Chapter 2
Water Resources and Related Conditions

Initial steps of the plan formulation process for Federal water resources studies and projects, consistent with the P&G (WRC 1983), study authorizations, and pertinent Federal, State, and local laws and policies, are as follows:

- Specifying water resources problems, needs, and opportunities to be addressed

- Inventorying, forecasting, and analyzing existing and likely future conditions in the study area

Following is a description of each of these steps.

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. The *NRDC, et al., v. Kirk Rodgers, et al.* Settlement in 2006 triggered a substantial change in the without-project conditions for the Investigation, including updating operations to account for SJRRP Restoration Flow requirements. Based on the overall authority of the Investigation, concerns expressed about existing and likely future water and related resources issues, and the Settlement, the following is a description of identified major water resources problems, needs, and opportunities that could be addressed in the feasibility study.

Improved water management flexibility is needed to meet current and future challenges associated with increasing population, environmental needs, and climate change. An integrated portfolio of solutions, regional and statewide, is needed to meet future water supply needs.

Water Supply Reliability and Operational Flexibility

California's water supply system faces critical challenges with demands exceeding supplies for urban, agricultural, and environmental water uses across the State. The *2009 California Water Plan Update* (DWR) concludes that California is facing one of the most significant water crises in its history, drought impacts are growing, ecosystems are declining, water quality is diminishing, and climate change is affecting statewide hydrology. Compounding these issues, Reclamation's *Water Supply and Yield Study* (2008b) describes dramatic increases in population, land-use changes, regulatory requirements, and limitations on storage and conveyance facilities further straining available water supplies and infrastructure to meet water demands. Resulting unmet water demands have increased competition for water supplies among urban, agricultural, and environmental uses.

Water supply reliability and operational flexibility problems and needs for the CVP Friant Division and SOD contractors, similar to those throughout the State, are associated with large annual hydrologic variations in water availability, regulatory constraints, 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 long-term contractors varies widely in response to hydrologic conditions (Figure 2-1). During dry periods when surface water deliveries are reduced, many 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.

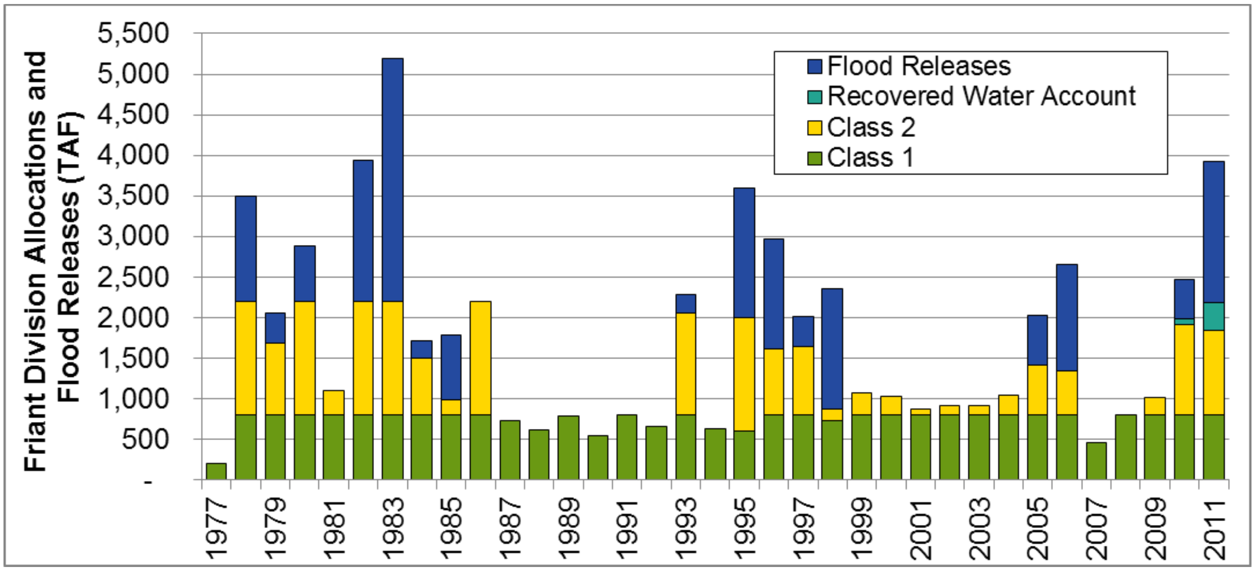

Figure 2-1. Friant Division Allocations and Flood Releases, 1977 – 2011

The following subsections discuss the identified key issues related to water supply reliability in California, including current and estimated water shortages, anticipated effects of population growth and climate change on water supply and demand, and limitations on system flexibility. The final subsection discusses strategies for meeting future statewide water supply needs.

Estimated Water Supply Shortages

Projecting accurate and quantified water supply and shortages in California is complex; there are numerous variables and, just as important, numerous opinions regarding these variables. Table 2-1 shows estimated water demands, available supplies, and shortages for the Central Valley and the State under existing conditions (Reclamation 2008b). Current water supply shortages for the State are estimated at 2.3 MAF and 4.2 MAF for average and dry years, respectively. As shown in Table 2-2, without further investment in water management and infrastructure, future statewide shortages are expected to increase to approximately 4.9 MAF and 6.1 MAF in average and dry years, respectively, by 2030. Representative demands for dry and average years were based on water use data from the *2005 California Water Plan Update* (DWR 2005), adjusted for population growth, increasing urban water use, and reductions in irrigated acreage and environmental flow due to insufficient water supplies. Shortages were determined on a regional basis, assuming that limitations on conveyance and storage would prevent surpluses from one region or use category from filling shortages in another.

Additionally, through implementation of the Settlement, average total system water deliveries from Friant Dam are expected to be reduced by about 150 TAF per year, or approximately 15 percent to 19 percent of deliveries under existing conditions. The Settlement does not detail all of the specific actions to achieve the Water Management Goal, nor does it identify specific quantities of water supply to be replaced, thereby reducing the flexibility of the system to meet demands.

Table 2-1. Estimated Water Demands, Supplies, and Shortages under Existing Conditions

Item[1]	Hydrologic Basin						State of California	
	Sacramento		San Joaquin		Two-Basin Total			
	Average Year[2]	Dry Year[2]	Average Year[2]	Dry Year[2]	Average Year[2]	Dry Year[2]	Average Year[2]	Dry Year[2]
Population[3]	2.9		2.0		4.9		36.9	
Water Demand (MAF)								
Urban	0.9	0.9	0.6	0.6	1.5	1.5	8.9	9.0
Agricultural	8.7	8.7	7.0	7.0	15.7	15.7	34.2	34.2
Environmental	11.9	9.4	3.1	2.3	15.0	11.7	17.5	13.9
Total	21.5	19.0	10.7	9.9	32.2	28.9	60.6	57.1
Water Supply (MAF)								
Urban	0.9	0.9	0.6	0.6	1.5	1.5	8.8	8.4
Agricultural	8.7	8.6	6.9	7.0	15.6	15.6	33.2	32.0
Environmental	11.5	8.7	2.5	1.8	14.0	10.5	17.5	12.6
Total	21.1	18.2	10.0	9.4	31.1	27.6	60.6	53.0
Total Shortage (MAF)[4]	0.4	0.8	0.7	0.5	1.1	1.3	2.3	4.1

Notes:
1 Water demands, supplies, and shortages are from the *Water Supply and Yield Study* (Reclamation 2008b).
2 Representative dry and average year supplies and demands were based on adjusted water use and supply data from the *2005 California Water Plan Update* (DWR 2005).
3 Population estimates are from the California Department of Finance (2010)
4 Total shortages are calculated as the sum of shortages for each category by region and, therefore, may not equal the difference between total demands and supplies. For categories where supply is greater than demand, the shortage is equal to zero.
Key:
MAF = million acre feet

Table 2-2. Estimated Water Demands, Supplies, and Shortages for 2030

Item[1]	Sacramento and San Joaquin Hydrologic Basins — Two-Basin Total		State of California	
	Average Year[2]	Dry Year[2]	Average Year[2]	Dry Year[2]
Population (million)[3]	10.5		49.2	
Water Demand (MAF)				
Urban	2.4	2.5	11.9	12.0
Agricultural	15.0	15.0	31.4	31.4
Environmental	14.9	11.7	17.5	14.0
Total	32.3	29.2	60.8	57.4
Water Supply (MAF)				
Urban	1.5	1.5	8.4	8.0
Agricultural	15.6	15.6	32.8	31.5
Environmental	14.0	10.5	16.3	12.6
Total	31.1	27.6	57.5	52.1
Total Shortage (MAF)[4]	1.8	2.2	4.9	6.1

Notes:
[1] Water demands, supplies, and shortages are from the *Water Supply and Yield Study* (Reclamation 2008b).
[2] Representative dry and average year supplies and demands were based on water use and supply data from the *2005 California Water Plan Update* (DWR 2005) adjusted for population growth, increasing urban water use, and reductions in irrigated acreage and environmental flow due to insufficient water supplies.
[3] Population estimates are from the California Department of Finance (2010)
[4] Total shortages are calculated as the sum of shortages for each category by region and, therefore, may not equal the difference between demands and supplies. For categories where supply is greater than demand, the shortage is equal to zero.

Key:
MAF = million acre feet

Potential Effects of Population Growth on Water Demands

A major factor in California’s future water picture is population growth. California’s population is expected to increase by just over 34 percent by 2050 (California Department of Finance 2010) and could force some of the existing water supplies currently identified for agricultural uses to be redirected to urban uses. Some portion of increased population in the Central Valley would occur on lands currently used for irrigated agriculture. Water that would have been needed for these lands for irrigation would instead be used to serve replaced urban demands. However, this would only partially offset the required agricultural-to-urban water conversion needed to sustain projected urban water demands, since much of the growth would occur on nonirrigated agricultural lands.

The *2009 California Water Plan Update* (DWR) estimates changes in future water demands by 2050 considering three different population growth scenarios as well as climate change. Table 2-3 shows results of this study for an average water year (DWR 2009a). The first scenario (Current Trends) assumes that recent population growth trends will continue until 2050. The second scenario (Slow and Strategic Growth) assumes that population growth will be slower than currently projected. The third scenario (Expansive Growth) assumes that population growth will be faster than currently projected, with nearly 70 million people living in California in 2050. Estimated reductions in agricultural water demands in Table 2-3 represent decreases in future agricultural water demands due to conversion from agricultural to urban land uses. Under the Current Trends and Expansive Growth scenarios, as much as 3 MAF and 8 MAF, respectively, of increased demand is projected, adding to the current water shortages estimated in Table 2-1.

Table 2-3. Estimated Annual Change in Water Demand in California for 2050 Considering Different Population Growth Scenarios

Item	Current Trends	Slow and Strategic Growth	Expansive Growth
Population (million)	59.5	44.2	69.8
Irrigated Crop Acreage (million)	8.6	9	8.3
Water Demand Change[1] (MAF)			
Urban	7	2	11
Agricultural	-4.5	-5.5	-4
Environmental	1	2	1
Total	3	-1.5	8

Source: DWR 2009a

Note:

[1] Water demand change is the difference between the average demands for 2043—2050 and 1998—2005.

Key:

MAF = million acre-feet

Potential Effects of Climate Change on Water Supply and Demand

Another potentially significant factor affecting water supply reliability is climate change. Potential impacts due to climate change are many and complex (DWR 2006a), varying through time and geographic location across the State (Reclamation 2011a). Changes in geographic distribution, timing, and intensity of precipitation are projected for the Central Valley (Reclamation 2011a), which could broadly impact rainfall-runoff relationships important for flood management as well as water supply. Additionally, when climate change is considered in projections of future water demand, annual water demand is higher than under a repeat of historical climate (DWR 2009a). Other possible impacts range from potential sea-level rise, which could impact coastal areas and water quality, to impacts to overall system storage for water supply.

A reduction in total system storage is widely predicted to occur with climate change. Precipitation held in snowpack makes up a significant quantity of total annual supplies needed for urban, agricultural, and many environmental uses. It is expected that in the future, climate change may significantly reduce water held in snowpack in the Sierra Nevada (Reclamation 2011a, DWR 2009a). Further potential for reductions in water conservation space in existing reservoirs in the Central Valley is anticipated because of increasing needs for additional space for flood management purposes. These potential reductions could significantly impact available water supplies. During drought periods, supplies could be further reduced, and expected shortages would be significantly greater. Possible effects of climate change on water supply in California are discussed in greater detail in the Modeling Appendix Attachment C.

System Flexibility

In addition to concerns about future water supply and demand, California's Federal and State water systems lack flexibility in timing, location, and capacity to meet the multiple purposes of the projects. The flexibility of the CVP and SWP has diminished over time as population continues to grow and environmental and ecosystem commitments and requirements continue to increase (Reclamation 2008b). Complicating this issue is the variability associated with water resources in California, coupled with anticipated changes in future supply and demand. Variability and uncertainty are the dominant characteristics of water resources in the State (Delta Stewardship Council 2012). Precipitation in California is seasonably, temporally, and spatially variable. In addition, urban, agricultural, and environmental water users have variable needs for quantity, quality, timing, and place of use. The water and flood systems face the threat of too little water to meet needs during droughts and too much water during floods, respectively. Challenges are greatest during drought years, when agricultural and environmental water becomes less available, and a greater reliance on groundwater results in overdraft (DWR 2009a).

Additionally, Delta vulnerabilities introduce opportunities related to system flexibility. More than half of Californians rely on water conveyed through the Delta for at least part of their water. The Delta faces extraordinary risks in both the near term and the long term, including earthquakes, river floods, sunny day levee failures, and continuing subsidence and sea-level rise (DWR 2009a). Previous analyses suggest that a catastrophic levee failure would result in cessation of pumping capacity for as much as 18 months, causing $30 billion to $40 billion in economic damage to the State (DWR 2009a).

Increasing CVP/SWP operational constraints have led to growing competition for limited system resources between various users and uses. Urban and required environmental water uses have each increased, resulting in increased competition and conflicting demands for limited water supplies. For example, the CVPIA, implemented in 1993, dedicated 800 TAF of CVP water supplies to the environment as well as additional water supplies for the Trinity River and wildlife refuges. Table 2-4 illustrates the impacts of the CVPIA, modeled using CalSim II, on urban and agricultural water deliveries to the north and south of the Delta. Dry year agricultural water deliveries were particularly impacted with deliveries to agricultural users, both NOD and SOD, reduced by about 50 percent.

Current CVP and SWP operational conditions are described in the 2008 *Formal ESA Consultation on the Proposed Coordinated Operations of the CVP and SWP* (USFWS 2008b) and the 2009 *BO and Conference Opinion on the Long-Term Operations of the CVP and SWP* (NMFS 2009), collectively known as the 2008/2009 BOs. The 2008/2009 BOs have resulted in increased Delta pumping constraints and other operational restrictions, coupled with drought conditions, and have even further decreased CVP deliveries. As competition for limited resources grows, water management flexibility and adaptability will be even more necessary in the future.

Table 2-4. Impact of CVPIA on CVP Deliveries

CVP Contract Deliveries	All Years			Driest Years		
	Pre-CVPIA (TAF)	Post-CVPIA (TAF)	Percent Change	Pre-CVPIA (TAF)	Post-CVPIA (TAF)	Percent Change
NOD Urban	176	167	-5%	166	145	-13%
NOD Agriculture	279	234	-16%	169	84	-50%
SOD Urban	134	122	-9%	114	96	-16%
SOD Agriculture	1,588	1,137	-28%	931	471	-49%
Total	2,176	1,660	-24%	1,381	796	-42%

Source: Reclamation 2008b
Notes:
[1] Deliveries were modeled using CalSim II. Key:

Key:
CVP = Central Valley Project
CVPIA = Central Valley Project Improvement Act
NOD = north of Delta
SOD = south of Delta
TAF= thousand acre-feet

San Joaquin Valley Refuge Water Supply

Securing a reliable water supply of sufficient quality has long been recognized as an important component for sustaining wetland habitats in the Central Valley and waterfowl of the Pacific Flyway, and supporting other wildlife species that depend on wetland habitat (Reclamation, et al. 2001). Of the 19 Central Valley refuges and managed wetlands, 10 SOD refuges and managed wetlands are served via Mendota Pool along the San Joaquin River. These refuges and managed wetlands include Grassland Resource Conservation District (GRCD), Los Banos Wildlife Area (WA), Mendota WA, Volta WA, the North Grasslands WA Complex’s Salt Slough and China Island units, and the San Luis National Wildlife Refuge Complex’s San Luis, West Bear Creek, Freitas, and Kesterson units.

The CVPIA Refuge Water Supply Program (Section 3406(b)), Reclamation is required to provide firm and reliable water supplies of suitable quality to maintain and improve wetlands and wildlife habitat on 19 specific Central Valley wildlife refuges. Numerous biological benefits have resulted from a reliable year-round water supply that adequately meets the delivery schedule for wetland management on CVPIA refuges (Reclamation 2012). Water supplies developed through the Refuge Water Supply Program also allow refuge managers to “flush” excess salts from wetlands while improving soil quality (Reclamation 2012).

Reclamation is currently implementing activities, such as shifted demand scheduling, reallocation of Level 2 supplies to other refuges, and supply flexibility options that are strategically prioritized, to improve coordinated management of refuge water supplies and lessen impacts to other water users (Reclamation 2012). Additionally, Level 2 diversification opportunities, which could provide mutual benefits to refuges and agricultural water service contractors, are being pursued.

Strategies to Address Water Supply Needs

As noted by Reclamation's *Water Supply and Yield Study* (2008b), the *California Water Plan Update 2009* (DWR 2009a), *A CVP Yield Feasibility Investigation Report: The Delivery Impact of the CVPIA* (Reclamation 2005a), CALFED (2000a), and the *Least-Cost Yield CVP Increase Plan* (Reclamation et al. 1995), an integrated portfolio of solutions, regional and statewide, is needed to meet future water supply needs. The *Water Supply and Yield Study* stated that a "variety of storage and conveyance projects and water management actions have the potential to help fill [the] gap" between water supply and demand in California.

The *California Water Plan Update 2009* (DWR 2009a) concluded that California must invest in reliable, high-quality, 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. However, even with major efforts by multiple agencies to address the complex water resources issues in the State, demands are expected to continue to exceed supplies in the future.

To avoid major impacts to the economy, overall environment, and standard of living in California, future water resource plans must consider additional water sources to increase supply reliability for expanding M&I uses and to maintain adequate supplies for agricultural and environmental purposes. Water management flexibility and adaptability will become even more necessary in the future to meet the challenges associated with increasing population, environmental needs, and climate change. Additionally, future water planning for the State should increase urban water use efficiency, recycling municipal supplies, and improving Delta conveyance through programs, such as the BDCP.

San Joaquin River Ecosystem

After construction of Friant Dam and before implementation of the SJRRP, the reach of the San Joaquin River from Friant Dam to the Merced River confluence (Figure 2-2) did not support a continuous riparian and aquatic ecosystem. Friant Dam was authorized and is operated to support two primary purposes: agricultural and M&I water supplies, and flood damage reduction. Since completion of Friant Dam, most of the water in the river was diverted for agricultural and M&I uses, with the exception of releases to comply with Holding Contract requirements upstream from Gravelly Ford, and flood releases. Between Friant Dam and Gravelly Ford, diversions and encroachments by agriculture and urban development led to fragmented riparian habitat and extensive changes in the aquatic ecosystem. Holding Contract requirements between Friant Dam and Gravelly Ford required that streamflow of at least 5 cfs must be maintained past each Holding Contract diversion point, with the last being near Gravelly Ford.

The reach of the lower 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 was groundwater seepage from adjacent agricultural lands. The reach from Sack Dam to Bear Creek was operationally dry, but this reach benefited from managed wetland development, whereas marshes were drained between Bear Creek and the Merced River. Generally unhealthy ecosystem conditions for the native cold water fishery resulted from lack of reliable flows and poor water quality in the San Joaquin River.

Implementing the SJRRP is expected and intended to alter ecosystem conditions of the San Joaquin River. Accomplishing the Restoration Goal, including the full release of Restoration Flows required under the Settlement, will require funding, and constructing extensive channel and structural improvements in many areas of the river, including some areas that have been without flows (except for occasional flood releases) for decades.. The exact nature of these structural improvements, and magnitude and timing of resulting ecosystem improvements, is the subject of a Programmatic EIS/EIR and multiple related studies prepared by Reclamation and others (SJRRP 2011).

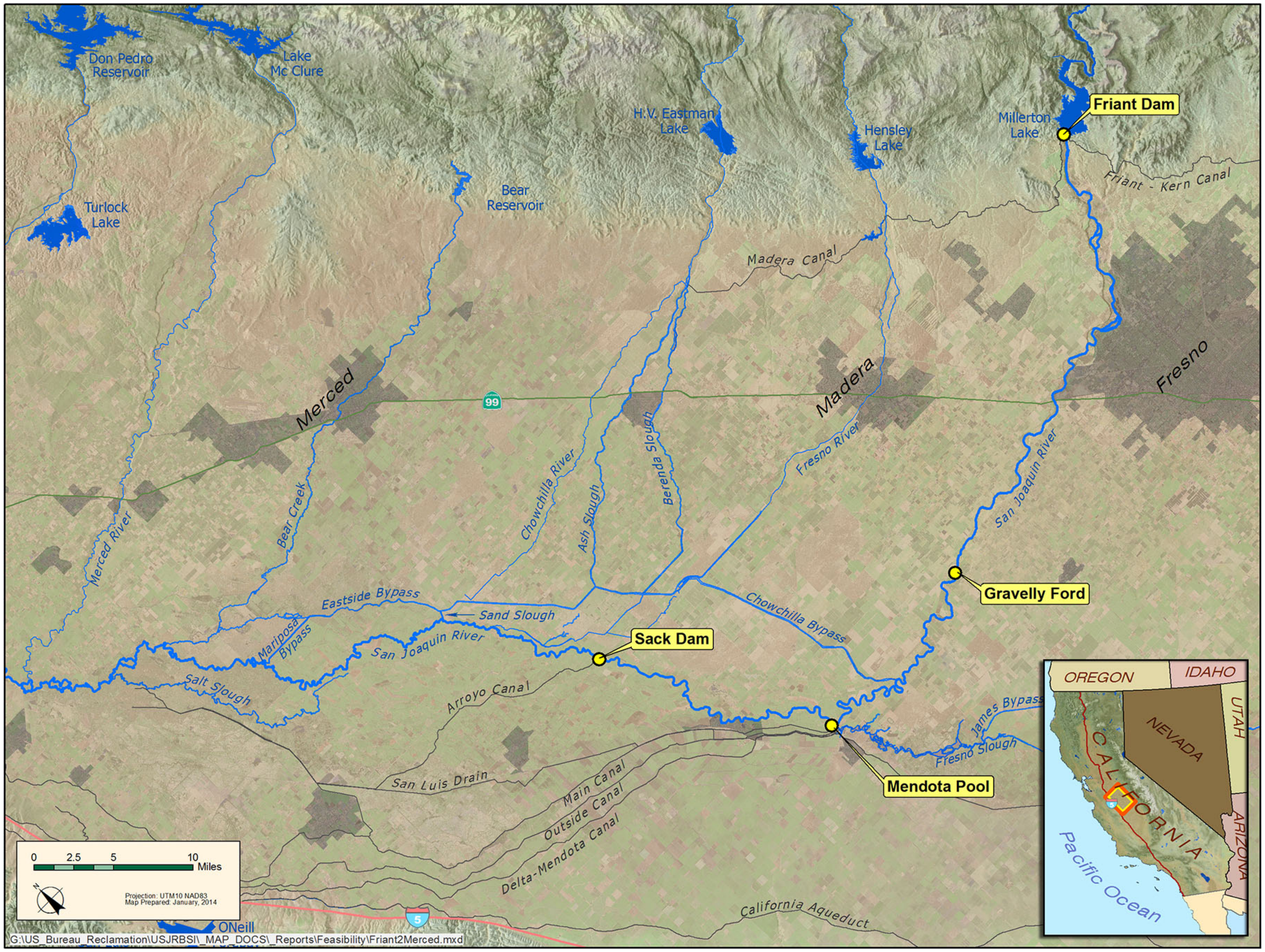

Figure 2-2. San Joaquin River from Friant Dam to Merced River

Interim Flows for experimental purposes began in 2009 and Restoration Flows began January 1, 2014. The flows will be increased gradually over the next several years up to the full flows specified in the Settlement, as channel capacity allows.

The stipulated releases to the San Joaquin River vary by water year type and represent the quantity of flows released from Friant Dam in addition to the volume of flows required to satisfy riparian diversions between Friant Dam and Gravelly Ford and maintain 5 cfs of flow at the Gravelly Ford gage station. There are also provisions for an additional buffer flow of up to 10 percent for release to the river; releases to address unexpected seepage losses; flushing flows to enhance gravel conditions for spawning during wet and normal-wet years; and riparian recruitment flows during wet years.

The Settlement includes the reintroduction of spring-run and fall-run Chinook salmon. The SJRRP implementing agencies have been conducting various fisheries studies on Chinook salmon requirements and habitat conditions in the San Joaquin River between Friant Dam and the Merced River and are performing initial reintroduction activities such as collection and transport of fall-run Chinook salmon and are anticipating release of Feather River Hatchery spring-run Chinook salmon in second quarter 2014.

In addition to flow, success of Chinook salmon populations is known to be affected by water temperature. The SJRRP has developed information on water temperature requirements for Chinook salmon, and the continuing water temperature studies provide the ability to monitor changes to habitat conditions. 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 could negatively impact spawning adults, egg maturation and viability, and pre-emergent 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 would inhibit the growth of juveniles. The ability to manage the necessary volumes of cold water and to release water from Friant Dam at suitable temperatures, especially in drier water years, may be challenges to restoring and maintaining naturally reproducing and self-sustaining anadromous fish.

Major storms during the past 3 decades have demonstrated that Friant Dam has little capacity to store water from large runoff events. For example, between 1977 and 2011 flood control releases from Friant Dam totaled almost 17 MAF, and flood releases were made in about 50 percent of the years.

Flood Damage Reduction

Annual unimpaired runoff at Friant Dam from the upper San Joaquin River basin ranges from about 360 TAF to 4,600 TAF, with an average of 1,800 TAF (water years 1901-2007). Millerton Lake, at approximately 520 TAF in volume, is often undersized to adequately manage annual inflows, underscoring the need for additional storage. 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 cfs downstream from Friant Dam.

Further, the level of flood 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, the USACE assessed system performance during major floods in the last 2 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 systemwide 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 million in the San Joaquin River Basin.

Energy Generation and Management

In 2009, the United States received approximately 7 percent of its electricity from hydropower (EIA 2010). Hydropower is also an important element of power supply in California. On average, hydropower generation constitutes between 9 and 30 percent of California’s annual energy supply, depending on the type of water year (CEC 2003). Due to its ability to rapidly increase and decrease power generation rates, hydropower could be used to support peak power loads in addition to base power loads.

Demands for power are expected to increase as population, industry, and associated infrastructure growth occurs in the future. Over the next 10 years, California’s peak demand for electricity is expected to increase up to 18 percent from about 278,000 gigawatt-hours (GWh) to 328,000 GWh (CEC 2013).

There are, and will continue to be, increasing demands for new electrical energy supplies, including clean energy sources, such as hydropower.

Renewable energy generation from solar and wind facilities is also expected to increase in response to Executive Orders S-14-08 and S-21-09, issued in 2008 and 2009, respectively, which established a goal of using renewable energy sources for 33 percent of the State's energy consumption by 2020 (California Public Utilities Commission 2011). Increased power demand and renewable energy production will increase needs for energy management and storage facilities, like hydroelectric powerplants with water storage, that could provide energy and ancillary services to the grid as needed.

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. In the primary study area, regional population growth is expected to result in increased demand for recreation at Millerton Lake and increased visitation (Reclamation 2008d).

Recreational boating, Millerton Lake

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 for lands draining to the San Joaquin River, SJRRP actions, and various TMDLs, including the San Joaquin River at Vernalis Salt and Boron TMDL and Basin Plan Amendment for the Control of Salt and Boron Discharges into the San Joaquin River upstream from Vernalis. 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 among 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).

Several environmental flow goals and objectives in the Central Valley, including the Delta, have been established through legal mandates to address the impacts of water operations and water quality deterioration on the San Joaquin River Basin and Delta ecosystems and on endangered and threatened fish populations. Planning efforts, such as the BDCP, are intended allow implementation of projects that restore and protect water supply and reliability, water quality, and ecosystem health in the Delta to proceed within a stable regulatory framework. Additional operational flexibility is needed to provide further opportunities to improve San Joaquin River and Delta water quality conditions.

Existing and Likely Future Resource Conditions in Study Area

One of the most important elements of any water resources evaluation is defining existing resource conditions in the affected environment, and how these conditions may change in the future. The magnitude of change not only influences the scope of the problems, needs, and opportunities, but the extent of related resources that could be influenced by possible actions taken to address them. Defining the existing and likely future conditions is critical in establishing the basis for comparing potential alternative plans consistent with P&G, NEPA, and CEQA guidance.

The following section briefly discusses existing conditions in the study area, including existing infrastructure, the physical environment, biological environment, cultural resources, and socioeconomic resources. The discussion of existing conditions focuses on the primary study area, but also provides information about water resources facilities and water deliveries in the extended study area. The primary and extended study areas are defined in Chapter 1.

Existing Condition Summary

This section describes existing conditions for the Friant Division, Friant Dam and Millerton Lake water control facilities, recreation facilities, and other infrastructure in the primary study area. The existing conditions will be described in more detail in the EIS/EIR.

Physical Infrastructure

Physical infrastructure in the study area includes facilities for the Friant Division, Friant Dam and Millerton Lake, recreational facilities and other reservoir area infrastructure, and facilities for flood risk management.

Friant Division of the Central Valley Project

Friant Dam and Millerton Lake

The reservoir facilities at Millerton Lake are part of the Friant Division of the CVP, and their operation affects flow in the San Joaquin River. The Friant Division provides water to over 1 million acres of irrigable land on the east side of the southern San Joaquin Valley. Principal features of the Friant Division include Friant Dam and Millerton Lake, and the Madera and Friant-Kern canals, which convey water north and south to agricultural and urban water contractors. Storage in Millerton Lake below the elevation for canal diversion is about 130 TAF (135 TAF for the Friant-Kern Canal diversion, 130 TAF for the

Madera Canal diversion), resulting in active storage of about 390 TAF. Annual water allocations and release schedules typically result in drawing reservoir storage to near minimum levels by the end of September.

Friant Dam and Millerton Lake

Friant Dam is a concrete gravity dam that impounds Millerton Lake on the San Joaquin River. It is located on the border between Fresno and Madera counties, near the community of Friant, about 20 miles northeast of Fresno.

Friant Dam, owned and operated by Reclamation, was constructed between 1939 and 1942. Three small saddle dams that close low areas along the reservoir rim are located on the south side of the reservoir. Millerton Lake has a volume of 524 TAF, a surface area of 4,905 acres, and an elevation of 580.6. Water deliveries, principally for irrigation, are made through outlet works to the Friant-Kern and Madera canals, which were completed in 1949 and 1944, respectively.

The spillway consists of an ogee overflow section, chute, and stilling basin at the center of the dam. Outlets to the Madera Canal are located on the right abutment; outlets to the Friant-Kern Canal are located on the left abutment. A river outlet works is located to the left of the spillway within the lower portion of the dam. Three powerhouses, owned and operated by the Friant Power Authority (FPA), are located on the canal and river outlets of Friant Dam. The combined capacity of the three powerhouses is 30 megawatts (MW).

Recreational Facilities and Other Reservoir Area Infrastructure

The general locations of facilities and developed lands around Millerton Lake are shown in Figure 1-1. The Millerton Lake SRA, managed by State Parks, contains numerous recreational facilities. The SJRGMA, administered by the BLM, is situated upstream from the SRA and also contains numerous recreational facilities. Three residential developments are located in Fresno County (Lakeview Estates, Winchell Bay, and Sky Harbor); one major development (Hidden View Estates) is located in Madera County. Other residential sites include two homes in the upper Millerton Lake area.

Several roads in the Millerton Lake area provide access to residential areas and recreational facilities. Two PG&E powerhouses, the Kerckhoff Powerhouse and Kerckhoff No. 2 Powerhouse, are located within 1 mile of the upstream end of

Millerton Lake (Figure 1-1). Water is diverted from Kerckhoff Lake at Kerckhoff Dam and conveyed through tunnels and penstocks to serve the powerhouse.

Flood Risk Management

Friant Dam is the principal flood storage facility on the San Joaquin River, with a dedicated flood management pool of 170 TAF during the flood season of October through March (USACE 1955). Under present operating rules, up to 85 TAF of the flood storage required in Millerton Lake may be provided by an equal amount of space in Mammoth Pool from November 1 to February 1, if available. Mammoth Pool is a 123 TAF reservoir upstream from Millerton Lake. During flood conditions, Friant Dam is operated to maintain releases to the San Joaquin River at or below a flow objective of 8,000 cfs. Other flood management facilities of the San Joaquin River Basin include levees along the San Joaquin River, Chowchilla Canal Bypass, Mariposa Bypass, and Eastside Bypass; levees along the lower portions of the Fresno River and Ash and Berenda sloughs; Bear Creek; and the Merced, Tuolumne, and Stanislaus rivers.

Physical Environment

Elements of the physical environment in the upper San Joaquin River Basin are described in this section, and include topography, geology, soils, geomorphology, sedimentation, erosion, climate, hydrology, water quality, groundwater resources, air quality, and noise.

Topography, Geology, and Soils

Regional topography consists of the nearly level floor of the San Joaquin Valley rising abruptly to moderately steep, northwest-trending foothills with rounded canyons. Millerton Lake is set in the lower foothills of the Sierras and extends from a relatively broad open portion near Friant Dam to a long, narrow reach upstream into the upper San Joaquin River. Elevations in the immediate area of Millerton Lake range from about elevation 310 at Friant Dam to over elevation 2,100 at the upper end of the reservoir. The topography of the San Joaquin River Basin rises to over elevation 12,000 in the upper watershed, located in the Sierra Nevada.

The Investigation study area is located along the western border of the central portion of the Sierra Nevada Province at its boundary with the eastern edge of the Great Valley Province of California. Intrusive Sierra Nevada batholith rocks underlie most of the primary study area. Occasional remnants of lava flows and layered tuff are present in the area at the highest elevations. The San Joaquin River above Millerton Lake passes through medium- to fine-grained metamorphosed granodiorite. Surface weathering has produced some decomposed granite and soils. The primary study area is in the Upland Soils Physiographic Region of the Central Valley.

Geomorphology, Sedimentation, and Erosion

The San Joaquin River upstream from Millerton Lake lies in a steep and narrow canyon, and is known as the Patterson Bend reach. This 9-mile reach has a bedrock channel with an overall average gradient of about 1 percent, many long narrow pools, and an occasional steep cascade. Several small, ephemeral streams enter the San Joaquin River in this reach. The river margins in this reach are steep and rocky and flood flows frequently scour the channel.

The stretch of the river downstream from the Kerckhoff powerhouses is referred to as Millerton Bottoms, after which the river flows into Temperance Flat. Temperance Flat is the only substantial area in upper Millerton Lake with a gently sloping shoreline, shallow water, and well-developed shoreline vegetation. Big Sandy Creek and a few small, unnamed tributaries provide minor flow contributions to Millerton Lake in this reach. The shoreline immediately downstream from Temperance Flat, known as the Big Bend area, has steep sides and is rocky, with little vegetation.

The substrate in the streams and river originating from direct erosion and mass wasting of resistant granite in the upper San Joaquin River watershed is generally composed of large boulders, cobbles of 4 inches or larger diameter, and fine sand, with a small number of intermediate size gravels (SCE 2003). Since natural and cut slopes in decomposed granite erode readily and produce these coarse materials, soil erosion potential is high (FERC 2002). The lack of favorable conditions for chemical weathering in the watershed, and the predominantly coarse-grained parent material, results in the absence of fine-grained silts and clays. Land-disturbing activities, such as road building and timber harvesting, have the greatest potential to increase erosion, resulting in sedimentation in watercourses (SCE 2003).

Climate and Hydrology

The climate of the San Joaquin River Valley is arid to semi-arid with dry, hot summers and mild winters. Higher elevation portions of the watershed have distinct wet and dry seasons. Most of the precipitation falls from November to April, with rain at the lower elevations and snow in the higher regions. Large areas of high elevation watershed supply snowmelt run off during the late spring and early summer months, which is the main contributor to flow in the upper San Joaquin River. Downstream from Friant Dam, the river flows westward toward the center of the valley floor, where it turns sharply northward and flows through the San Joaquin Valley to the Delta. Along the valley floor, the San Joaquin River receives additional flow from the Merced, Tuolumne, and Stanislaus rivers and numerous smaller tributaries.

Upper San Joaquin River flows have been greatly affected by storage and releases of SCE and PG&E power projects. In addition to hydropower generation, reservoirs associated with these projects provide storage, flood management capacity, and recreational opportunities. Annual unimpaired runoff (estimates of flow that would occur at a specific location if upstream facilities were not in place) from the upper San Joaquin River Basin (at Friant Dam) ranges from about 362 TAF to 4,642 TAF, with an average of 1,818 TAF (Water Years [WY] 1901 – 2007).

In the reach between Friant Dam and Gravelly Ford, flow is influenced by releases from Friant Dam, with minor contributions from agricultural and urban return flows. However, agricultural return flows have reached up to 300 cfs on occasion (EPA 2007). Stormwater runoff from the Fresno metropolitan area is managed by the Fresno Metropolitan Flood Control District. All but five of the District’s 161 drainage basins route stormwater to retention and detention facilities, limiting urban surface runoff. Releases from Friant Dam to the San Joaquin River since 1941 have generally been limited to releases for Holding Contract requirements and flood management releases. As described in the section on likely future conditions, the implementation of the Settlement will change this condition.

The existing conditions include the SJRRP Restoration Flow water releases from Friant Dam, which began January 1, 2014. The flows will be increased gradually over the next several years up to the full flows specified in the Settlement, as channel capacity allows.

Water Quality

Most of Millerton Lake becomes thermally stratified during spring and summer months. Complete mixing of the water column likely occurs during winter months. Water temperatures in Kerckhoff Lake rarely exceed 68 degrees Fahrenheit (°F). Summer water temperatures in the San Joaquin River below Kerckhoff Dam often exceed 75°F because of low streamflow and warming of the FERC-mandated releases from Kerckhoff Dam. During summer, cold water outflows from the Kerckhoff and Kerckhoff No. 2 powerhouses bypass an 8- and 9.5-mile segment of the San Joaquin River through tunnels from Kerckhoff Lake and are returned to the river near the upper portion of Millerton Lake. The colder, denser river inflow submerges at a location referred to as the “plunge point,” and continues to flow downstream below the warmer reservoir surface layer (Ford 1990, PG&E 2001).

The upper reaches of the rivers draining to the San Joaquin River Basin originate in large drainage areas high on the west side of the Sierra Nevada. The water in these rivers is generally soft, with low mineral concentrations. Water is nutrient- and mineral-poor due to the insolubility of the granite substrate. As the San Joaquin River flows from the Sierra Nevada foothills below Friant Dam across the eastern valley floor, mineral concentrations steadily increase, largely as a result of depleted freshwater flows, M&I wastewater discharges, salt loads in agricultural drainage and runoff, and loads of other constituents associated with agricultural irrigation and production (DWR 2005). These constituents include nutrients, selenium, boron, organophosphate pesticides such as diazinon and chlorpyrifos, and toxicity of unknown origin.

Downstream from the primary study area, the reach from Gravelly Ford to a location upstream from Mendota Pool (about 17 miles) has been frequently dry historically, except during flood releases. As described in the section on likely future conditions, the implementation of the Settlement will change this condition. The entire stretch of the San Joaquin River from Friant Dam to the Mendota Pool is listed as an impaired water body under Section 303(d) of the CWA, with the main concern being invasive species (State Water Board 2010).

During the irrigation season, most of the water released from the Mendota Pool to the San Joaquin River is imported from the Delta via the DMC, and generally has higher concentrations of total dissolved solids (TDS) than water in the upper reaches of the San Joaquin River. Most of the water released from the Mendota Pool to the San Joaquin River is diverted at or above Sack Dam for agricultural uses. Historically, the San Joaquin River has been often dry between Sack Dam and the confluence with Salt Slough. From Salt Slough to Fremont Ford, most of the flow in the San Joaquin River is derived from irrigation return flows carried by Salt and Mud sloughs. This reach typically has the poorest water quality of any reach of the river. As the San Joaquin River flows downstream from Fremont Ford, water quality generally improves at successive confluences, specifically at those with the Merced, Tuolumne, and Stanislaus rivers. The San Joaquin River below the Mendota Pool is listed as an impaired water body under Section 303(d) of the CWA (State Water Board 2010).

Groundwater Resources

Within the primary study area, the majority of groundwater occurs in fractured bedrock. Localized alluvial material and weathered bedrock have potential to provide groundwater in the area, but large volumes of these materials were not identified within the Auberry-Prather area during a regional study of groundwater resources in eastern Fresno County (Fresno County 2006).

Figure 2-3 shows the locations of groundwater subbasins underlying the San Joaquin Valley within the primary and extended study areas. Groundwater quality throughout the region is suitable for most urban and agricultural uses. Local water quality impairments do exist for such constituents as TDS, nitrate, boron, chloride, and organic compounds (DWR 2003).

Air Quality and Noise

Air quality in the San Joaquin Valley Air Basin (SJVAB) is regulated by the San Joaquin Valley Air Pollution Control District (SJVAPCD), which consists of Merced, Madera, Fresno, Kern, Kings, San Joaquin, Stanislaus, and Tulare counties. The entire SJVAB is designated nonattainment with respect to the national 8-hour and State 1-hour ozone (O_3) standards, national and State particulate matter (PM) standards of 10 microns in aerometric diameter or less (PM_{10}) and 2.5 microns or less ($PM_{2.5}$).

Figure 2-3. San Joaquin Valley Groundwater Subbasins

Noise levels in densely populated areas of the State are influenced predominantly by the presence of limited-access highways carrying extremely high volumes of traffic, particularly heavy trucks. Noise in rural areas, where traffic generally is low to moderate, is measured at considerably lower decibels. Noise at Millerton Lake is generally affected by the presence of boats and personal watercraft.

Hazardous Materials

Metals may be present in inactive and abandoned mines around Millerton Lake, Temperance Flat, and the San Joaquin watershed. A records search did not reveal any sites on the Federal National Priorities List; however, there are several abandoned gold and/or quartz mines in the area.

Agricultural and Important Farmlands

Within the primary study area, there are no farmlands designated as prime farmland, unique farmland, or farmland of statewide importance; however, just downstream from the primary study area there is both prime farmland and unique farmland in Madera County. In the extended study area, the San Joaquin River Basin downstream from Friant Dam to the Delta, the Delta, and the CVP and SWP water service areas are all rich in agricultural resources.

Biological Environment

Elements of the aquatic and terrestrial biological environment in the upper San Joaquin River Basin are described in this section. The discussion focuses on habitat and species, including special-status species.

Aquatic and Fishery Resources

The following sections discuss existing aquatic and fishery resources in the primary study area.

Millerton Lake and San Joaquin River below Kerckhoff Dam

Under current reservoir operations, Millerton Lake water levels change by 1 foot or more per day almost 50 percent of days, and change by 2 feet or more about 10 percent of days. Extreme water-level fluctuation in reservoirs resulting from reservoir management priorities is perhaps the most important environmental factor affecting reservoir fish population productivity. The direct and indirect effects of fluctuating water levels are also responsible for other fishery management issues, such as limited cover habitat, limited littoral habitat, and shoreline erosion.

Riparian vegetation along most of the San Joaquin River from Kerckhoff Dam to Millerton Lake is poorly developed because the river margins are steep and rocky, and flood flows frequently scour the channel. Some riparian vegetation occurs at the confluence of small streams in the upper portion of this reach.

Most of Millerton Lake becomes thermally stratified during spring and summer months and, therefore, potentially supports a two-stage fishery, with cold-water species residing in deep water and warm-water species inhabiting surface waters and shallow areas near shore.

Most of the commonly occurring species in Millerton Lake are introduced game or forage species. The principal game species are spotted bass (*Micropterus punctulatus*), largemouth bass (*Micropterus salmoides*), smallmouth bass (collectively referred to as black bass) (*Micropterus dolomieu*), bluegill (*Leopomis macrochirus*), black crappie (*Pomoxis nigromaculatus*), and striped bass (*Morone saxatilis*). The principal forage species for most of the game fishes is threadfin shad (*Dorosoma petenense*). Rainbow trout (*Oncorhynchus mykiss*), also an important game species, is frequently abundant in the upper San Joaquin River reach between Millerton Lake and Kerckhoff Dam. Several native nongame species have been collected from the reservoir, including Sacramento sucker (*Catostomus occidentalis*), Sacramento pikeminnow (*Ptychocheilus grandis)*, Sacramento blackfish (*Orthodon microlepidotus*), hitch (*Lavinia exilicauda*), hardhead (*Mylopharodon conocephalus*), and white sturgeon (*Acipenser transmontanus*). However, most of the native species have been substantially impacted in recent years (Mitchell pers. com. 2006).

The Millerton Lake population of American shad (*Alosa sapidissima*) is the only known successfully spawning, landlocked population. Because of its unique status, the population has attracted scientific interest and has been intensively studied in connection with PG&E's FERC licensing studies for the Kerckhoff No. 2 Hydroelectric Project (PG&E 1986, 2001).

Temperance Flat Area, Millerton Lake

The San Joaquin River between Millerton Lake and Kerckhoff Dam has spawning habitat for American shad and striped bass. Native fish species in the reach include hardhead, Sacramento pikeminnow, Sacramento sucker, and rainbow trout. Nonnative fish species include smallmouth bass and green sunfish (*Lepomis cyanellus*). Kern brook lamprey (*Lampetra hubbsi*), were originally thought to be endemic to the east side of the San Joaquin Valley, however, in recent years, they have been found in the San Joaquin River downstream from Friant Dam and in several tributaries of the Sacramento River (Goodman pers. com.). In addition to fish, beds of the large, freshwater pearlshell clam (*Margaritifera* spp.) have been found on the river bottom in this reach but the distribution and abundance of this clam are poorly known. The clam is listed as a "Special Animal" by CDFW, with its status in California classified as uncertain.

No aquatic species in the primary study area are federally or State-listed as threatened or endangered. Three species have special Federal and/or State status because they are relatively rare or are declining in abundance and/or distribution: hardhead, hitch, and Kern brook lamprey.

San Joaquin River from Friant Dam to Merced River
Aquatic habitat conditions vary spatially and temporally throughout the San Joaquin River between Friant Dam and the Merced River and in the flood bypasses in this area (collectively referred to as the Restoration Area in the SJRRP). This is because of differences in habitat availability and connectivity, water quantity and quality, channel morphology, and predation risks. Throughout the area, physical barriers, reaches with poor water quality or no surface flow, and the presence of false migration pathways have reduced habitat connectivity for anadromous and resident native fishes. In addition to barriers, false migration pathways may impede fish movement in the Restoration Area.

Fish assemblages currently found in the San Joaquin River are the result of substantial changes to the physical environment, combined with more than a century of nonnative species introductions. Areas where unique and highly endemic fish assemblages once occurred are now inhabited by assemblages composed primarily of introduced species.

Of the approximately 21 native fish species historically present in the San Joaquin River, at least 8 are now uncommon, rare, or extinct, and an entire native fish assemblage – the deep-bodied fish assemblage (e.g., Sacramento splittail [*Poqonichthy macrolepidotus*], Sacramento blackfish) has been largely replaced by nonnative warm-water fish species (e.g., carp, catfish) (Moyle 2002). Warm-water fish assemblages, comprising many nonnative species, such as black bass species and sunfish species, appear better adapted to current, disturbed habitat conditions than native assemblages. However, habitat conditions in Reach 1 (slightly higher gradient, cooler water temperatures, and higher water velocities) seem to have restricted many introduced species from colonizing.

Vegetation and Habitat Types

The following sections discuss existing vegetation and habitat types in the primary study area.

Millerton Lake and San Joaquin River Below Kerckhoff Dam

Vegetation around Millerton Lake includes annual grassland, oak woodland, and foothill pine oak woodland habitat types. Nonnative annual grassland is common on the north side of the reservoir near Friant Dam, and grades into oak woodland and foothill pine oak woodland pine to the east. The south side of Millerton Lake near Friant Dam supports more forest land than the north side but also contains small patches of grassland and urban areas. Foothill pine oak woodland is found throughout the primary study area, especially in ravines and on north- and east-facing slopes. It intergrades with blue oak woodland, which is more frequent on drier, less shaded sites, most commonly occurring on the north side of Millerton Lake. Interior live oak woodland occurs at the higher elevation limits of the primary study area on steep and rocky, north-facing slopes and becomes more abundant just outside of the primary study area. Buckbrush chaparral is the most common shrub-dominated habitat type in the study area; bush lupine scrub also occurs in the area.

Various riparian communities occur in the area, dominated by species that include white alder (*Aluns rhombifolia*), sycamore (*Plantanus racemosa*), willow (*Salix* spp.), cottonwood (*Populus* spp.), and buttonbrush (*Cephalanthus occidentalis*), and nonnative species, such as Himalayan blackberry (*Rubus armeniacus*), fig (*Ficus* spp.), and Spanish broom (*Spartium junceum*). Riparian vegetation occurs along the San Joaquin River and its intermittent and ephemeral tributaries.

Historically, the area has been affected by manmade and natural disturbances. A number of nonnative species have been intentionally or inadvertently introduced in the course of human settlement in the region, including invasive plants and game fish and wildlife species. Cattle grazing, a traditional land use managed by BLM, is pervasive on public and private lands in the area. Ecosystems in the basin have been extensively affected by fires, and many plant and wildlife species are fire-adapted. Historical records indicate that over half of the upper San Joaquin River watershed had burned before the 1950s. Since then, fire suppression has decreased the number of fires in the study area to infrequent, random events triggered by natural causes (lightning).

A number of rare and listed plant species are known to occur in the primary study area. These include Ewan's larkspur (*Delphinium hansenii* subsp.), Michael's piperia (*Piperia michaelii*), tree anemone (*Carpenteria californica*), and Madera leptosiphon (*Leptosiphon serrulatus*). Two plant species, the elderberry (*Sambucus* spp.) and California pipevine (*Aristolochia californica*), which serve as hosts for invertebrates of interest, are also known to occur in the area.

San Joaquin River from Friant Dam to Merced River
Descriptions of reach-specific physical conditions, plant communities, and sensitive resources by reach are based on the SJRRP PEIR/PEIS and the California Natural Diversity Database (CNDDB) (CDFW, 2013).

Reach 1A
Reach 1A presently supports continuous riparian vegetation, except where the channel has been disrupted by instream aggregate removal or off-channel aggregate pits that have been captured by the river. This reach has the greatest diversity of vegetation types and has the highest overall diversity of plant species. Based on the vegetation surveys conducted in 2000 by DWR (DWR 2002), eight identified riparian communities (cottonwood, willow, mixed, and oak riparian forest; willow and riparian scrub and elderberry savanna; and emergent wetlands) are present in this reach. No special-status plants have previously been documented in Reach 1A (CDFW 2013).

Reach 1B
Reach 1B has a low ratio of natural vegetation per river mile. In 14 miles of channel, there is a little more than 1 square mile of natural habitat present. Woody riparian vegetation is prevalent and occurs mainly in narrow strips immediately adjacent to the river channel. No special-status plants have previously been documented in Reach 1B (CDFW 2013).

Reach 2A
Riparian vegetation in the upper 10 miles of this reach is sparse or absent because the river is usually dry and the shallow groundwater is overdrafted (McBain and Trush 2002). Grassland/pasture is relatively abundant in Reach 2A,

contributing almost 50 percent to the total natural land cover (excluding urban and agricultural land cover types). The most abundant riparian communities present are riparian and willow scrub habitats. The only significant stand of elderberry savanna mapped in the extended study area occurs on the left bank of this reach.

One occurrence of heartscale (*Atriplex cordulata*) has previously been documented in the grasslands on the terraces above the alluvial plain, and outside the identified extended study area in this reach.

Reach 2B

The lower few miles of this reach support narrow, patchy, but nearly continuous vegetation, because this area is continuously watered by the backwater of the Mendota Pool affecting both surface and groundwater elevation. The riparian zone is narrowly confined to a thin strip 10 – 30 feet wide bordering the channel. The herbaceous understory is rich in native species and a high portion of the total vegetative cover is native plants. The margins of Mendota Pool support some areas of emergent vegetation dominated by cattails and tules; a few cottonwoods and willows grow above the waterline. Lost Hills crownscale (*Atriplex vallicola*) has been documented at the Grasslands Wildlife Management Area (WMA) (CDFW 2013).

Reach 3

Nearly continuous riparian vegetation of various widths and cover types occurs on at least one side of the channel in this reach (McBain and Trush 2002); however, the narrow width of the riparian corridor results in a low ratio of native vegetation per river mile (DWR 2002). In this reach, cottonwood riparian forest is the most abundant native vegetation type, followed by willow scrub, willow riparian forest, and riparian scrub.

Reach 4A

Reach 4A is sparsely vegetated, with a thin band of vegetation along the channel margin (or none at all). Willow scrub and willow riparian forest occur in small to large stands, and ponds rimmed by small areas of marsh vegetation are present in the channel; however, this reach has the fewest habitat types and lowest ratio of natural vegetation per river mile in the extended study area.

Reach 4B

Reach 4B is divided into Reaches 4B1 and 4B2. Reach 4B1 supports a nearly unbroken, dense, but narrow corridor of willow scrub or young mixed riparian vegetation on most of the reach, with occasional large gaps in the canopy. It no longer conveys flows because the Sand Slough Control Structure diverts all flows into the bypass system. As a result, the channel in Reach 4B1 is poorly defined and filled with dense vegetation and, in some cases, is plugged with fill material. Because of the wider floodplain and available groundwater, as well as management of the land as part of the San Luis NWR, Reach 4B2 contains vast areas of natural vegetation compared to the upstream reaches. Grasslands and pasture are the most common vegetation type, but willow riparian forest and emergent wetlands are also relatively abundant (DWR 2002).

The San Luis NWR and Grasslands WMA in Reach 4B support marsh and emergent wetlands, native grasslands, alkali sink, riparian forests, and vernal pool vegetation communities; the Grasslands WMA supports the largest remaining block of contiguous wetlands in the Central Valley. Numerous documented occurrences of special-status species affiliated with these habitats have been documented throughout this subreach; however, only one special-status plant, Delta button-celery (*Eryngium racemosum*), has previously been documented in Reach 4B. Critical habitat for Hoover's spurge (*Chamaesyce hooveri*) and Colusa grass (*Neostapfia colusana*) has been designated within and adjacent to Reach 4B2 of the extended study area.

Reach 5

In Reach 5, the San Joaquin River is surrounded by large expanses of upland grassland with numerous inclusions of woody riparian vegetation in the floodplain. The most abundant plant community is grassland and pasture, followed by willow riparian forest, emergent wetland, willow and riparian scrub, and willow, oak, and cottonwood riparian forests. Alkali scrub is also present in this reach (DWR 2002).

Just north of its confluence with Bear Creek, the San Joaquin River flows through Great Valley Grasslands State Park and then traverses the San Luis NWR. The State Park and San Luis NWR support the following vegetation communities: marsh and emergent wetlands, alkali sacaton (*Sporobolus airoides*) grasslands, alkali sink, riparian forest, and vernal pool. Delta button-celery has previously been documented within Reach 5 (CDFW 2013). The Great Valley Grasslands State Park and San Luis NWR also support occurrences of other rare and endangered species, although these are not documented in the extended study area itself; these species include alkali milk-vetch (*Astragalus tener* var. *tener*), brittlescale (*Atriplex depressa*), heartscale, Hispid bird's-beak (*Cordylanthus mollis* ssp. *hispidus*), lesser saltscale, prostrate navarretia (*Navarretia prostrata*), vernal pool smallscale (*Atriplex persistens*), and Wright's trichocoronis (*Trichocoronis wrightii*). Farther along this reach, the river flows through the North Grasslands WA, which contains more than 7,000 acres of wetlands, riparian habitat, and uplands.

Wildlife

The following sections discuss existing wildlife resources in the primary study area.

Millerton Lake and San Joaquin River below Kerckhoff Dam

The primary study area hosts a diverse wildlife community, both resident and seasonal. A relatively diverse community of reptile and amphibian species exists in the study area. The western pond turtle (*Actinemys marmorata*), a California Species of Special Concern, is known to occur in several portions of the primary study area. The presence of the nonnative bullfrog (*Rana catesbeiana*) has changed, and continues to dramatically alter, the extant reptile and amphibian community through predation and because of its ability to out-compete native species. The federally listed California tiger salamander (*Ambystoma californiense*) has also been reported in the vicinity of the primary study area, and Critical Habitat has been designated for this species near, but outside of, the primary study area. Limited areas of potential breeding habitat for California tiger salamander have been identified in the San Joaquin River Gorge.

Bald eagles (*Haliaeetus leucocephalus*) are known to winter around Millerton Lake, and a pair has recently been observed nesting in the primary study area. Golden eagles (*Aquila chrysaetos*) and several bird species associated with riparian habitats, including the least Bell's vireo (*Vireobellii pusillus*) and willow flycatcher (*Empidonax traillii*), have been known to occur historically in the primary study area, but have not been recently documented. As in the reptile and amphibian community, a number of nonnative birds are present in the primary study area that influence the native bird community through competition (e.g., European starlings [*Sturnus vulgaris*]) and nest parasitism (e.g., brown-headed cowbird [*Molothrus ater*]).

San Joaquin River near Kerckhoff Powerhouse

The mammalian community has been affected by considerable habitat change associated with livestock grazing, residential development, recreational activity, and suppression of the natural fire regime. A number of special-status bat species have potential to occur in the primary study area, and suitable roost sites occur throughout the area. Other special-status species that may occur in the primary study area include the ringtail (*Bassariscus astutus*), American badger (*Taxidea taxus*), and San Joaquin pocket mouse (*Perognathus inornatus*). Important game species also occur in the primary study area, specifically mule deer (*Odocoileus hemionus*), California quail (*Callipepla californica*), wild turkey (*Meleagris galloparo*), and feral pigs (*Sus scrufa*). The region provides winter range and migratory routes for the San Joaquin deer herd. Hunting of these species contributes substantially to the local economy.

San Joaquin River from Friant Dam to Merced River

Three types of scrub habitat—willow scrub, riparian scrub, and elderberry savanna—are found in the extended study area. Typical bird species found in scrub habitats include western wood-pewee (*Contopus sordidulus*), black phoebe (*Sayornis nigricans*), yellow-billed magpie (*Pica nuttalli*), bushtit (*Psaltriparus minimus*), Bewick's wren (*Thryomanes bewickii*), and blue grosbeak (*Passerina caerulea*). Mammals using scrub habitats are similar to those described for riparian forest habitats above.

Emergent wetlands typically occur in the river bottom immediately adjacent to the low-flow channel. Sites like backwaters and sloughs where water is present through much of the year support emergent marsh vegetation. Many wildlife species are known to use emergent wetlands, including song sparrow (*Melospiza melodia*), common yellowthroat (*Geothlypis trichas*), marsh wren (*Cistothorus palustris*), and red-winged blackbird (*Agelaius phoeniceus*). Mammal species that use this habitat include California vole (*Microtus californicus*), common muskrat (*Ondatra zibethicus*), and the nonnative Norway rat (*Rattus norvegicus*). Sierran treefrog and western terrestrial garter snake (*Thamnophis elegans*) are commonly present in this habitat.

The nonnative giant reed plant community is characterized by dense stands of the invasive grass species giant reed (*Arundo donax*). These stands are up to 13 feet tall and consist solely of giant reed with no other plant species present. Giant reed stands provide very little habitat value for wildlife.

Grassland and pasture habitats are forb- and grass-dominated plant communities. Typical bird species associated with grasslands include northern harrier (*Circus cyaneus*), mourning dove (*Zenaide macroura*), savannah sparrow (*Passerculus sandwichensis*), and the nonnative ring-necked pheasant (*Phasianus colchicus*). Mammal species that use grasslands include deer mouse (*Peromyscus maniculatus*), California vole, California ground squirrel (*Otospermophilus beecheyi*), Botta's pocket gopher (*Thomomys bottae*), and coyote (*Canis latrans*). Common amphibians and reptiles associated with grasslands in the San Joaquin Valley include western toad (*Bufo boreas*), western fence lizard (*Sceloporus occidentalis*), western racer (*Coluber constrictor mormon*), and gopher snake (*Pituophis catenifer*).

Alkali sinks are shallow, seasonally flooded areas or playas that are dominated by salt-tolerant plants. Wildlife species typically associated with alkali sink habitats include species of common kangaroo rats (*Dipodomys* spp.), coyote, and side-blotched lizard (*Uta stansiburiana*).

Agricultural lands in the extended study area consist primarily of annual crops, orchards, and vineyards. Cropland agricultural habitats can provide food and cover for wildlife, but the value of the habitat varies greatly among crop type and agricultural practice. Grain crops provide forage for songbirds, small rodents, and waterfowl at certain times of year. Pastures, alfalfa, and row crops, such as beets and tomatoes, provide foraging opportunities for raptors because of the frequent flooding, mowing, or harvesting of fields, which make prey readily available. Orchards and vineyards have relatively low value for wildlife because understory vegetation growth that would provide food and cover typically are removed. Species that use orchards and vineyards, such as ground squirrel, American crow (*Corvus brachyrhynchos*), Brewer's blackbird (*Euphagus cyanocephalus*), and the nonnative European starling, often are considered agricultural pests.

Open water is characterized by permanent or semi-permanent ponded or flowing water. Open-water areas provide habitat for waterfowl, pond turtle, Sierran treefrog *(Pseudacris sierra*), and the nonnative American bullfrog. Both submersed and floating aquatic vegetation are used as basking or foraging habitat and provide cover for aquatic wildlife. Deeper open-water areas without vegetation provide habitat for species that forage for fish, crayfish (*Pacifastacus ssp.*), or other aquatic organisms, such as river otter (*Lontra canadensis*) and waterfowl.

Riverwash consists of alluvial sands and gravel associated with the active channel of the San Joaquin River. Generally, riverwash areas exist as sand and gravel point bars within the floodplain of the river. Riverwash provides nesting habitat for shorebirds, such as killdeer (*Charadrius vaciferus*). Other species, such as mallard (*Anas platyrhynchos*) and western pond turtle, may use riverwash habitats for roosting or resting.

Disturbed areas include roads, canals, levees, and aggregate pits. Also included are areas used by off-highway vehicles and sites where rubble or fill has been deposited. Active and former aggregate mines are included if they are dry or unvegetated. As with agricultural habitats, low vegetation cover and species diversity in disturbed habitats limit their value to wildlife. However, these habitats are expected to support some common mammals, such as California ground squirrel, deer mouse, and desert cottontail (*Sylvilagus audubonii*).

Within each of the habitat types above, a variety of invasive plants is found. Plant communities dominated by invasive plant species are often less suitable for native wildlife, and often support a higher number and higher densities of nonnative wildlife species. Nonnative eucalyptus trees may provide roosting and nesting habitat for native birds (e.g., hawks and waterbirds) and insects (i.e., monarch butterflies [*Danaus plexippus*]); however, studies have found the diversity and abundance of wildlife to be lower in eucalyptus groves than in native scrub and oak woodland habitats (Hanson et al. 1979). While native habitats often support nonnative wildlife species, such as American bullfrog, crayfish, and red-eared slider (*Trachemys scripta elegans*), habitats with nonnative vegetation often support higher densities than native habitats of nonnative wildlife species, such as Norway rat (*Rattus norvegicus*), house mouse (*Mus musculus*), house sparrow (*Passer domesticus*), European starling, and rock pigeon (*Columba livi*a).

Cultural Resources

Sixty-nine archaeological sites are documented within the primary study area. These include 57 prehistoric sites, 6 historic-era sites, and 6 sites with both components. In addition, 9 historic-era structures have been formally recorded within the primary study area; four buildings/structures, including Friant Dam, one road, and four hydroelectric power generation features. The study area also encompasses portions of the Squaw Leap Archaeological District, within the SJRGMA managed by BLM. The Squaw Leap Archaeological District was determined eligible for the National Register of Historical Places (NRHP) by the Keeper on May 5, 1980, and is included on the California Register of Historic Resources.

Within the primary study area, a variety of religious, economic, historic, and other values could be identified for Native American groups. Sixteen groups, including those listed by the Native American Heritage Commission (NAHC), represent Native American interests in the study area.

Federally recognized tribes have certain inherent rights of self-government (i.e., tribal sovereignty) and are entitled to receive certain Federal benefits, services, and protections because of their special relationship with the United States. At present, there are five federally recognized tribes in the vicinity of the Primary Study Area: Big Sandy Rancheria, Picayune Rancheria, Table Mountain Rancheria, Cold Springs Rancheria, and North Fork Rancheria.

The NAHC reviewed its sacred lands file and identified a sacred land filing within the primary study area; its location is confidential. Forty-two sensitive areas were identified by Native Americans as of August 1, 2006, including six directly adjacent to the study area, six within the current boundaries of Millerton Lake, and 30 within the primary study area, for cultural resources evaluations.

Paleontological Resources

Based on a record search conducted at University of California Museum of Paleontology (2011), there are no previously recorded fossil localities within or adjacent to the primary study area. Of the rock formations found within the primary study area, Turlock Lake Formation and Mehrten Formation are considered to be of high paleontological sensitivity. Holocene-age formations, Tertiary volcanic pyroclastic rocks, and Mesozoic and Paleozoic rock formations are considered to be of low paleontological sensitivity.

Socioeconomic Resources

This section describes socioeconomic resources in the study area, including water resources, power and energy, demographics, employment and labor force, land use, traffic and transportation, and recreation and public access. This section focuses on socioeconomic resources of the primary study area, but includes the extended study area where relevant.

Water Supply and Availability

The east side of the San Joaquin Valley includes numerous streams and rivers that drain the western slope of the Sierra Nevada and flow into the Central Valley. During the past 50 years, water resources of all major rivers have been developed through construction of dams and reservoirs for water supply, flood risk management, and hydropower generation.

Groundwater is a major source of agricultural and urban water supplies in the extended study area. Expansion of agricultural practices between 1920 and 1950 caused declines in groundwater levels in many areas of the San Joaquin River and Tulare Lake hydrologic regions. At a 1995 level of development, annual average groundwater overdraft is estimated at about 240 TAF per year in the San Joaquin River Hydrologic Region and at about 820 TAF per year in the Tulare Lake Hydrologic Region (DWR 1998). Historical groundwater use has resulted in land subsidence in the southwest portion of the region.

Central Valley Project

The CVP, approved by President Franklin Roosevelt on December 2, 1935, is the largest surface water storage and delivery system in California, covering 29 of the State’s 58 counties. Operated by Reclamation, the CVP consists of 20 reservoirs with a combined storage capacity of nearly 11 MAF; 11 power plants, 500 miles of major canals and aqueducts, and many tunnels, conduits, and power transmission lines (Reclamation 2004a). The CVP irrigates about 3 million acres of farmland (Reclamation 2008b), supplies water to more than 2.5 million people and businesses, and is also the primary source of water for much of California's wetlands (Reclamation 2008b).

CVP operations are divided into nine divisions. NOD operations include the Trinity, Shasta, Sacramento River, and American River divisions, known collectively as the Northern CVP System. SOD operations, the Delta, West San Joaquin, and San Felipe divisions, are known collectively as the Southern CVP System. Operations of the Eastside and Friant divisions of the CVP differ from the divisions in the Northern and Southern CVP systems in that their water deliveries are not linked to Delta pumping operations.

The Northern CVP and Southern CVP supply irrigation, M&I, and refuge water to more than 250 long-term water contractors in the Central Valley, Santa Clara Valley, and Bay Area. For most water users, water service contracts represent a supply supplemental to local sources, including groundwater. Northern CVP and Southern CVP water service contracts total 3,326 TAF/year (DWR and Reclamation 2007).

During development of the CVP, the United States entered into two types of long-term agreements with many major water right holders: the Sacramento River Settlement Contractors and the Exchange Contractors. Sacramento River Settlement Contractors primarily claim water rights on the Sacramento River. Because of the major influence of Shasta Dam operations on flows in the Sacramento River, these water right claimants entered into contracts with Reclamation. Most of the agreements established the quantities of water the contractors are allowed to divert from April through October without payment to Reclamation, and a supplemental CVP supply allocated by Reclamation. CVP contracts with the Sacramento River Settlement Contractors total 2,194 TAF per year (DWR and Reclamation 2007).

The Exchange Contractors are contractors who receive CVP water from the Delta via the Mendota Pool. Under Exchange Contracts, the parties agreed not to exercise their San Joaquin River water rights in exchange for a substitute CVP water supply from the Delta. These exchanges allow water to be diverted from the San Joaquin River at Friant Dam for use by water service contractors in the eastern San Joaquin Valley and Tulare Lake Basin. CVP contracts with the Exchange Contractors total 840 TAF per year (DWR and Reclamation 2007).

Friant-Kern Canal

Friant Division of the Central Valley Project

The Friant Division of the CVP encompasses Friant Dam and Millerton Lake, and the Madera and Friant-Kern canals, which convey water north and south, respectively, to agricultural and urban water contractors. Friant Dam is operated as an annual reservoir, meaning all water supplies available in a given year are allocated with the expectation of delivery. River releases are made to satisfy downstream Holding Contract diversions. Streamflow of at least 5 cfs must be maintained past each Holding Contract diversion point, with the last being near Gravelly Ford. Under current conditions, specific releases are not made to the San Joaquin River to maintain fishery conditions downstream from Friant Dam. Friant Division contracts total 2,201 TAF per year.

Class 1 contracts, which are based on a firm water supply, are generally assigned to M&I and agricultural water users who have limited access to good-quality groundwater. Class 2 water is a supplemental supply and is delivered directly for agricultural use or for groundwater recharge, generally in areas that experience groundwater overdraft. In addition to Class 1 and Class 2 water deliveries, Reclamation Reform Act of 1982 water is provided in Section 215 of the Act, which authorizes the delivery of unstorable irrigation water that would be released in accordance with flood management criteria or unmanaged flood flows. Delivery of Section 215 water has enabled groundwater replenishment at levels higher than otherwise could be supported with Class 1 and Class 2 contract deliveries.

State Water Project

The SWP, planned and operated by DWR, was originally designed to deliver irrigation water to Southern California and to large San Joaquin Valley farms. It provided water to farmers in the San Joaquin Valley that were ineligible for CVP water because of acreage limitations in Federal reclamation law. The SWP provides water to 25 million Californians and 750,000 acres of irrigated farmland (DWR 2010a). SWP deliveries are allocated 70 percent to M&I use and 30 percent to agricultural use (DWR 2008b). The SWP includes 34 storage facilities, reservoirs, and lakes; 20 pumping plants; 4 pumping-generating plants; 5 hydroelectric powerhouses; and about 701 miles of open canals and pipelines (DWR 2010a). The SWP's 21 primary reservoirs have a total water storage capacity of 5.8 MAF (DWR 2008b). Major SWP aqueducts include the North Bay and South Bay aqueducts, the California Aqueduct, and the West and Coastal branches of the California Aqueduct.

The SWP delivers water under long-term contracts to 29 public water agencies throughout the State, including the San Joaquin Valley, Tulare Basin, and Southern California service areas (DWR 2010a). The public water agencies, in turn, either deliver water to water wholesalers or retailers or deliver it directly to agricultural and urban water users. Five contractors use SWP water primarily for agricultural purposes (mainly in the southern San Joaquin Valley), and the remaining 24 use the water primarily for municipal purposes (DWR 2008c).

The SWP has contracted a total of 4.16 MAF for average annual delivery (DWR 2008b). SWP contract types include Table A, Article 21, Article 56, and carryover water. The Table A amount is the maximum contractual amount that SWP contractors can request each year, and is given the first priority of delivery. Under shortage conditions, the current SWP policy is to equally impact all Table A water contractors. Between 1997 and 2006, annual water deliveries to SWP contractors averaged 2.9 MAF/year (DWR 2008d), and as little as 1.4 MAF/year in dry years (DWR 2008c).

Population, Employment, and Housing

In the primary study area in 2010, the City of Clovis had the highest proportion of residents identified as white (70.9 percent), while the City of Fresno had the lowest proportion of white residents (49.6 percent). In general, the Fresno Census-County Division (CCD) had a higher proportion of African-American and Asian populations than the surrounding communities and the State. The Hispanic population represented the largest non-white population, ranging from 25.6 percent in the City of Clovis to 76.7 percent in the City of Madera. The proportions of residents responding as being American Indian, Pacific Islander, and “two or more races” is generally consistent with the State for many of the cities and counties in this study area. However, the proportions of residents responding as “some other race” are higher in than the State as a whole. In the extended study area, the white population of Madera County (62.6 percent) was greater than Fresno and Merced counties (55.4 percent and 58.0 percent, respectively) and the State as a whole (57.6 percent). People identifying themselves as Hispanic represented were the largest non-white group in all three counties, accounting for an average of 53.0 percent of the total population. This percentage is substantially higher than the 37.6 percent of the State population identified as Hispanic (U.S. Census Bureau 2010).

The median household income for Fresno and Madera counties and nearby communities is less than the statewide median household income ($60,632). The City of Clovis registered the highest median household income, approximately $65,300. The City of Madera recorded the lowest median household income ($41,991), which averaged $19,000 less than the State’s average and lowest per capita income ($14,685). In the extended study area, the overall median household income for Merced County is $43,945. The population percentage in counties and nearby communities below the poverty level does not exceed 50 percent and is not meaningfully greater than the population percentage of the general population in the State (i.e., areas where poverty levels are twice as great as those of the State [28.8 percent]). The percentage of populations of Fresno and Madera counties at income levels below the poverty threshold (23.4 percent and 19.8 percent, respectively) were higher than the statewide average of 14.4 percent. The City of Fresno had the highest poverty rate (25.9 percent) in the area and only Clovis had proportions below the statewide poverty threshold, with 10.4 percent (U.S. Census Bureau 2010).

The unemployment rate for Fresno County was 9.9 percent in December 2007; Madera County's unemployment rate was 8.5 percent during the same period. These rates are both higher than the December 2007 unemployment rate for California (5.9 percent) and the Nation (4.8 percent) (California Employment Development Department 2008). The total number of jobs increased in both counties between December 2006 and December 2007. In Fresno County, the greatest growth occurred in the trade, transportation, and utilities sectors, with the majority of the jobs concentrated in the retail trade. The government sector was responsible for the greatest job increase in Madera County during the same period (California Employment Development Department 2008).

As of 2006, there were a total of 299,578 housing units in Fresno County, and 47,671 in Madera County. The vacancy rate in Fresno and Madera counties was 7.5 percent and 46.8 percent, respectively. From 2000 to 2006, Fresno and Madera counties experienced a 25.2 percent and 56.4 percent increase in the number of vacant housing units, which is higher than the State increase of 7.5 percent (U.S. Census Bureau 2000, 2006).

Power and Energy

The San Joaquin River watershed upstream from Millerton Lake is extensively developed for hydroelectric generation. In this area, PG&E and SCE own and operate several hydropower generation facilities. Hydropower also is generated by the FPA at the Friant Power Plant. In total, the upper San Joaquin River basin has 19 powerhouses with an installed capacity of almost 1,300 MW, which represents approximately 9 percent of the hydropower generation capacity in California.

Land Use

The primary study area, all within Fresno or Madera counties, is composed predominantly of publicly owned lands, although it also comprises private lands, including lands specifically set aside for conservation purposes. Lands in the lower portion of Millerton Lake, near Friant Dam, are either within the Millerton Lake SRA, managed by State Parks, or parcels that are privately held. Several residential areas have been established around Millerton Lake and include a total of more than 440 parcels. Further upstream from Friant Dam, most of the lands surrounding Millerton Lake are managed by Reclamation, State Parks, or CDFW. Private properties in the area include the Sierra Foothill Conservancy (McKenzie Preserve at Table Mountain), some undeveloped parcels, and a few residences. Most lands along the San Joaquin River from Millerton Lake to Kerckhoff Dam are managed by BLM as the SJRGMA. Private lands in this area include parcels associated with the PG&E power facilities, and vacant agricultural land used for cattle grazing.

Transportation and Circulation

Several roads in the Millerton Lake area provide access to residential areas and recreational facilities. Along the south side of the reservoir, Millerton Road connects the community of Friant with Auberry Road. Winchell Cove Road and Sky Harbor Road extend north from Millerton Road into residential areas. Sky Harbor Road continues to the South Fine Gold picnic area within the SRA. Madera County Road 206 and Road 145 on the north side of the lake lead to recreational facilities in the SRA. County Road 216 provides access from north of Millerton Lake to the Hidden View residential area near the confluence of Fine Gold Creek and Millerton Lake.

Wellbarn Road, extending to Spearhead Road from Auberry Road, provides access to Temperance Flat. Smalley Road, which spurs off Auberry Road, provides the main access to the SJRGMA and to the PG&E powerhouses, Kerckhoff and Kerckhoff No. 2. Smalley Road, a paved road, also provides access to the Kerckhoff Powerhouse switchyard, BLM primitive campground, and the San Joaquin River Trail. Powerhouse Road and Bridge connect Fresno and Madera counties across Kerckhoff Lake. Extending from Auberry Road in Fresno County to Road 222 in Madera County, the road and bridge provide access to Wishon Powerhouse for PG&E staff in Fresno County, and to schools in Fresno County for residents in the North Fork area.

Recreation

The Millerton Lake SRA contains about 10,500 acres in total and is one of the most popular recreational areas in the San Joaquin Valley. Millerton Lake, the centerpiece of the SRA, is more than 15 miles in length, has a surface area of about 4,900 acres, and a shoreline of about 63 miles at top of active storage. From 1996 to 2006, the SRA received an average of 440,000 visits per year, with the highest use occurring in May, June, and July. The SRA provides several recreational facilities, most of which are located on the gently sloping southern and northern shores of the lower portion of the reservoir, closest to population centers. Facilities include boat ramps, picnic areas, campgrounds, a marina, and a historic courthouse. The fishing season is open year-round and occasionally bass fishing tournaments are held on the lake. Wildlife viewing within the SRA is enhanced by the biological diversity of the area and the variety of plant and animal species present.

San Joaquin River Trail

Located 5 miles northwest of Auberry, the BLM SJRGMA covers approximately 6,700 acres of land on both the north and south sides of the San Joaquin River. The SJRGMA has experienced a rapid increase in visitation, from historical levels of about 20,000 recreational visits per year, to 60,000 to 70,000 visits the last few years. The SJRGMA offers several educational and recreational facilities, concentrated in the Squaw Leap area on the south side of the river, accessible via Smalley Road from Auberry. Hunting of game species is permitted in the SJRGMA.

Public Health and Safety

At Millerton Lake, water hazards are generally associated with recreational use. Downstream from Friant Dam, water-related hazards may be associated with rapid increases in flow in the San Joaquin River, as during flood events. Operations at Friant Dam have historically attempted to help dampen rapid changes in flow in the San Joaquin River, particularly in the reach between Friant Dam and the Mendota Pool; however, due to the average annual flows through the San Joaquin River are more than three times the size of Friant Dam, some flooding does still occur. Downstream from the Mendota Pool, Friant Dam has a decreasing influence on flow conditions and associated water-related hazards.

Visual Resources

Visual resources in the study area include views of and from Friant Dam and Millerton Lake. There are no highways located in the primary study area that are designated or are eligible for designation as State or County Scenic Highways. California's Scenic Highway Program was created to preserve and protect scenic highway corridors from change that would diminish the aesthetic value of lands adjacent to the highways.

Utilities and Public Service Systems

Various county and local agencies provide the primary study area with solid waste and wastewater removal and management, emergency services, public safety, and law enforcement services. PG&E is responsible for providing electrical and natural gas service to the primary study area. Gas is delivered to the study area through portions of PG&E's 40,000 miles of natural gas pipelines. Many areas scattered throughout Fresno and Madera counties are served by individual septic systems.

Indian Trust Assets

Indian Trust Assets (ITA) are legal interests in property held in trust by the United States for federally recognized Indian tribes or individual Indians. No Indian reservations are located within the primary study area. Indian Trust Lands corresponding to the Big Sandy Rancheria of Western Mono Indians are partially located within the primary study area. Additionally, Indian Trust Lands exist approximately 3 miles east-southeast of Millerton Lake, outside of the primary study area. These lands correspond to the Table Mountain Rancheria, which is the Rancheria of the Chukchansi band of Yokuts and the Monache tribe.

Likely Future Without Project Conditions Summary

Identification of the magnitude of potential water resources and related problems, needs, and opportunities in the study area is based not only on the existing conditions highlighted above but also on an estimate of how these conditions may change in the future. Predicting future conditions is complicated by a variety of factors, including uncertainty regarding future regulatory requirements, and ongoing programs and projects affecting the study area.

This section describes the changes in the environment expected in the study area, assuming that no Federal (or State) actions are implemented to develop and manage additional water supplies in the upper San Joaquin River Basin to address the stated planning objectives. The likely future condition includes actions reasonably expected to occur in the future. This includes projects and actions that are currently authorized, funded, and permitted. Predicting future changes to the physical, biological, socioeconomic, and cultural environments in the primary and extended study areas requires predicting changes that will result through implementation of the Settlement, as well as ongoing programs and projects primarily related to CALFED and the CVPIA. Several additional ecosystem restoration, water quality, water supply, and levee improvement projects are likely to be implemented in the future. Collectively, these efforts may result in changes to San Joaquin River habitat and water quality, Delta water quality, water supply, and levees.

For the purposes of the Investigation, the future without-project conditions include Settlement implementation of SJRRP Restoration Flows. The future without-project conditions do not include any specific projects or actions to develop additional local conveyance and storage capacity under the Settlement, as such actions are not included in the SJRRP alternatives and would require separate project-specific planning, design, and environmental compliance processes.

As described above, several projects are being implemented or are expected to be implemented in the future in the primary and extended study areas. Various other projects and programs are expected to be implemented in the future, including CVP contract renewals and further implementation of CVPIA(b)(2) water accounting, and land development plans and projects in the primary and extended study areas. The baselines for analysis of future conditions without project implementation include reasonably foreseeable actions with current authorization, complete funding for design and construction, and complete environmental permitting and compliance. Other programs currently in the planning phases could also potentially influence the Investigation in the future. A prominent example is the State of California's BDCP. This project has not been included in the evaluation of the alternative plans for the Investigation because there has not been a specific decision to implement BDCP at this time. Additional emerging concerns and trends such as climate change may also influence the likely future conditions.

The No-Action Alternative, as described later in this report, is considered to be the basis for comparison with potential alternative plans, consistent with the Federal P&G (WRC 1983) and NEPA guidelines.

The remainder of this chapter describes some of the future changes in physical, environmental, socioeconomic, and cultural conditions expected to occur in the primary and extended study areas.

Physical Environment

Physical conditions in the primary study area are expected to remain relatively unchanged in the future. No changes to area topography, geology, or soils are foreseen. Without major physical changes to the river systems upstream from Friant Dam (which are unlikely), hydrologic conditions would probably remain unchanged. Some speculation exists that regional hydrology would be altered should there be substantial changes in global climatic conditions. Scientific work by others in this field of study is continuing.

Physical changes to the San Joaquin River from Friant Dam to the Merced River are expected to be implemented through the Settlement. These changes include levee modifications associated with improving habitat conditions in the San Joaquin River, and channel capacity changes to accommodate Restoration Flows.

Settlement implementation will result in changes in hydrologic conditions in the San Joaquin River below Friant Dam through changed releases to the San Joaquin River. The Settlement includes a set of six different Restoration Flow hydrographs that vary in shape and volume according to annual unimpaired runoff in the basin. Average annual flood releases from Friant Dam are also anticipated to decrease through Settlement implementation.

A serious consequence of long-term groundwater overdraft in the San Joaquin and Tulare Lake hydrologic regions is land subsidence, or a drop in the natural land surface. Land subsidence results in a loss of aquifer storage space and may cause damage to public facilities such as canals, utilities, pipelines, and roads. Continued groundwater overdraft and land subsidence is expected to continue in the future, as the availability of surface water supplies remains uncertain and deliveries consistently fall below requests (USGS 2013). For example, flows to the San Joaquin River from Friant Dam pursuant to the Settlement have reduced surface water supplies available for irrigation.

Much effort has been expended to control the levels and types of herbicides, fungicides, and pesticides that can be used in the environment. Further, efforts are underway to better manage the quality of runoff from urban environments to major stream systems. Water quality conditions in the future without-project conditions upstream from Friant Dam are expected to generally remain unchanged and similar to existing conditions. However, with implementation of the San Luis Drainage Feature Reevaluation selected alternative, the Settlement, and various TMDLs, water quality conditions downstream from Friant Dam in the future are expected to improve over existing conditions.

Most of the air pollutants in the primary and extended study areas would continue to be influenced by both urban and agricultural land uses. As the population continues to grow, with about 4 million additional people expected in the Central Valley by 2030, and agricultural lands converted to urban centers, a general degradation of air quality conditions could occur.

It is unclear to what extent potential changes to the region’s climate could occur in association with global climate change. As the population continues to grow and agricultural lands are converted to urban and industrial uses, a general degradation of air quality conditions could occur. However, because of technological innovation and stringent regulations, air quality could improve over time. While similar types and sources of hazardous materials and waste are likely to be present in the future, increasing population will likely increase the potential for hazardous waste issues. Similarly, an increasing population will likely affect increases in environmental noise and vibration.

Biological Environment

As described earlier, Settlement implementation will include the restoration and maintenance of fish populations in "good condition" in the main stem San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish. Additional efforts are underway by numerous agencies and groups to restore various biological conditions throughout the study area. Accordingly, major areas of wildlife habitat, including wetlands and riparian vegetation areas, are expected to be protected and restored. However, as population and urban growth continues and land uses are converted to urban centers, wildlife and plants dependent on native habitat types may be adversely affected.

Through the efforts of Federal and State wildlife agencies, populations of special-status species in the riverine and nearby areas are estimated to generally remain as under existing conditions. Although increases in anadromous and resident fish populations in the San Joaquin River are likely to occur through implementation of projects such as the SJRRP, some degradation may occur through other actions that reduce San Joaquin River flows or elevate water temperatures.

Cultural Resources

In the vicinity of Millerton Lake any paleontological, archaeological, historic, or ethnographic resources currently affected by erosion due to reservoir fluctuations would continue to be impacted. These archaeological sites, and others situated around the perimeter of the existing reservoir, and other accessible locations within the primary study area (both documented and undocumented), would continue to be subject to collection and occasional inadvertent effects from recreation. The Native American community members would continue their ceremonies within the primary study area and would be able to maintain their traditional spiritual connection to the primary study area. They would also continue to gather plant and animal species from historically important areas. Fossils and artifacts located around the perimeter of the existing reservoir will continue to be subject to collection by recreationalists. Similarly, conditions related to the cultural environment downstream from Friant Dam are unlikely to change significantly.

Socioeconomic Resources

The State's population is estimated to increase from approximately 37 million in 2005 to about 44 million by 2020, and to approximately 60 million by 2050. Between 2011 and 2050, Fresno and Madera counties are expected to continue their historic growth trends. According to the California Department of Finance (2007, 2010), Fresno County's population is expected to increase by 105 percent by 2050 to a total of approximately 1,928,411 residents. This represents approximately twice the expected percent increase in population as for the State as a whole. Growth in Madera County during this period is expected to be even faster than in Fresno County. Madera County's population is expected to increase by 172 percent by 2050 to a total of approximately 413,569 residents.

To support these expected increases in population, some conversion of agricultural and other rural land to urban uses is anticipated. More transportation routes are likely to be constructed to connect the anticipated population increase in the Central Valley to transportation infrastructure. Anticipated increases in population growth will also impact visual resources as areas of open space on the valley floor are converted to urban uses.

Increases in population would increase demands for electric, natural gas, and wastewater utilities; public services such as fire, police protection, and emergency services; and water-related and communication infrastructure. The increase in population, and the aging "baby boomer" generation would increase the need for health services. The region's superior outdoor recreational opportunities and moderate housing cost are expected to attract increasing numbers of retirees from outside the region and the State. An increasing population would produce employment gains, particularly in retail sales, personal services, finance, insurance, and real estate. Recreation is expected to remain an important element of the community and regional economy.

Anticipated increases in population growth in the Central Valley will also significantly increase demands on water resources systems for additional and reliable water supplies, energy supplies, water-related facilities, recreational facilities, and flood management facilities, as summarized in Table 2-2. As shown in the table, estimated future shortages of water supplies in drought years are expected to be substantial.

Increases in population and water demand are expected to continue well beyond the planning horizon of the Investigation.

Potential future water shortages, however, may be greater than shown in Table 2-2. Implementation of the Settlement requires the use of approximately 185 TAF of former-Friant Division water supplies per year, or approximately 15 to 20 percent of pre-Settlement supplies, for the purposes of restoring salmon in the San Joaquin River. It is also anticipated that implementing Settlement Restoration Flows would affect water levels at Millerton Lake and FPA power generation at Friant Dam in the future without-project conditions.

In April 2006, the Orange Cove Irrigation District filed an application with FERC to augment the generating capacity of a small turbine on a river outlet diversion to a fish hatchery by using Restoration Flow releases from Friant Dam. In March 2008, Orange Cove Irrigation District informed FERC of a partnership with the FPA to construct the new powerhouse. The proposal adds 1.8 MW in capacity, although this may increase in the future. This potential increase in generation has not been evaluated to date.