Chapter 2
Plan Formulation Process

This chapter describes the process for formulating and evaluating potential alternatives consistent with the study authorizations, and describes major water resources problems, needs, and opportunities in the study area. Water resource problems, needs, and opportunities provide a framework for plan formulation and help establish planning objectives for the Investigation. The basic plan formulation process for Federal water resources studies and projects consists of the following iterative steps, consistent with the P&G (WRC, 1983), study authorizations, and pertinent Federal, State, and local laws and policies:

- Specifying water resources problems, needs, and opportunities to be addressed (Chapter 2).
- Developing planning objectives, constraints, considerations, and criteria (Chapter 2); identifying potential management measures (Chapter 4).
- Inventorying, forecasting, and analyzing existing and likely future conditions in the study area (Chapter 3).
- Formulating alternative plans (Chapter 5).
- Evaluating effects of alternative plans (Chapter 5).
- Comparing alternative plans (Chapter 6).

The planning process is led by a multiple-agency planning team of professional water resources planners, engineers, environmental scientists, and experts, and involves the input and participation of concerned stakeholders, advisory groups, regulatory agencies, and members of the general public. Upon completion of the feasibility study, the planning process will be documented in a Feasibility Report and accompanying EIS/EIR as the basis for decision-making by the President and Congress. Cooperating agencies and entities, including the State, will participate in this decision-making.

The plan formulation approach for the Investigation is shown in Figure 2-1.

Following is a description of identified water resources problems, needs, and opportunities, and planning objectives, constraints, considerations, and criteria.

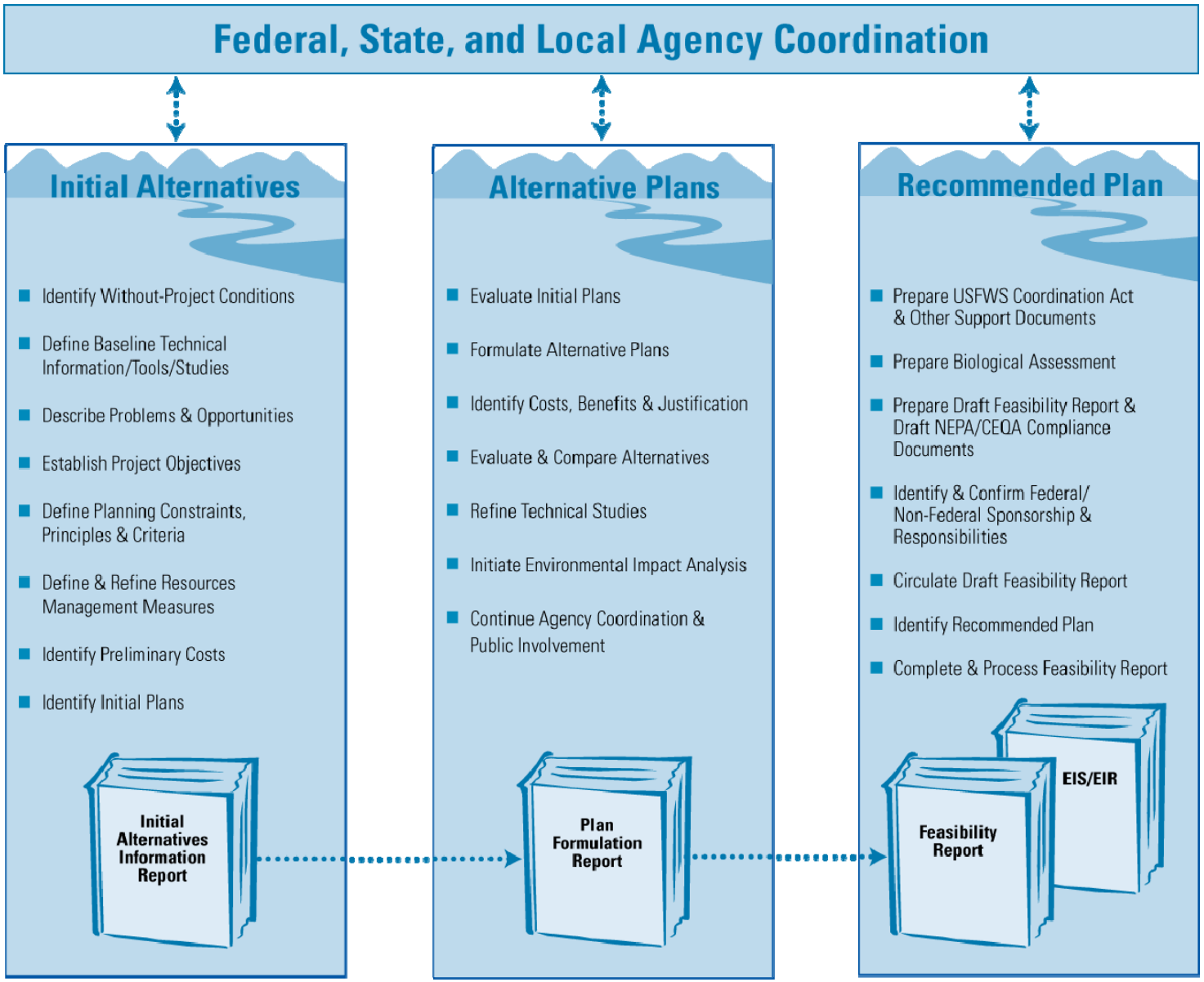

Figure 2-1. Plan Formulation Process

Water and Related Resources Problems, Needs, and Opportunities

Problems and needs to be addressed by the Investigation were identified in the CALFED ROD (2000a) and from stakeholder input. The primary purposes identified in the CALFED ROD for developing and managing additional water supplies from the upper San Joaquin River basin include contributing to restoration of the San Joaquin River; improving water quality in the San Joaquin River; facilitating additional conjunctive water management; and supporting water exchanges that improve the quality of water deliveries to urban communities. These problems and needs formed the basis for initial plan formulation.

The Settlement triggered a substantial change in the without-project conditions for the Investigation. The inclusion of Settlement-stipulated releases from Friant Dam for river restoration as a without-project condition has caused reassessment of the water resources problems, needs, and opportunities for the Investigation.

This section describes water resources problems and needs for the Investigation in greater detail, and is organized by water supply reliability problems and needs, San Joaquin River ecosystem problems and needs, and opportunities.

Water Supply Reliability Problems and Needs

This section includes discussions on water supply reliability problems and needs in the State and Central Valley, and Friant Division of the CVP.

State of California and Central Valley

Predicting expected future water supply demands and/or shortages in the Central Valley of California is difficult. There are numerous variables and, just as important, numerous interpretations associated with these variables. Water supply reliability problems and needs are based on quantities and estimates in the 1998 Water Plan Update (DWR); however, qualitative information in the California Water Plan Update 2005 (DWR) and in the Water Supply and Yield Study Interim Report (Reclamation, 2006) leads to consistent conclusions. Some of the primary conclusions reached in the reports are that California must invest in reliable, high quality, sustainable and affordable water conservation; efficient water management; and development of water supplies to protect public health, and improve California's economy, environment, and standard of living.

Major factors affecting California's future water supplies include rapid population growth; agricultural-to-urban land use conversion; and climate change and related uncertainties, including Delta infrastructure, operations criteria, and ecosystem conditions. Uncertainties about the sustainability of the

Delta prompted the appointment of an independent Delta Vision Blue Ribbon Task Force by the Governor of California that will be responsible for developing a strategic plan to support environmental and economic functions that are critical to the people of California. One of 12 integrated and linked recommendations provided to the Governor for development of a durable vision for sustainable management of the Delta is to develop new facilities for conveyance and storage, and a better linkage between the two for managing California's water resources (Delta Vision, 2008).

DWR identified some of the impacts associated with climate change on various water resources areas. Potential impacts due to climate change are many and complex (DWR, 2006a). They range from potential sea level rise, which could impact coastal areas and estuarine water quality, to changes in rainfall runoff relationships important for flood management. Another potential impact may be a reduction in total system storage. Precipitation held in mountain snowpack makes up a substantial quantity of total annual water supplies needed for irrigation, urban, and many environmental uses. In the future, climate change may substantially reduce or change the timing of snowmelt from water held in snowpack in the Sierra Nevada Mountains.

Much of the emphasis in future water planning for the State will be on increasing urban water use efficiency (WUE) and recycling municipal supplies. The Governor of California recently outlined a goal of 20 percent reduction in per capita water use by 2020 (Governor, 2008). WUE will play a large role in actions related to the CALFED ROD (2000a). Even so, it is believed that to avoid major impacts to the economy, overall environment, and standard of living in California, a critically important element in any future water resources plan will be development of additional water supplies (DWR, 2005). These additional supplies are needed to increase the reliability of existing supplies for expanding municipal and industrial (M&I) uses and to maintain adequate supplies for agricultural and environmental purposes.

Even with major efforts by multiple agencies to address the complex water resources issues in the State, demands are expected to exceed supplies in the future. As described in Chapter 3, the CVP and SWP have experienced considerable water shortages in dry years. For the State's water supply system in the year 2050, it is estimated that overall, a dry scenario of climate warming could reduce average annual statewide water availability by 27 percent, resulting in an average annual reduction in water deliveries of 17 percent (California Climate Change Center, 2006).

Friant Division of the Central Valley Project

Water supply reliability problems and needs within the Friant Division, similar to those throughout the State, are associated with large annual hydrologic variations in water availability and the limited capacity of current water storage and conveyance facilities. Projected demands exceed supply for agriculture, urban, and environmental purposes. The Friant Division of the CVP provides

surface water supplies to many areas that also rely on groundwater, and was designed and is operated to support conjunctive water management to reduce groundwater overdraft in the eastern San Joaquin Valley.

Annual allocation of water to Friant Division contractors varies widely in response to hydrologic conditions. During dry periods when surface water deliveries are reduced, water contractors rely heavily on groundwater to meet water demands. Although surface water deliveries from Friant Dam help reduce groundwater pumping and contribute to groundwater recharge, the groundwater basins in the eastern San Joaquin Valley remain in a state of overdraft in most years (i.e., more groundwater is pumped out than is replenished either naturally or artificially). The continued general downward trend of groundwater levels reveals that considerable water supply reliability problems remain. Moreover, it is expected that the continued downward trend in groundwater levels may result in localized areas of impaired groundwater quality, and may ultimately reduce water use and irrigated acreage in the San Joaquin Valley.

Additionally, through implementation of the Settlement, average total system water deliveries from Friant Dam, as described in Chapter 3, are expected to be reduced by about 208 TAF per year, or approximately 15 to 19 percent of deliveries under existing conditions. The Settlement does not include specific actions to achieve the Water Management Goal, nor does it identify specific quantities of water supply to be replaced.

San Joaquin River Ecosystem Problems and Needs

The reach of the San Joaquin River from Friant Dam to the Merced River confluence (Figure 2-2) does not currently support a continuous natural riparian and aquatic ecosystem. Friant Dam was authorized and is operated to support two primary purposes: agricultural and M&I water supplies, and flood protection. Since completion of Friant Dam, most of the water in the river has been diverted for agricultural and M&I uses, with the exceptions of releases to satisfy riparian water rights upstream from Gravelly Ford, and flood releases. Consequently, the river reach from Gravelly Ford to Mendota Pool is often dry.

Flow in the San Joaquin River from Mendota Pool to Sack Dam contains Delta water for delivery to the San Luis Canal Company and wildlife refuges. Between Sack Dam and the confluence with Salt Slough, the primary source of flow in the San Joaquin River is groundwater seepage from adjacent agricultural lands. The reach from Sack Dam to Bear Creek is operationally dry, but this reach benefits from managed wetland development, whereas marshes have been drained between Bear Creek and the Merced River. Generally unhealthy ecosystem conditions have resulted from lack of reliable flows and poor water quality in the San Joaquin River.

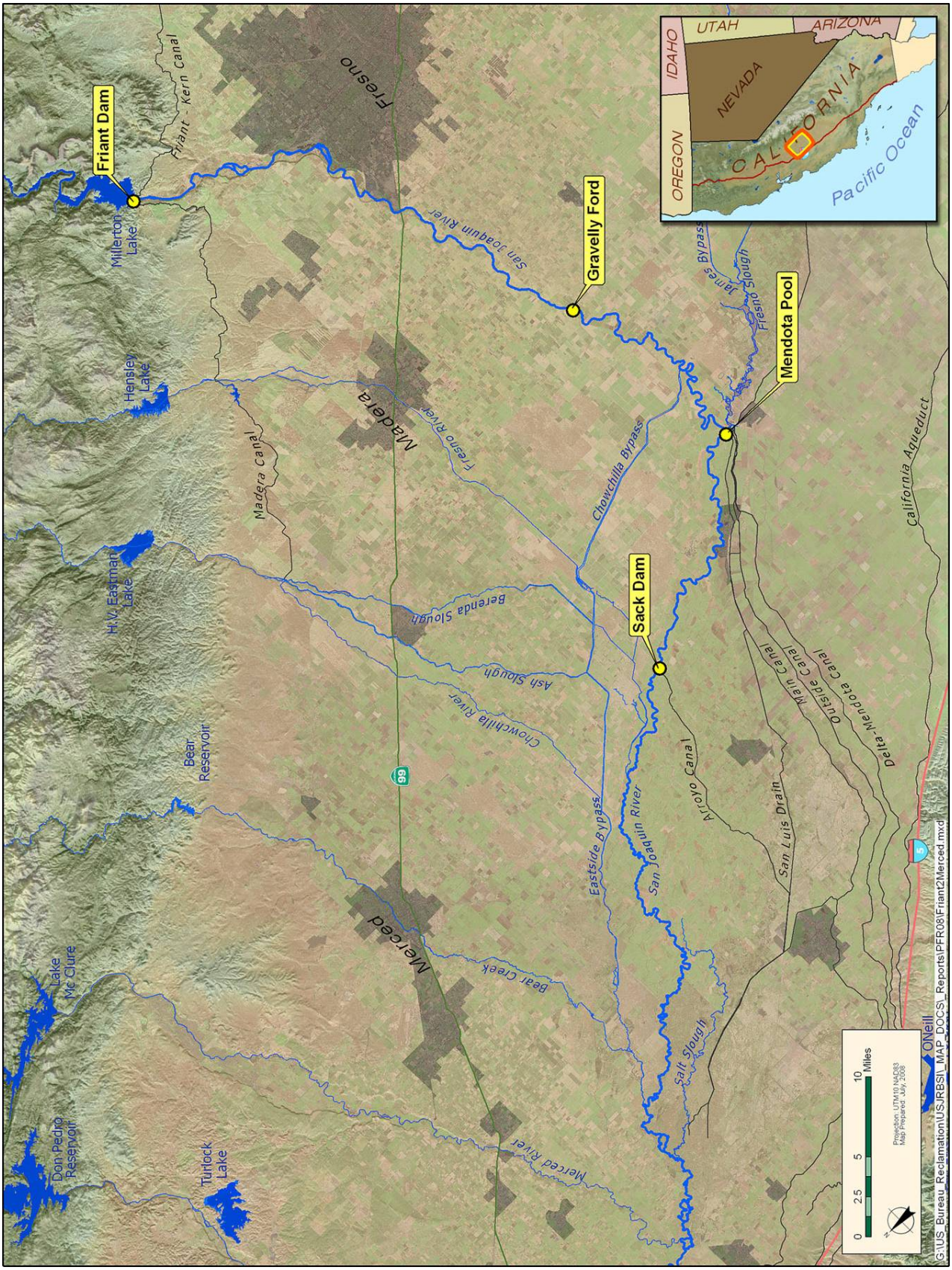

Figure 2-2. San Joaquin River from Friant Dam to Merced River

The Settlement, which is assumed under future without-project conditions, is expected to extensively alter the ecosystem conditions of the San Joaquin River. The Restoration Goal of the Settlement is to provide continuous flows in the San Joaquin River at Friant Dam to sustain naturally reproducing Chinook salmon and other fish populations in the 153-mile-long stretch of river between Friant Dam and the Merced River. Accomplishing this goal will require funding and constructing extensive channel and structural improvements in many areas of the river, including some that have been without flows for decades. The exact nature of these structural improvements, and magnitude and timing of resulting ecosystem improvements, is presently unknown.

The stipulated releases to the San Joaquin River for restoration vary by water year-type. The water year-types from the Settlement are determined based on ranking of annual unimpaired runoff at Friant Dam for water years (October 1 to September 30) from 1922 to 2004. Restoration Flows for the various water year-types are about 556 TAF during wet years, about 356 TAF during normal-wet years, about 248 TAF during normal-dry years, about 184 TAF during dry years, and about 71 TAF during critical-high years. During critical-low years, however, no flow above current riparian releases is prescribed to be released from Friant Dam to the river. There are also provisions for an additional buffer flow of up to 10 percent for release to the river if seepage losses are greater than anticipated, and for flushing flows to enhance gravel conditions for spawning during wet and normal-wet years.

In addition to flow, success of Chinook salmon populations is known to be affected by water temperature. The SJRRP is currently developing information on optimal water temperature requirements for Chinook salmon. Water temperatures that are too high, or in some cases too low, can be detrimental to the various life stages of salmon. Elevated water temperatures can negatively impact spawning adults, egg maturation and viability, and preemergent fry, substantially diminishing the resulting ocean population and next generation of returning spawners. Stress caused by high water temperatures also may reduce the resistance of fish to parasites, disease, and pollutants. Conversely, water that is too cold is detrimental to the rapid growth of some juveniles.

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

Opportunities

This section describes water resources opportunities that could be addressed through development and management of San Joaquin River supplies. These include flood damage reduction, energy generation and management, recreation, improved San Joaquin River water quality, and improved urban water quality.

Flood Damage Reduction

Flood operations at Friant Dam are based on anticipated precipitation and snowmelt runoff and the operations of upstream reservoirs. Flood releases from Friant Dam are maintained, when possible, at levels that could be safely conveyed through the San Joaquin River and Eastside Bypass. Generally, flood operations target releases at or below 8,000 cubic feet per second (cfs) downstream from Friant Dam. Major storms during the past two decades have demonstrated that Friant Dam, among other Central Valley dams, may not provide the level of flood protection that was intended at the time the flood management system was designed. Further, the level of protection initially provided may not be appropriate for current downstream land uses and development levels. January 1997 flood flows of nearly 60,000 cfs from Friant Dam resulted in levee failures and extensive downstream flooding.

As part of the Comprehensive Study, USACE assessed system performance during major floods in the last two decades. The study found that Friant Dam was effective in reducing damages during floods, but that substantial damages were still experienced during recent flood events (USACE and The Reclamation Board, 2002). The Comprehensive Study also developed a set of system-wide tools to simulate flood system performance for the entire San Joaquin River basin. Under existing conditions, expected annual damages from flooding were estimated as $29.0 million in the San Joaquin River basin. Opportunities to improve flood damage reduction, in association with development and management of additional San Joaquin River supplies, will be considered in the Investigation.

Energy Generation and Management

Hydropower is an important element of power supply in California. On average, hydropower generation constitutes between 10 to 27 percent of California's annual energy supply, depending on the type of water year. The United States receives between 7 and 12 percent of its electricity from hydropower. Due to its ability to rapidly increase and decrease power generation rates, hydropower can be used to support peak power loads in addition to base power loads.

As population, industry, and associated infrastructure growth occurs in the future, demands for power would also increase. Over the next 10 years, California's peak demand for electricity is expected to increase almost 30 percent from about 50,000 to 65,000 megawatts (MW). Although some new power generation capacity likely would be developed in California during the next few decades, it is expected that additional new generation capacity would

still be required. The Investigation will consider opportunities for additional hydropower generation capacity in association with the development and management of San Joaquin River water supplies.

Recreation

As the population of the State of California continues to grow, demands would increase for water-oriented recreation at and near the lakes, reservoirs, streams, and rivers of the Central Valley. Demands for water-based and land-based recreational opportunities in the San Joaquin River basin are high. Some of these demands are served by reservoirs on the western slope of the Sierra Nevada Mountains. In the primary study area, regional population growth is expected to result in increased demand for recreation at Millerton Lake and increased visitation (Reclamation, 2008a). Opportunities for recreation site development and water level management could be potential elements of a plan to help meet future recreation demands.

San Joaquin River Water Quality

Water quality in various segments of the San Joaquin River has been a problem for several decades due to low flow and poor quality discharges from agricultural areas, wildlife refuges, and M&I treatment plants. Over time, regulatory requirements for water quality in the river have become more stringent and the number of locations along the river at which specific water quality objectives are identified and monitored has increased. Water quality conditions in the San Joaquin River would likely improve through implementation of the San Luis Drainage Feature Reevaluation selected alternative, SJRRP actions, and various TMDLs. However, the extent of water quality improvements is difficult to anticipate until water quality monitoring and analyses are completed for these actions.

Urban Water Quality

Water pumped from the Delta is the source of drinking water for approximately 25 million people in California. Delta water supplies generally contain elevated concentrations of bromide and organic carbon during late summer and early fall months. This increases drinking water treatment costs in urban areas and limits the use of Delta supplies for blending with other sources. In addition to conflicts between management of Delta water supplies for environmental, agricultural, and urban uses that reduce the reliability of water deliveries from the Delta, an increasing emphasis on facilitating exchanges and operational flexibility would place additional demands on water supplies and conveyance systems. A complementary action recommended for continued study in the CALFED ROD under the Conveyance and Water Quality programs was to facilitate water quality exchanges and similar programs to make available high-quality Sierra Nevada water in the eastern San Joaquin Valley to urban interests receiving water from the Delta (CALFED, 2000a). Through development and management of San Joaquin River supplies, there may be opportunities to improve the quality of water supplies delivered to urban areas over the range of hydrologic conditions.

Planning Objectives

This section discusses Federal and State planning objectives and objectives specific to the Investigation.

Federal and State Objectives

The Federal objective of water and related land resources planning is to contribute to national economic development (NED) consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are direct net benefits that accrue in the planning area and the rest of the Nation (WRC, 1983).

Because of its many water management partnerships with the Federal government, DWR has a policy that economic analyses conducted for programs and projects be fundamentally consistent with the Federal planning principles defined in the P&G (WRC, 1983), but can also incorporate innovative methods and tools when appropriate. According to DWR (2008a), the reasons for this policy are as follows:

> This policy is necessary because (a) the P&G has not been updated for more than 20 years, (b) Federal and State planning and economic analyses sometimes have different regional analysis perspectives, and (c) water management projects and programs have become more complex.

CALFED provides a programmatic framework to develop and implement a long-term comprehensive plan to restore ecological health and improve water management for beneficial uses of the Bay-Delta system.

Investigation-Specific Planning Objectives

On the basis of the problems, needs, and opportunities identified and defined above, study authorizations, and other pertinent direction, including information contained in the August 2000 CALFED ROD (2000a), the planning objectives below were developed. These objectives guide formulation of alternatives to address the problems, needs, and opportunities, consistent with Federal and State planning guidance:

- **Planning Objectives** – Formulate alternatives specifically to accomplish the following:
  - Increase water supply reliability and system operational flexibility for agricultural, M&I, and environmental purposes in the Friant Division, other San Joaquin Valley areas, and other regions.
  - Enhance water temperature and flow conditions in the San Joaquin River from Friant Dam to the Merced River in support of restoring and maintaining naturally reproducing and self-sustaining anadromous fish (i.e., Settlement reintroduced fall- and/or spring-run Chinook salmon).
- **Opportunities** – To the extent possible, through pursuit of the planning objectives, alternatives will also include features to help address the following:
  - Improve management of flood flows at Friant Dam.
  - Preserve and increase energy generation, and improve energy management in the study area.
  - Preserve and increase recreation opportunities in the study area.
  - Improve San Joaquin River water quality.
  - Improve the quality of water supplies delivered to urban areas.

Planning Constraints and Other Considerations

The P&G provides fundamental guidance for the formulation of Federal water resources projects (WRC, 1983). In addition, basic planning constraints and other considerations specific to the Investigation must be developed and identified. Following is a summary of constraints and considerations being used for the Investigation.

Planning Constraints

Planning constraints are used to help guide a feasibility study. Some planning constraints are more rigid than others. Examples of more rigid constraints include congressional direction; current applicable laws, regulations, and policies; and physical conditions (e.g., topography, hydrology). Other planning constraints may be less restrictive but are still influential in guiding the process. Several major constraints identified for the Investigation are as follows:

- **Study Authorization** – In 2003, Federal authorization was provided to prepare a Feasibility Report for storage in the upper San Joaquin River basin (Public Law 108-7, Division D, Title II, Section 215). Congress again authorized the Secretary to conduct planning and feasibility studies for storage in the upper San Joaquin River basin in Fresno and Madera counties through the October 2004 Water Supply, Reliability, and Environmental Improvement Act (Public Law 108-361). Based on Section 227 of the State of California Water Code, State authorization is in place to study reservoirs or reservoir systems for gathering and distributing flood or other water not under beneficial use in any stream, stream system, lake, or other body of water.

- **CALFED Record of Decision** – The CALFED ROD includes program goals, objectives, and projects primarily to benefit the Bay-Delta system. The storage program element recommends five investigations of potential increased surface storage capabilities at various locations in the Central Valley, including the upper San Joaquin River basin, and various groundwater storage projects to help reduce the discrepancy between water supplies and projected demands. The program also includes numerous other projects to help improve the ecosystem functions of the Bay-Delta system. Alternative plans developed in the Investigation should be cognizant of the goals, objectives, and programs/projects of the CALFED ROD (2000a).

- **Laws, Regulations, and Policies** – Numerous laws, regulations, executive orders, and policies need to be considered, among them the P&G, NEPA, Fish and Wildlife Coordination Act, Clean Air Act, CWA, National Historic Preservation Act, California Public Resources Code, Federal and State ESAs, CEQA, and the CVPIA. Other important laws and regulations are included in Chapter 7.

- **CVPIA Section 3404(a)** – In accordance with Section 3404(a) of the CVPIA, the Secretary shall not enter into any new short-term, temporary, or long-term contracts or agreements for water supply from the CVP for any purpose other than fish and wildlife before the provisions of Subsections 3406(b)-(d) (fish, wildlife, and habitat restoration) are met.

Other Planning Considerations

Other planning considerations were specifically identified to help formulate, evaluate, and compare alternative plans as follows:

- Alternative plans should address, at a minimum, all of the identified planning objectives.
- Measures to address identified opportunities should be either directly or indirectly related to the planning objectives (i.e., plan features should not be independent increments).
- Alternative plans should include integrated features for mitigating impacted hydropower generation through development of replacement hydropower generation facilities in preference to purchasing replacement energy. This consideration is due to private utility preferences for generation capacity, limitations of existing electricity transmission facilities in the region, uncertainty of future power prices, and uncertainty of hydropower mitigation requirements.
- Alternative plans should consider issues raised in coordination with other Federal and State agencies.
- Alternatives should avoid any increases in flood damages or other substantial hydraulic impacts to areas downstream on the San Joaquin River.
- Alternatives should either avoid potential adverse impacts to environmental, cultural, and historical resources or include features to mitigate unavoidable impacts.
- Alternatives should not result in a substantial adverse impact to existing and future water supplies, or related water resources conditions.
- Alternatives should either avoid potential adverse impacts to recreation resources or include features to mitigate unavoidable impacts.
- Alternatives should be formulated and evaluated based on a 100-year period of analysis.
- Construction costs for alternatives should reflect current prices and price levels, and annual costs should include the current Federal discount rate and an allowance for interest during construction (IDC).
- Alternatives should have a high certainty for achieving intended benefits and not depend on long-term actions (past the initial construction period) for success.

Criteria

The Federal planning process in the P&G also includes four specific criteria for consideration in formulating and evaluating alternatives: (1) completeness, (2) effectiveness, (3) efficiency, and (4) acceptability (WRC, 1983). Completeness is a determination of whether a plan includes all elements necessary to realize planned effects, and the degree that intended benefits of the plan depend on the actions of others. Effectiveness is the extent to which an alternative alleviates problems, achieves objectives, and employs opportunities. Efficiency is the measure of how efficiently an alternative alleviates identified problems while realizing specified objectives and opportunities consistent with protecting the Nation's environment. Acceptability is the workability and viability of a plan with respect to its potential acceptance by other Federal agencies, State and local governments, and public interest groups and individuals. These criteria and how they apply to the planning process are described in Chapter 4.