**
Riparian Habitat	
White Alder Riparian	25.2
Mixed Riparian	2.1
Fig - Willow Riparian	2.6
Willow Woodland	1.9
Fig Riparian	0.5
Spanish Broom Scrub	0.5
Sycamore Woodland	0.4
Buttonbush Scrub	0.3
Subtotal	**33.5**
Herbaceous Wetland Habitat	
Seasonal Wetland[1]	152.4
Freshwater Seep	0.5
Subtotal	**152.9**
Aquatic Habitat	
Lacustrine Unconsolidated Bottom	78.1
Lacustrine Unconsolidated Shoreline[1]	114.0
Riverine	200.0
Subtotal	**392.1**
Other	
Barren	24.7
Developed	6.0
Subtotal	**30.7**
Total	**3,488.1**

Note:
[1] Habitat types that are periodically inundated, because they are below the ordinary high water mark of Millerton Lake.

Key:
RM = river mile

Table 5-37. Special-Status Plant Species Found in the Temperance Flat RM 279 Reservoir Inundation Area

Species	Occurrences[1]	Individuals
Tree anemone	1	6
Ewan's larkspur	none observed, but likely to occur	
Madera leptosiphon	1	~5,000
Michael's piperia	none observed, but likely to occur; observed just outside primary study area boundary	
Farnsworth jewelflower	3	~1,300
Hall's wyethia	4	~1,900
Small-flowered monkeyflower	8	~9,400

Note:

[1] An occurrence, as defined by CNPS and CNDDB, is a group of rare plants located within 0.25 miles of each other. Occurrences may consist of a number of individuals and clumps of individuals (colonies), the distribution of which may or may not differ between inundation areas and/or buffers.

Key:
CNPS = California Native Plant Society
CNDDB = California Natural Diversity Database
RM = river mile

Amphibians and Reptiles Three aquatic features that may provide potential breeding habitat for California tiger salamander were identified within the inundation area for Temperance Flat RM 279 Reservoir alternative plans during 2007 surveys. Each feature was evaluated during surveys for potential suitability, and classified as either suitable or marginal. One of the features was considered to be marginal and two were classified as suitable habitat. The determination of potential suitability of these features is conservative; bullfrogs were observed in at least one pond, which is also known to hold water permanently.

Potentially suitable western pond turtle habitat was mapped, and western pond turtle presence and habitat features were surveyed across the primary study area. Western pond turtle was previously documented in the primary study area and was observed during 2007 Investigation surveys in Big Sandy Creek (three individuals outside the inundation area of Temperance Flat RM 279 Reservoir alternative plans) and the San Joaquin River (one individual in the inundation area). Based on 2007 surveys, 82.3 acres of potential western pond turtle habitat were identified in the inundation area for Temperance Flat RM 279 Reservoir alternative plans. The most suitable habitat (providing more suitable basking sites, aquatic vegetation, and food sources) was identified along the San Joaquin River.

Approximately 8,955 linear feet of potentially suitable and marginal stream habitat would be affected by Temperance Flat RM 279 Reservoir alternative plans. While potentially suitable habitat was identified in the study area, no recent sightings of foothill yellow-legged frogs have been documented near the primary study area. Based on the presence of nonnative predators (bullfrogs

and centrarchids) in the San Joaquin River and adjacent streams, foothill yellow-legged frogs are unlikely to be present in the inundation area for the Temperance Flat RM 279 Reservoir alternative plans.

Birds As described for the Temperance Flat RM 274 Reservoir alternative plans, several raptor species (American kestrel, Cooper's hawk, red-tailed hawk, sharp-shinned hawk) were incidentally observed in the primary study area during 2007 field surveys. Existing information and data collected during 2007 surveys suggest that raptors and other special-status bird species may nest in the area.

Mammals Potential effects to special-status bat species for the Temperance Flat RM 279 Reservoir alternative plans are similar to those discussed for the Temperance Flat RM 274 Reservoir alternative plans. Suitable roost sites occur throughout the primary study area, and one Townsend's big-eared bat was sighted during 2007 surveys in a rock outcrop within the inundation area for Temperance Flat RM 279 Reservoir alternative plans. Western mastiff bats are known to breed on the cliffs above the primary study area and are likely to occupy portions of the area.

Recreation Resources

A relatively narrow and winding lake extending about 13.5 miles up the San Joaquin River to Kerckhoff Dam, with about 3,482 surface acres at the top of active storage (elevation 985), would be created with the Temperance Flat RM 279 Reservoir alternative plans. The reservoir would be over 1.25 miles wide at Temperance Flat (about RM 281) but would be quite narrow in the upstream third of the pool, farther up the river gorge. Only the uppermost 2 miles of Millerton Lake within the SRA and adjacent lands would be substantially affected. The full length of the SJRGMA along the San Joaquin River would be impacted.

Recreational facilities upstream from RM 279 that would be affected by the Temperance Flat RM 279 Reservoir alternative plans include the Temperance Flat Boat-In Campground within the Millerton Lake SRA, the San Joaquin River Trail, and San Joaquin River Trail bridge at Big Sandy Creek. Within the BLM SJRGMA, an extension of the San Joaquin River Trail, a footbridge over the San Joaquin River, a primitive campground, and a reproduction Native American village would be affected by the Temperance Flat RM 279 Reservoir alternative plans. Figure 5-4 shows the extent of Temperance Flat RM 279 Reservoir and affected recreation features in the reservoir area.

The Temperance Flat RM 279 Reservoir alternative plans would result in reduced informal shoreline access throughout the season. The substantially higher pool elevation and resulting 1,000- to 1,700-acre increase in reservoir surface area would improve boating conditions in the primary study area.

Cultural Resources

Previously, archaeological surveys inventoried 35.2 percent of the Temperance Flat RM 279 Reservoir area and recorded a total of 28 archaeological sites, which were mostly prehistoric resources. No historical structures were recorded in the Temperance Flat RM 279 Reservoir area. Similar to the Temperance Flat RM 274 Reservoir alternative plans, local Native American tribes expressed opposition to the Temperance Flat RM 279 alternative and suggested that a new nearby dam would be very detrimental. Tribes indicated that the area is very sensitive, with 19 identified areas of concern, including village sites, gathering areas, and religious areas. According to some Native American groups, the most sensitive and important locations are in the Temperance Flat and Squaw Leap areas.

Based on the sensitivity analyses conducted for the Temperance Flat RM 279 alternative, approximately 108 archaeological sites and historical resources are estimated within the Temperance Flat RM 279 Reservoir area. This estimate includes 60 historic-era resources (mostly mining related) and 48 prehistoric resources (see Table 5-38). The actual number of archaeological sites could be substantially less or greater than the number of sites estimated.

Table 5-38. Estimated Number of Archaeological Sites for Temperance Flat RM 279 Reservoir Alternative Plans

Archaeological Sites	Temperance Flat RM 279 Reservoir (690 TAF)
Historic-Era Resources	**60**
Homestead-related sites	6
Sites associated with structures	3
Mines and mining patents	6
Sites within Big Bend Mining Claim concentration	0
Sites within Temperance Flat/Crook Mountain Mining Claim concentration	42
Roads	0
Hydroelectric/water engineering facilities	3
Recorded structures	0
Prehistoric Resources	**48**
Residential sites	18
All other sites	30
Total Resources	**108**

Key:
RM = river mile
TAF = thousand acre-feet

Economics

This section summarizes information for estimated costs and potential benefits of the Temperance Flat RM 279 Reservoir alternative plans.

Estimated Costs

Estimated costs for construction of Temperance Flat RM 279 Reservoir are presented in Table 5-39. This appraisal-level cost estimate for Temperance Flat RM 279 Reservoir is subject to change as the feasibility study progresses. The magnitude of contingencies would also decrease as the feasibility study progresses and uncertainties regarding site conditions decrease.

Table 5-39. Cost Estimate Summary for Temperance Flat RM 279 Reservoir Alternative Plans

Item	Estimated Cost[1,2] ($million)
Features	
Embankment Dam	$300
Diversion Structures	$390
Spillway	$470
Outlet Works	$90
Power Features	$880
Affected Infrastructure	$10
Temperature Control Device at Friant Dam	$155
TOTAL FIELD COST[3]	**$2,295**
Non-Contract Costs	
Planning, Engineering, Design and Construction Management (10%)	$230
Acquisition of Private Lands	$11
Replacement Recreation Facilities	$7
Environmental Mitigation	$11
Cultural Resources Mitigation	$6
TOTAL CONSTRUCTION COST	**$2,559**
Interest During Construction	$403
TOTAL CAPITAL COST	**$2,962**
Interest and Amortization	$146
Annual Operations and Maintenance	$4
Annual Replacement Power	$0
Annual Transvalley Exchange Power	NE
TOTAL ANNUAL COST[4]	**$150**

Notes:
General: This appraisal-level cost estimate is preliminary and subject to revision in the Feasibility Report.
[1] Costs are presented in 2006 dollars
[2] Values may not add to totals because of rounding.
[3] The embankment dam costs include the following allowances: 5 percent mobilization, 10 percent unlisted items, and 20 percent construction contingency. All other features include allowances of 5, 15, and 25 percent, respectively.
[4] Based on 4-7/8 discount rate and 100-year period of analysis.
Key:
NE = not estimated
RM = river mile

Potential Benefits

Estimated potential monetary benefits for the Temperance Flat RM 279 Reservoir alternative plans, developed for several categories using methods described previously in this chapter, are summarized in Table 5-40.

Table 5-40. Potential Annual Benefits for Temperance Flat RM 279 Reservoir Alternative Plans

Item	Operations Integration				
	Friant Only	SWP/CVP/ Friant[1]		SWP/ Friant	SWP/ Friant
		Transvalley Conveyance			
		SW/CVC/AE			AE
Monetary Benefits ($million)					
Agricultural Water Supply Reliability	$40.0	$44.4		$40.0	$38.9
M&I Water Supply Reliability	$1.1	$36.5		$46.3	$31.3
M&I Water Quality	$0.0	$7.5		$7.4	$3.0
Flood Damage Reduction	$2.3	$0.7		$0.7	$1.4
Hydropower Generation	$0.8	$0.3	-$0.8	$0.3	$0.4
Recreation	$5.4	$4.0	$7.3	$4.0	$4.0
Emergency Water Supply2	$6.4	$11.5		$11.1	$9.5
Ecosystem	$24.5	$24.5		$24.5	$24.5
Total Monetary Benefits	$80.5	$129.5	$131.7	$134.4	$113.0

Note:
[1] Millerton Baseline reservoir balancing option listed on the left and Millerton High reservoir balancing option listed on the right.

Key:
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
M&I = municipal and industrial
RM = river mile
SLIS = selective level intake structure
SW = Shafter-Wasco
SWP = State Water Project
TCD = temperature control device

Regional Economic Effects

Table 5-41 presents the results of the Friant Division and statewide regional economic model simulations for Temperance Flat Reservoir RM 279 Reservoir.

Table 5-41. Regional Economic Effects by Impact Area for Temperance Flat RM 279 Alternative Plans

Item	Output ($million)		Income ($million)		Employment (jobs)	
Impact Area	Direct	Total	Direct	Total	Direct	Total
Friant Division	$23.3	$32.0	$4.8	$7.5	140	210
Statewide	$29.8	$46.6	$8.1	$14.6	170	300

Key:
RM = river mile

Temperance Flat RM 279 Reservoir with Trans Valley Canal Alternative Plans

This section describes the components, accomplishments, potential effects, and economics of the Temperance Flat RM 279 Reservoir with Trans Valley Canal alternative plans.

Plan Components

Surface water storage measures, water temperature management measures, and energy generation measures for this grouping of alternative plans are the same as described previously for the Temperance Flat RM 279 Reservoir alternative plans.

Increase Transvalley Conveyance Capacity Measures

This measure would be the same as described under the Temperance Flat RM 279 Reservoir with Trans Valley Canal alternative plans.

Reservoir Operations and Water Management Measures

Alternative plans for Temperance Flat RM 279 Reservoir with Trans Valley Canal were evaluated under three distinct operations scenarios, which vary according to the approaches applied for the extent of operations integration, available transvalley conveyance, and reservoir balancing, as summarized in Table 5-42 and as described previously under water management measures for Temperance Flat RM 274 and RM 279 reservoir alternative plans.

Table 5-42. Three Reservoir Operation Scenarios Simulated for Temperance Flat RM 279 with Trans Valley Canal Alternative Plans

Alternative Plans	Integration Scenario Options	Transvalley Conveyance Options	Reservoir Balancing Options
Temperance Flat RM 279 Reservoir + Trans Valley Canal	SWP/Friant	TVC/SW/CVC/AE	Millerton Baseline
	CVP/Friant	TVC/SW/CVC/AE	Millerton Baseline
	SWP/CVP/Friant	TVC/SW/CVC/AE	Millerton Baseline

Key:
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project
TVC = Trans Valley Canal

Potential Accomplishments

This section summarizes the potential accomplishments of the Temperance Flat RM 279 Reservoir with Trans Valley Canal alternative plans, including water supply reliability, water temperature, energy generation, flood damage reduction, M&I water quality, recreation opportunities, emergency water supply, and ecosystem enhancement.

Water Supply Reliability

Table 5-43 summarizes average annual changes in water deliveries for the Temperance Flat RM 279 Reservoir with Trans Valley Canal alternative plans, based on CALSIM simulations. The operations scenarios involving the SWP, CVP, and Friant Division, and CVP/Friant only would produce the largest average annual increase in delivery. The SWP/Friant operations scenario would result in the greatest increase in both total and dry year SWP deliveries.

On average, the Temperance Flat RM 279 Reservoir with Trans Valley Canal alternative plans would provide between 120 to 162 TAF per year of additional agricultural and M&I water deliveries, depending on operations scenario.

Table 5-43. Average Annual Change in Delivery for Temperance Flat RM 279 Reservoir with Trans Valley Canal Alternative Plans

Item	Operations Integration					
	SWP/CVP/Friant		SWP/Friant		CVP/Friant	
	Transvalley Conveyance SW, CVC, AE					
	Change in Delivery	TVC Increment	Change in Delivery	TVC Increment	Change in Delivery	TVC Increment
Total (TAF)						
Dry & Critical Years	137	+17	126	+22	124	+39
All Years	158	+26	120	+13	162	+34
Friant Division (TAF)						
Dry & Critical Years	81	-1	81	0	82	-1
All Years	82	-1	83	-1	84	-1
CVP (TAF)						
Dry & Critical Years	29	+9	1	+0	75	+44
All Years	51	+19	1	+0	87	+34
SWP (TAF)						
Dry & Critical Years	27	+8	44	+22	-33	-4
All Years	25	+8	36	+13	-8	+1

Note:
All dry and critical year values are reported based on the Sacramento River Index. Reporting of changes in Friant Division deliveries based on the San Joaquin River Index would result in higher dry and critical year values.
Key:
AE = Arvin-Edison Canal
CVC = Cross Valley Canal
CVP = Central Valley Project
RM = river mile
SW = Shafter-Wasco Pipeline
SWP = State Water Project
TAF = thousand acre-feet
TVC Trans Valley Canal

Emergency Water Supply

Emergency water supply benefits associated with Temperance Flat RM 279 alternatives are presented in Table 5-44. As shown, annual benefits range from $15.0 to $15.8 million.

Table 5-44. Annual Emergency Water Supply Benefits from Temperance Flat RM 279 Reservoir with Trans Valley Canal Alternative Plans

Item	Operations Integration	
	SWP/CVP/Friant	SWP/Friant
	Transvalley Conveyance TVC/SW/CVC/AE	
Avg. Emergency Water Supply, 20-Island Breach (TAF)	330	307
Annual Benefits, 20-Island Breach ($million)	$15.8	$15.0

Key:
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project
TAF = thousand acre-feet
TVC = Trans Valley Canal

Ecosystem and Water Temperature

Water temperature evaluations for Temperance Flat RM 279 Reservoir with Trans Valley Canal alternative plans were not conducted during plan formulation. Based on results of water temperature analyses performed for Temperance Flat RM 279 Reservoir and Temperance Flat RM 274 Reservoir with Trans Valley Canal alternative plans, scenarios for these alternatives are likely to be effective in preserving cold water volumes in Millerton Lake and Temperance Flat RM 279 reservoirs.

The Temperance Flat RM 279 Reservoir with Trans Valley Canal alternative plans were not evaluated specifically for monetary ecosystem benefits. The results of these alternative plans are expected to be similar to those for the Temperance Flat RM 279 alternative plans.

Energy Generation

Hydropower simulations were not performed for this grouping of alternative plans. However, energy generation decreases associated with the Trans Valley Canal would be similar to those of Temperance Flat RM 274 with Trans Valley Canal alternative plans.

Flood Damage Reduction

Potential annual flood damage reduction benefits accomplished through the Temperance Flat RM 279 Reservoir with Trans Valley Canal alternative plans are listed in Table 5-45. Potential flood damage reduction benefits range from almost $0.1 to $0.3 million.

Table 5-45. Annual Flood Damage Reduction for Temperance Flat RM 279 Reservoir with Trans Valley Canal Alternative Plans (90 percent exceedence)

Item	Operations Integration	
	SWP/CVP/ Friant	SWP/ Friant
	Transvalley Conveyance TVC/SW/CVC/AE	
90% Exceedence Flood Space (TAF)	172	180
Annual Flood Damage Reduction ($million)	$0.1	$0.3

Key:
AE = Arvin-Edison
CVC= Cross Valley Canal
CVP = Central Valley Project
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project
TAF = thousand acre-feet
TVC = Trans Valley Canal

M&I Water Quality

M&I water quality benefits through the Temperance Flat RM 279 with Trans Valley Canal alternative plans are listed in Table 5-46. The estimated benefits based on willingness to pay range from $13.0 million to $15.7 million.

Table 5-46. Annual M&I Water Quality WTP Benefits from Temperance Flat RM 279 Reservoir with Trans Valley Canal Alternative Plans

Item	Operations Integration	
	SWP/CVP/ Friant	SWP/Friant
	Transvalley Conveyance TVC/SW/CVC/AE	
Average Change in TDS (mg/L)	NE	8.7
Annual M&I Water Quality Benefit ($million)	$15.7	$13.0

Key:
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
M&I = municipal and industrial
mg/L = milligrams per liter
NE = not estimated
RM = river mile
SW = Shafter-Wasco
SWP = State Water Project
TAF = thousand acre-feet
TDS = total dissolved solids
TVC = Trans Valley Canal

Recreation Opportunities

The Temperance Flat RM 279 Reservoir with Trans Valley Canal alternative plans were not evaluated for effects on recreation opportunities. The results of these alternative plans are expected to be similar to those for the Temperance Flat RM 279 alternative plans.

Primary Potential Effects

Primary potential effects are described below for aquatic biological resources, terrestrial biological resources, recreation resources, and cultural resources affected by the RM 279 Reservoir with Trans Valley Canal alternative plans.

Aquatic and Fisheries Biological Resources

Temperance Flat RM 279 with Trans Valley Canal alternative plans are likely to have the same effects on recreation resources in the primary study area as Temperance Flat RM 279 Reservoir alternative plans. Impact analyses for the Trans Valley Canal measure for this alternative have not yet been conducted, but will be completed for the Feasibility Report and EIS/EIR.

Terrestrial Biological Resources

Effects of Temperance Flat RM 279 Reservoir with Trans Valley Canal alternative plans on terrestrial biological resources within the inundation area for the alternatives would be the same as the effects described above for Temperance Flat RM 279 Reservoir alternative plans. Potential effects for the Trans Valley Canal measure for these alternative plans have not been evaluated, but will be completed for the Feasibility Report and EIS/EIR.

Recreation Resources

Potential effects on recreation resources in the primary study area for the Temperance Flat RM 279 with Trans Valley Canal alternative plans are likely to be the same as potential effects described for the Temperance Flat RM 279 Reservoir alternative plans. Impact analyses for the Trans Valley Canal measure for this alternative have not yet been conducted, but will be completed for the Feasibility Report and EIS/EIR.

Cultural Resources

Potential effects on cultural resources associated with the Temperance Flat RM 279 Reservoir for these alternative plans would be the same as the potential effects described above for the Temperance Flat RM 279 alternative. Impact analyses for the Trans Valley Canal measure for this alternative have not yet been conducted, but will be completed for the Feasibility Report and EIS/EIR.

Economics

This section summarizes information for estimated costs and potential benefits of the Temperance Flat RM 279 Reservoir with Trans Valley Canal alternative plans.

Estimated Costs

Estimated costs for construction of Temperance Flat RM 279 Reservoir and the Trans Valley Canal are presented in Table 5-47.

The cost information for the Trans Valley Canal is based on pre-appraisal level cost estimates prepared on behalf of the FWUA-MWDSC Partnership and provide a preliminary indication of the relative magnitude of costs for the Trans Valley Canal to facilitate comparison with the incremental benefits provided by the Trans Valley Canal to determine whether more detailed study is warranted.

Table 5-47. Cost Estimate Summary for Temperance Flat RM 279 Reservoir with Trans Valley Canal Alternative Plans

Item	Estimated Cost[1,2] ($millions)
Features	
Embankment Dam	$300
Diversion Structures	$390
Spillway	$470
Outlet Works	$90
Power Features	$880
Affected Infrastructure	$10
Temperature Control Device at Friant Dam	$155
Trans Valley Canal	$490
TOTAL FIELD COST[3]	**$2,785**
Non-Contract Costs	
Planning, Engineering, Design and Construction Management[4]	$328
Acquisition of Private Lands	$19
Replacement Recreation Facilities	$7
Environmental Mitigation[5]	$17
Cultural Resources Mitigation	$7
TOTAL CONSTRUCTION COST	**$3,163**
Interest During Construction	$499
TOTAL CAPITAL COST	**$3,662**
Interest and Amortization	$180
Annual Operations and Maintenance	$5
Annual Replacement Power	$0
Annual Cross Valley Exchange Power	NE
TOTAL ANNUAL COST[6]	**$185**

Notes:

General: This appraisal-level cost estimate is preliminary and subject to revision in the Feasibility Report.

[1] Costs are presented in 2006 dollars.

[2] Values may not add to totals due to rounding.

[3] The embankment dam costs include the following allowances: 5 percent mobilization, 10 percent unlisted items, and 20 percent construction contingency. The Trans Valley Canal costs include allowances of 5, 20, and 30 percent, respectively. All other features include allowances of 5, 15, and 25 percent, respectively.

[4] The planning, engineering, design, and construction management cost for the dam features and Trans Valley Canal is 10 and 20 percent of each feature's field cost, respectively.

[5] Environmental mitigation has not been estimated for the Trans Valley Canal.

[6] Based on 4-7/8 discount rate and 100-year period of analysis.

Key:
NE = not estimated
RM = river mile

Potential Benefits

Estimates of potential monetary benefits for the Temperance Flat RM 279 Reservoir with Trans Valley Canal alternative plans, developed for several categories using methods described previously in this chapter, are summarized in Table 5-48.

Table 5-48. Potential Annual Benefits for Temperance Flat RM 279 Reservoir with Trans Valley Canal Alternative Plans

Item	Operations Integration	
	SWP/CVP/ Friant	SWP/Friant
	Transvalley Conveyance TVC/SW/CVC/AE	
Potential Monetary Benefits ($million)		
Agricultural Water Supply Reliability	$45.0	$40.0
M&I Water Supply Reliability	$41.2	$57.1
M&I Water Quality	$15.7	$13.0
Flood Damage Reduction	$0.1	$0.3
Hydropower Generation	$0.3	$0.3
Recreation	$4.0	$4.0
Emergency Water Supply	$15.8	$15.0
Ecosystem	$24.5	$24.5
Total Potential Monetary Benefits	**$146.6**	**$154.2**

Key:
AE = Arvin-Edison
CVC = Cross Valley Canal
CVP = Central Valley Project
M&I = municipal and industrial
RM = river mile
SLIS = selective level intake structure
SW = Shafter-Wasco
SWP = State Water Project
TAF = thousand acre-feet
TCD = temperature control device
TVC = Trans Valley Canal