# CHAPTER 3. WITHOUT-PROJECT CONDITIONS

One of the most important elements of any water resources evaluation is defining the scope of the problems to be solved and opportunities to be addressed. Significant in this process is defining existing resources conditions 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. Accordingly, this chapter presents a brief assessment of existing conditions and estimated future without-project baseline conditions in the primary study area.

## EXISTING CONDITIONS

This section describes the primary study area and existing physical, biological, social and economic, and cultural conditions in the study area. Additional information on these conditions, and conditions in an extended study area that includes the Sacramento-San Joaquin Delta, will be contained in future Investigation documents.

### Study Area

As described in **Chapter 1**, the area of emphasis for the Investigation includes the San Joaquin River watershed upstream of Friant Dam, the San Joaquin River from Friant Dam to the Delta, and the portions of the San Joaquin and Tulare Lake hydrologic regions served by the Friant-Kern and Madera canals. These areas are highlighted in **Figure 1-1** and include all potential storage sites under consideration, the region served by the Friant Division of the CVP, the eastern San Joaquin Valley groundwater basins, and the portion of the San Joaquin River most directly affected by the operation of Friant Dam.

Because of the large geographic extent of the area of emphasis for the Investigation, the study area is described in two parts: a primary study area and an extended study area. In general, the primary study area includes specific locations that would be affected by the implementation of project actions. At this time, the primary study area includes locations that would be affected by reservoir sites evaluated in this report. This includes Friant Dam and Millerton Lake, several potential storage locations on the San Joaquin River upstream of Friant Dam, potential offstream locations in the San Joaquin River watershed, and potential off-canal locations in Yokohl Valley. As the Investigation proceeds, the primary study area will continue to be revised to include specific sites that would be affected by surface water and groundwater storage components of alternatives.

The extended study area is defined as areas potentially affected by operations of Friant Dam, deliveries from the Friant-Kern and Madera canals, and releases to the San Joaquin River. At this time, the extended study area includes the San Joaquin River downstream of Friant Dam, including the Delta, lands with San Joaquin River water rights, the Friant Division service area, and the eastern San Joaquin Valley groundwater basins. Operational changes at Friant Dam also could affect the broader geographic area served by the CVP and SWP. Information on conditions in the extended study area will be included in future documents for the Investigation.

## Friant Dam and Millerton Lake

This section describes existing conditions for Friant Dam and Millerton Lake water control facilities, recreation facilities, and other reservoir area infrastructure.

### *Existing Water Control Facilities*

Friant Dam is located on the San Joaquin River 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. It is a concrete gravity dam that impounds Millerton Lake on the San Joaquin River. Three small saddle dams that close low areas along the reservoir rim are located on the southern side of the reservoir. The reservoir, with a gross storage capacity of 520 TAF at an elevation of 578 feet above mean sea level (elevation 578), is operated for water supply and flood control. 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. Physical data pertaining to Friant Dam and Millerton Lake are presented in **Table 3-1.**

*Friant Dam*

The spillway consists of an ogee overflow section, chute, and stilling basin at the center of the dam. The spillway is controlled by one 18-foot-high by 100-foot-wide drum gate, and two comparably sized Obermeyer gates. 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, are located on the downstream side of Friant Dam. A powerhouse on each canal generates hydroelectricity as water is released to the Friant-Kern and Madera canals for delivery. A third powerhouse located at the base of the dam adjacent to the spillway generates hydroelectricity as water is released to the San Joaquin River. The combined capacity of the three powerhouses is 30 megawatts (MW).

### *Recreation Facilities and Other Reservoir Area Infrastructure*

Lands around Millerton Lake have been developed for recreational, residential, and power development purposes. The general locations of facilities and developed lands around Millerton Lake are shown in **Figure 3-1** and summarized in **Table 3-2**.

# TABLE 3-1.
# PERTINENT PHYSICAL DATA – FRIANT DAM AND MILLERTON LAKE

| | | | |
|---|---|---|---|
| **General** | | | |
| Drainage Areas | | Unimpaired Flows of Friant Dam | |
| Friant Dam | 1,638 square miles | Mean annual runoff (1873-1977) | 1,790,300 acre-feet |
| Mono Creek at Lake Thomas A. Edison | 95.2 square miles | Average flow | 2,470 cfs |
| South Fork San Joaquin River at Florence Lake | 171 square miles | Min mean daily inflow (10 Oct 1977) | 0 cfs |
| | | Max mean daily inflow (23 Dec 1955) | 61,700 cfs |
| Big Creek at Huntington Lake | 80.5 square miles | Max instantaneous inflow (23 Dec 1955) | 97,000 cfs |
| North Fork Willow Creek at Bass Lake | 50.4 square miles | | |
| Stevenson Creek at Shaver Lake | 29.1 square miles | Max mean daily outflow (6 Jun 1969) | 12,400 cfs |
| San Joaquin River at Mammoth Pool Reservoir | 1,003 square miles | Min mean daily outflow (20 Oct 1940) | 5.5 cfs |
| San Joaquin River at Redinger Lake | 1,295 square miles | Spillway design flood | |
| San Joaquin River at Kerckhoff Diversion | 1,461 square miles | Peak inflow | 197,000 cfs |
| San Joaquin River at Mendota | 3,943 square miles | Peak outflow | 158,500 cfs |
| **Friant Dam and Millerton Lake[1]** | | | |
| **Friant Dam (concrete gravity)** | | **Millerton Lake** | |
| Elevation, top of parapet | 585.0 feet above msl | Elevations | |
| Freeboard above spillway flood pool | 3.25 feet | Minimum operating level[2] | 466.1 feet above msl |
| Elevation, crown of roadway | 581.25 feet above msl | Gross pool | 578.0 feet above msl |
| Max height, foundation to crown of roadway | 319 feet | Spillway flood pool | 585.0 feet above msl |
| Length of crest | | Area | |
| Left abutment, non-overflow section | 1,478 feet | Minimum operating level | 2,100 acres |
| Overflow river section | 332 feet | Gross pool | 4,850 acres |
| Right abutment, non-overflow section | 1,678 feet | Spillway flood pool | 5,085 acres |
| Total length | 3,488 feet | Storage capacity | |
| Width of crest at elevation 581.25 | 20.0 feet | Minimum operating level | 130,000 acre-feet |
| Total concrete in dam and appurtenances | 2,135,000 yd$^3$ | Gross pool | 520,500 acre-feet |
| | | Spillway flood pool | 555,450 acre-feet |
| **Spillway (gated ogee)** | | **Friant-Kern Canal** | |
| Crest length | | Length | 152 miles |
| Gross | 332 feet | Operating capacity below Friant Dam | 4,000 cfs |
| Net | 300 feet | Operating capacity at terminus of canal | 2,000 cfs |
| Crest elevation | 560 feet above msl | | |
| Discharge capacity (height = 18.0 feet) | 83,160 cfs | **Madera Canal** | |
| Crest gates (1 drum and 2 Obermeyer) | | Length | 35.9 miles |
| Number and size | 3 @ 100 feet by 18 feet | Capacity below Friant Dam | 1,000 cfs |
| Top elevation when lowered | 560 feet above msl | Capacity at Chowchilla River | 625 cfs |
| Top elevation when raised | 578 feet above msl | | |
| **Outlets** | | | |
| River outlets (110-inch dia. w/ 96-inch hollow jet valves) | | | |
| Number and elevation | 4 @ 380 feet above msl | | |
| Capacity at minimum pool | 4,000 cfs | | |
| Capacity at gross pool | 12,300 cfs | | |
| Diversion outlets, Madera (91-inch dia. w/ 86-inch needle valve) | | | |
| Number and elevation | 2 @ 446 feet above msl | | |
| Capacity at minimum pool | 1,000 cfs | | |
| Capacity at gross pool | 4,600 cfs | | |

Key:
cfs – cubic feet per second; kW – kilowatt; yd$^3$ – cubic yard
hp – horsepower; msl – mean sea level

Notes:
1 Elevations given are in vertical datum NGVD 1929.
2 Minimum operating level generally corresponds with elevation of Madera Canal outlets. Minimum storage for Friant-Kern Canal diversion is about 135 TAF.

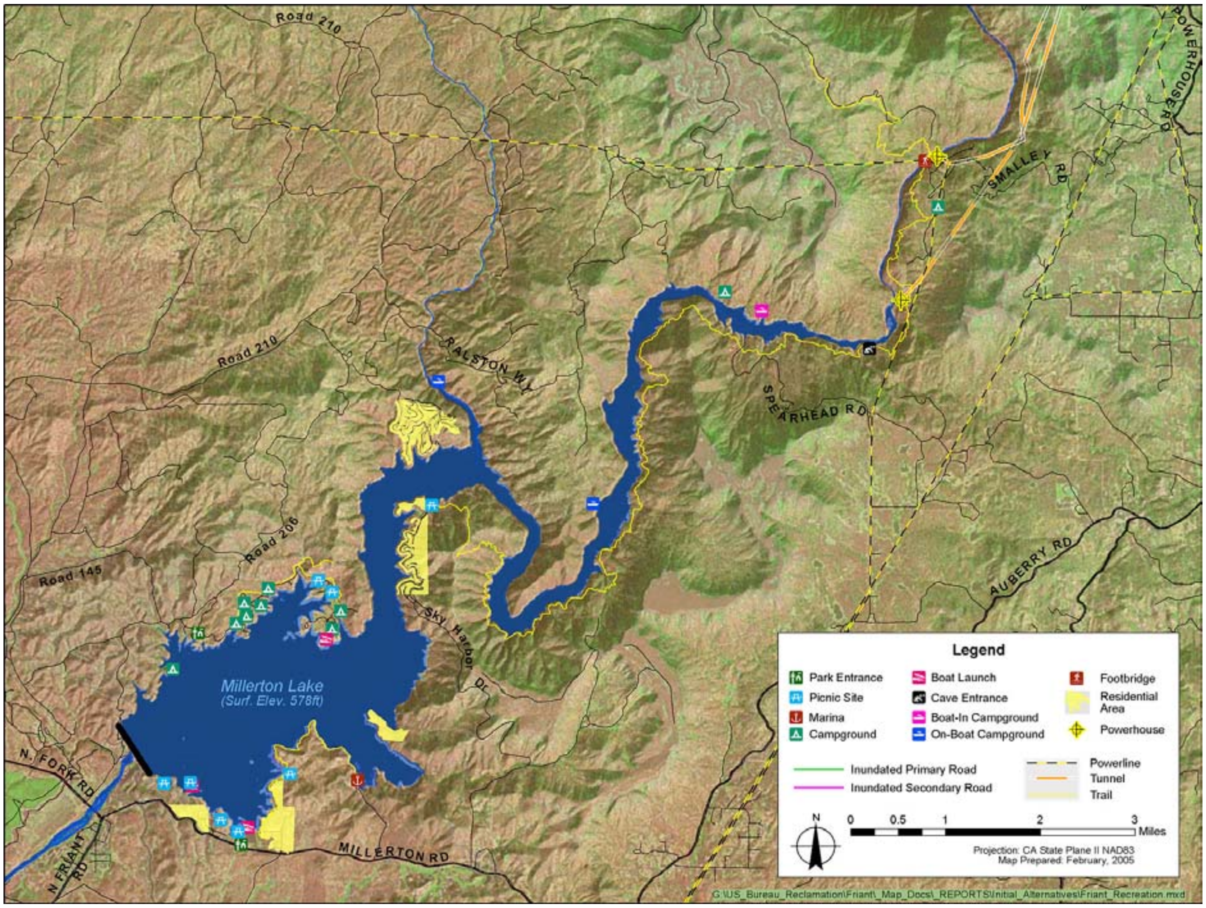



**FIGURE 3-1.**
**MILLERTON LAKE AREA FACILITIES AND DEVELOPED LANDS**

The Millerton Lake SRA, managed by the CDPR, contains numerous recreation facilities on both the north and south sides of the reservoir. These include 10 camping areas, 6 boat ramps, a privately operated marina, 3 picnic and day-use areas, 4 trails, and parking, telephone, and toilet facilities.

The San Joaquin River Gorge, a management area administered by BLM, is situated upstream from the SRA. It contains a replicated Native American village, trails, a footbridge across the San Joaquin River, and a primitive campground. The most prominent trail is the San Joaquin River Gorge Trail, which connects the South Fine Gold picnic area in the SRA to the BLM primitive campground off Smalley Road, crosses the footbridge, and climbs the terrain north of the river.

The Fresno County Courthouse was removed from an area now within Millerton Lake at the time of Friant Dam construction. The brick and stone building now overlooks the lake from a site on the south side of the reservoir.

## TABLE 3-2.
## MILLERTON LAKE AREA FACILITIES ABOVE FRIANT DAM

| Approximate Elevation (feet above msl) | Approximate Location (SJR River Mile) | Facility |
|---|---|---|
| 569 | 269 | Boat Ramps Nos. 2-5 |
| 580 | 268 | Boat Ramp No. 1 |
| 580 | 269 | South Bar Picnic Area |
| 580 – 765 | 267.5 - 268.5 | Lakeview Estates Residential Area (west) |
| 580 – 971 | 271 - 273 | Sky Harbor Residential Development |
| 580 – 883 | 272.5 - 273 | Hidden View Residential Development |
| 580 | 273 | Fine Gold Day Use Area |
| 580 – 600 | 269 - 270 | SRA Blue Oak Trail |
| 580 – 650 | 269 - 270 | SRA North Shore Trail |
| 580 – 1,240 | 273 - 284 | San Joaquin River Trail (SRA to SJR Gorge portion) |
| 582 | 270 | Boat Ramp No. 6 |
| 585 | 269.5 | Millerton Marina |
| 589 | 281 | Temperance Flat Boat-In Campground |
| 590 | 268 | Rocky Point Campground |
| 590 | 268.5 | North Shore Area Park Entrance |
| 590 | 269 | Dumna Strand Campground |
| 592 – 705 | 280.5 - 281 | Temperance Flat Residences |
| 594 – 640 | 269 - 269.5 | Lakeview Estates Residential Area (east) |
| 597 – 705 | 270 | Winchell Bay Residential Area |
| 600 | 268 | Historic Courthouse |
| 600 | 268 | Picnic Facilities at South Shore of Millerton Lake |
| 600 | 268 | South Shore Area Park Entrance |
| 600 | 269 | Fort Miller Campground |
| 600 | 270 | Valley Oak Campground |
| 600 | 277 | On-Boat Camping |
| 605 | 282.5 | Kerckhoff No. 2 Powerhouse Access Tunnel Entrance |
| 620 | 269 | Rocky Point Campground |
| 620 | 269 | Group Campground |
| 630 | 269 | Mono Campground |
| 630 | 281 | Toilet Facility |
| 640 | Fine Gold Creek, RM1 | N. Fine Gold On-Boat Camping Area |
| 650 | 280 | Hewitt Valley Environmental Camps |
| 650 – 1,088 | 269.5 - 270 | SRA Buzzards Roost Trail |
| 675 | 284.5 | Kerckhoff Powerhouse Main Floor |
| 680 | 284.5 | BLM Footbridge |
| 680 – 2,120 | 283.5 - 284.5 | San Joaquin River Trail (SJR Gorge portion) |
| 778 | 283 | Substation for Kerckhoff No. 2 Powerhouse |
| 889 | 292.5 | Base of Kerckhoff Dam |
| 921 | 284.5 | Surge Chamber for Kerckhoff Powerhouse |
| 960 | 285 | BLM Native American Village (reproduction) |
| 971 | 292.5 | Kerckhoff Dam Crest |
| 1,030 | 284 | BLM Primitive Campground |

Key:
BLM – Bureau of Land Management
msl – mean sea level
RM – river mile
SJR – San Joaquin River
SRA – State Recreation Area

Several residential areas have been established around Millerton Lake. 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. Each of these residential areas includes developed and undeveloped parcels. Other residential sites include two homes in the Temperance Flat area.

*Winchell Cove Marina*

Several roads in the Millerton Lake area provide access to residential areas and recreation facilities. Millerton Road skirts the south side of the reservoir, connecting the community of Friant with Auberry Road. Winchell Cove Road and Sky Harbor Road extend from Millerton Road north into residential areas. 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 into the Hidden View residential area near the confluence of Fine Gold Creek and Millerton Lake.

Two Pacific Gas and Electric (PG&E) powerhouses, the Kerckhoff Powerhouse and Kerckhoff No. 2 Powerhouse, are located within a mile of the upstream end of Millerton Lake. Water is diverted from Kerckhoff Lake at Kerckhoff Dam and conveyed through tunnels and penstocks to serve the powerhouses. The Kerckhoff Powerhouse was commissioned in 1920, has a generation capacity just under 40 MW, and is located on the San Joaquin River at RM 284.5, about a mile upstream of the upper limit of Millerton Lake. The Kerckhoff No. 2 Powerhouse is a relatively modern facility, commissioned in 1983, with a capacity of 155 MW. It discharges directly to the upstream portion of Millerton Lake at RM 282.5.

## Physical Environment

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

### *Topography*

Regional topography consists of the nearly level floor of the San Joaquin Valley rising abruptly to moderately steep, northwest-trending foothills with rounded canyons. 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.

Farther east, the terrain becomes steeper and the canyons become more incised. The canyons were cut by southwest- to west-flowing rivers and associated large tributaries. The topography of the San Joaquin River basin rises to over elevation 12,000 in the upper watershed, located in the Sierra Nevada.

## Geology

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. The Sierra Nevada batholith comprises primarily intrusive rocks, including granite and granodiorite, with some metamorphosed granite and granite gneiss. Intrusive Sierra Nevada batholith rocks underlie most of Millerton Lake and the Temperance Flat area dam sites. Occasional remnants of lava flows and layered tuff are present in the area at the highest elevations.

The central Sierra Nevada has a complex history of uplift and erosion. The greatest uplift tilted the western flank of the Sierra Nevada to the west. At the western border, alluvium and sedimentary rocks of the Great Valley Province overtop the Sierra Nevada. Metamorphic rocks in the Friant Dam area dip steeply downstream to the west, and strike northwesterly. The contact of these metamorphic rocks with the Sierra Nevada batholith lies just east of the dam in Millerton Lake. Friant Dam is founded on metamorphic rocks consisting of quartz biotite schist intruded by aplite and pegmatite dikes and by inclusions of dioritic rocks. Erosion has resulted in thin colluvial cover (Reclamation, 2002).

*Table Top Formation, near Temperance Flat*

The west- to northwest-trending Yokohl Valley is located in what may be an erodible zone along a geologic contact between granitic rocks and a roof pendant of pre-Cretaceous metasedimentary rock. At the dam site, an undated Reclamation geologic map shows that pre-Cretaceous metagabbro and Mesozoic ultrabasic intrusive (serpentenite and talcose serpentenite) rocks are found in both proposed dam abutments. Pre-Cretaceous amphibolite also is found in the right abutment. The perimeter of the potential reservoir is surrounded by Mesozoic granitics (quartz diorite), basic and ultrabasic intrusive rocks, and pre-Cretaceous metasedimentary rocks.

## Climate and Hydrologic Setting

The climate of the San Joaquin River Valley is arid to semi-arid with dry, hot summers and mild winters. Summer temperatures on the valley floor often exceed 100 degrees Fahrenheit (°F) for extended periods of time, while winter temperatures only occasionally fall below freezing. 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. On the valley floor, precipitation decreases from north to south, ranging from 14 inches in Stockton to 8 inches at Mendota.

The San Joaquin River originates in the Sierra Nevada at over elevation 12,000 and flows into the San Joaquin Valley at Friant. Snowmelt is the main contributor to flow in the upper San Joaquin River. Large areas of high elevation watershed supply snowmelt runoff during the late spring and early summer months. Downstream of 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.

The upper San Joaquin River section, upstream of the confluence with the Merced River, was historically characterized by runoff from the San Joaquin River. During the past 100 years, development in this area has resulted in groundwater overdraft conditions, and the river loses much of its flow through percolation.

Flows in the upper San Joaquin River are regulated by Friant Dam, which was completed in 1941 to store and divert water to the Madera and Friant-Kern canals for irrigation and M&I water supplies in the eastern portion of the San Joaquin Valley. 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. Average monthly releases from Friant Dam to the San Joaquin River since 1941 are generally limited to minimum releases to satisfy water rights, instream flows above Gravelly Ford, and flood control releases.

Millerton Lake, formed by Friant Dam, has a capacity of 520 TAF. Above Friant Dam, the San Joaquin River drains an area of approximately 1,676 square miles and has an annual average unimpaired runoff of 1.7 MAF. The median historical unimpaired runoff is 1.4 MAF, with a range of 0.4 to 4.6 MAF. Several reservoirs in the upper portion of the San Joaquin River watershed, including Mammoth Pool and Shaver Lake, are used primarily for hydroelectric power generation. Operation of these reservoirs affects the inflow to Millerton Lake.

The California Data Exchange Center (CDEC) maintains estimates of unimpaired flow (flow that would occur at a specific location if upstream facilities were not in place) at four locations in the upper San Joaquin River basin. As indicated in **Table 3-3**, annual runoff from the upper San Joaquin River basin (at Friant Dam) varies widely, ranging from about 362 TAF in 1977 to 4,642 TAF in 1983.

Normal annual precipitation over the Yokohl Creek watershed averages 20 inches, ranging from about 11.5 inches at its confluence with the Kaweah River to about 30 inches in its headwaters.

**TABLE 3-3.**
**RUNOFF IN THE UPPER SAN JOAQUIN RIVER BASIN**

| Station (CDEC ID) | Record Period | Annual Runoff (TAF) | | |
|---|---|---|---|---|
| | | Maximum | Average | Minimum |
| Big Creek below Huntington Lake (BHN) | 2/1905 – 9/1980 | 297.8 | 110.6 | 14.4 |
| San Joaquin South Fork near Florence (SFR) | 10/1900 – 9/1980 | 248.9 | 652.5 | 71.3 |
| San Joaquin River at Mammoth Pool (SJM) | 10/1905 – 9/1980 | 2,964.1 | 1,323.8 | 307.9 |
| San Joaquin River below Friant Dam (SJF) | 10/1900 – present | 4,641.9 | 1,830.3 | 361.6 |

Key:
CDEC – California Data Exchange Center
TAF – thousand acre-feet

### Hydrology and Geomorphology

This section describes hydrology and geomorphology in discrete river reaches along the San Joaquin River, Granite, Jackass, Chiquito and Fine Gold creeks, and in Yokohl Valley. These river reaches were identified to support evaluations presented in later chapters of this report. The geographic extent of the river reaches is described in **Table 3-4** and shown in **Figure 3-2** (Yokohl Valley is not shown in **Figure 3-2**).

**TABLE 3-4.**
**RIVER REACHES IN THE INVESTIGATION PRIMARY STUDY AREA**

| River Reach | From | To |
|---|---|---|
| Millerton Lake and Big Bend | Friant Dam | RM 280 |
| Temperance Flat and Millerton Bottoms | RM 280 | RM 284 |
| Patterson Bend | RM 284 | Kerckhoff Dam |
| Kerckhoff Lake and Horseshoe Bend | Kerckhoff Dam | Redinger Dam |
| Mammoth Reach | RM 315 | Mammoth Pool Dam |
| Granite Creek | San Joaquin River | Granite Creek Headwaters |
| Jackass Creek | Mammoth Pool | Jackass Creek Headwaters |
| Chiquito Creek | Mammoth Pool | Chiquito Creek headwaters |
| Fine Gold Creek | Millerton Lake | Fine Gold Creek headwaters |
| Yokohl Valley | Friant-Kern Canal | Yokohl Creek headwaters |

Key:
RM – river mile

#### Millerton Lake and Big Bend

Millerton Lake is the largest reservoir on the San Joaquin River. The lake is set in the lower foothills of the Sierras, is fairly open, and mostly surrounded by low hills. These reservoir facilities are part of the Friant Division of the CVP, and their operation significantly affects the flow in the San Joaquin River. Inflow to Millerton Lake is influenced by the operation of several upstream hydropower generation projects. Friant Dam is operated to supply water to agricultural and urban areas in the eastern San Joaquin Valley and to provide flood protection to downstream areas.

The narrow and steep-sided Big Bend area, also referred to as upper Millerton Lake, is immediately downstream of Temperance Flat. The shoreline in much of this portion of the reservoir is steep-sided and rocky, with little vegetation.

#### Temperance Flat and Millerton Bottoms

Temperance Flat is the only substantial area in upper Millerton Lake with a gently sloping shoreline, shallow water, and well-developed shoreline vegetation. The stretch of the river downstream of the Kerckhoff powerhouses, flowing into Temperance Flat, is referred to as Millerton Bottoms.

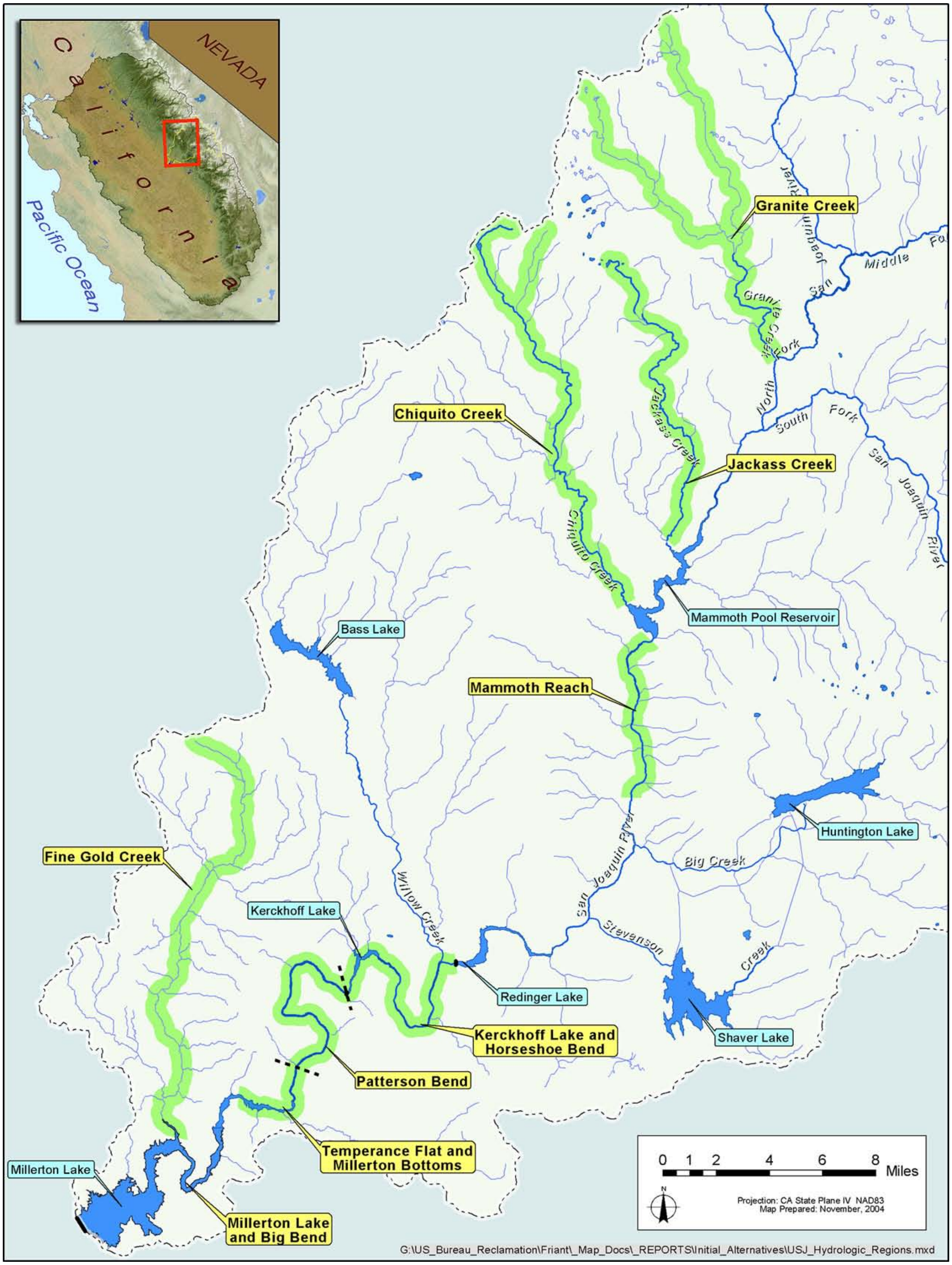



**FIGURE 3-2.**
**RIVER REACHES IN THE INVESTIGATION PRIMARY STUDY AREA**

### Patterson Bend

The San Joaquin River upstream of Temperance Flat lies in a steep and narrow canyon that is particularly steep in the upper portion, and is known as the Patterson Bend reach. The river channel is bedrock-controlled with little gradient and many long, narrow pools. Average channel gradient in the reach is relatively low, at about 33 feet per mile. Stream flow in the reach usually results from flow releases mandated by the Federal Energy Regulatory Commission (FERC) for instream habitat: 15 cfs in dry water years and 25 cfs in normal water years (PG&E, 1999). Water is directed at Kerckhoff Dam through tunnels to downstream powerhouses and thus bypasses the reach, resulting in low flow.

### Kerckhoff Lake and Horseshoe Bend

Kerckhoff Lake is a narrow, 2.5-mile-long reservoir with a capacity of about 4 TAF. The upper portion is shallow with a well-vegetated shoreline due to deposition of silt. The lower portion is in a steep-walled canyon with shoreline consisting mostly of bedrock.

Horseshoe Bend runs through a steep-sided canyon similar to the canyon below Kerckhoff Lake. The river channel has a low gradient and is bedrock-controlled, forming a series of long, deep pools and runs separated by rockfall debris. Average gradient is about 35 feet per mile, similar to that in the reach from Kerckhoff Reservoir to Millerton Reservoir. Much of the natural flow of the San Joaquin River is diverted at Redinger Dam to the Big Creek No. 4 Powerhouse. The FERC-mandated minimum flow for most of the reach is 20 cfs.

### Mammoth Reach

For purposes of this Investigation, the Mammoth reach of the San Joaquin River extends from RM 315 to the base of the Mammoth Pool Dam (RM 322). The river is at elevation 3,052 at Mammoth Pool Dam and drops to elevation 2,340 at RM 315, running through a deep granitic canyon. Sediment supply in this reach tends to exceed transport capacity, resulting in net deposition and storage of sediments (SCE, 2003b). The segment from about Rock Creek to Ross Creek is somewhat wider and less confined than all other segments of Mammoth reach. Rock and Ross creeks are designated transport reaches (SCE, 2003b). Pools dominate habitat, with many riffles and a mixture of other habitat types, including several boulder and cobble bars that provide sediment storage (SCE, 2003b).

### Granite Creek

The Granite Creek drainage basin totals 69.5 square miles and is entirely within the SNF, mostly contained within the Minarets Wilderness Area. Two major forks, East Fork and West Fork, originate from alpine lakes at elevations 9,000 to 10,000. Peak flows in Granite Creek occur in May or June and drop quickly through the summer months to very low flow conditions by early August (USJRWPA, 1982c).

In upstream sections of Granite Creek, the streambeds of the forks are wide, with cobble and gravel substrates. Banks in downstream sections are steep, and streambeds are heavily scoured with large boulder and granite bedrock substrates (USJRWPA, 1982c).

### Jackass Creek

Jackass Creek flows approximately 15 miles from its source in Jackass lakes to Mammoth Pool Reservoir. The main stem has a watershed area of 24 square miles, and its lone major tributary, West Fork, adds 11 square miles of drainage (USJRWPA, 1982c). Elevations in the Jackass drainage exceed 9,750 in some areas; and average elevation 7,050 (USJRWPA, 1982c). Data from a gaging station indicate peak flows occur during May with average daily flows between 75 to 200 cfs, and drop steadily to no surface flow by early August (USJRWPA, 1982c).

Jackass Creek has a highly variable gradient. The streambed is primarily gravel and sand, with some cobble in faster stretches, and very little exposed bedrock. Banks generally have gradual slopes, and are heavily forested.

### Chiquito Creek

Chiquito Creek flows north to south from its headwaters near Chiquito Lake, just west of the Ansel Adams Wilderness Area, to Mammoth Pool Reservoir. Elevation in the watershed ranges from 3,400 at Mammoth Pool Reservoir to 9,000 at the creek's source in the Sierra. The USGS maintained a gaging station on Chiquito Creek, near Arnold Meadow, from 1922 to 1928, and again from 1956 to 1970. Flow records from the gage, which was situated mid-watershed, indicate that peaks flows ranging from 300 to 410 cfs occur during the month of May and taper off to a base flow of about 10 cfs through the summer months.

### Fine Gold Creek

The drainage area at the Fine Gold Dam site covers approximately 90 square miles. The terrain is mostly mountainous with steep slopes and moderate to heavy forest cover. Elevations range from about 600 at the dam site, to about 4,400 along the northern basin boundary. Fine Gold Creek is a largely intermittent foothill stream, with many of its smaller tributaries drying completely during summer months (Moyle et al., 1996). Most reaches of Fine Gold Creek consist of a few bouldery pools, 1 to 2 meters deep in summer, connected by long sandy-bottomed sections of stream (Moyle et al., 1996).

### Yokohl Valley

Flows in Yokohl Creek are the result of rainfall only, since the watershed is below elevations where significant snow accumulates. Winter rain floods generally occur from November through April and are characterized by sharp peaks with most of the volume occurring within a few days. Average annual runoff from Yokohl Creek was not reported. The modeled Standard Project Flood for Yokohl Creek was reported as 10,400 cfs, with a maximum 1-day flow of 9,111 cfs (Corps, 1990b). Detailed flood data were not identified in the documents reviewed.

## Soils

The primary study area for the Investigation is in the Upland Soils Physiographic Region of the Central Valley. Upland soils are found on hilly to mountainous topography on the perimeter of the Central Valley and are formed in place through the decomposition and disintegration of the underlying parent material. The more widespread upland soil groups include shallow depth, moderate depth, and deep depth to bedrock. Two upland soil groups, shallow depth and deep depth, are found in this geographic region and typically developed on igneous rocks.

#### *Shallow Depth to Bedrock*

This group of upland soils is found in the Sierra Nevada foothills that surround the Central Valley. The soil has a loam-to-clay-loam texture with low organic matter, and some areas have calcareous subsoils. These soils usually have a shallow depth to weathered bedrock of less than 2 feet and are found in areas of low to moderate rainfall that support grasslands used primarily for grazing. Tilled areas are subject to considerable erosion.

#### *Deep Depth to Bedrock*

These soils are found at the higher elevations in the Sierra Nevada on hilly to steep topography. This group of upland soils is characterized by moderate to strongly acidic reactions, especially in the subsoils, which can extend 3 to 6 feet in thickness before reaching bedrock. Bedrock consists of metasedimentary and granitic rocks. Soils forming on granitic rocks contain decomposed granitic sands. These soils receive 35 to 80 in/yr of precipitation and support extensive forests.

### *Sedimentation and Erosion*

The substrate in the streams and river originating from the erosion of resistant granite in the upper San Joaquin River watershed generally comprises large boulders, larger cobbles of 4 inches or larger, and fine sand, with a small number of intermediate size gravels (SCE, 2003a). Since natural and cut slopes in decomposed granite erode readily and produce these coarse materials, soil erosion potential is high (FERC, 2002). Direct erosion and mass wasting into the watercourses is the primary reason that angular to subangular, medium-to coarse-grained sands, and large boulders make up most of the substrate of granitic watersheds (SCE, 2003a). The lack of favorable conditions for chemical weathering in the watershed 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, 2003a). Sedimentation rates were not evaluated for the potential Yokohl Valley Reservoir, nor were downstream sedimentation issues.

### *Flood Control*

Friant Dam is the principal flood storage facility on the San Joaquin River, with a dedicated flood management pool of 170 TAF. 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. Several flood events in the past few decades resulted in flows greater than 8,000 cfs downstream from Friant Dam and, in some cases, flood damages resulted.

Other flood management facilities of the San Joaquin River basin, shown in **Figure 3-3**, include levees along the San Joaquin River, Chowchilla Canal 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. The Chowchilla Canal Bypass diverts San Joaquin River flood flow and conveys it to the Eastside Bypass, which also intercepts flows from minor tributaries and rejoins the San Joaquin River between Fremont Ford and Bear Creek. Flood flows from the Kings River North enter Mendota Pool via the James Bypass. Dedicated flood storage space also is provided in Lake McClure (Merced River), Lake Don Pedro (Tuolumne River) and New Melones Reservoir (Stanislaus River). It should be noted that the San Joaquin River levee and diversion system is not designed to contain the release objective from each project reservoir simultaneously.

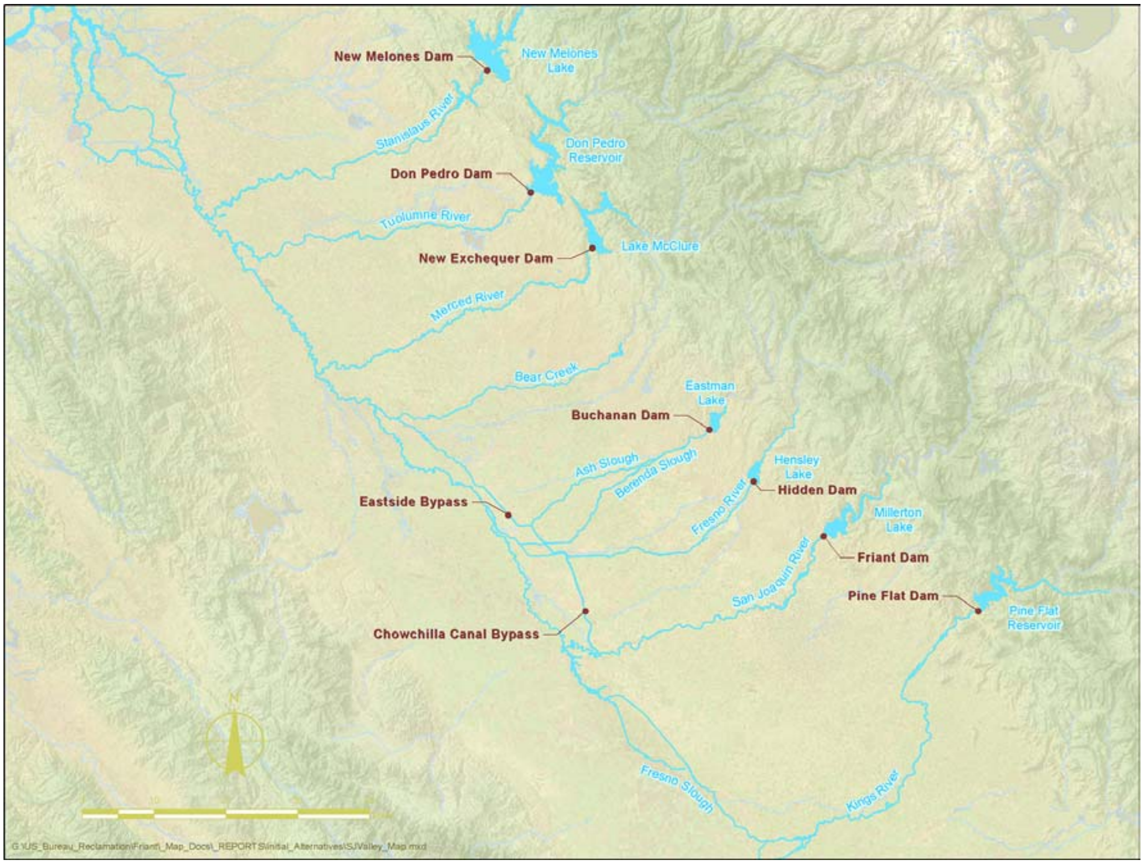



**FIGURE 3-3.**
**EXISTING FLOOD MANAGEMENT FACILITIES IN THE SAN JOAQUIN RIVER BASIN**

### *Water Quality*

Water quality in the San Joaquin River varies considerably along the river's length. Above Millerton Lake and downstream towards Mendota Pool, water quality is generally excellent. 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 these streams flow from the Sierra Nevada foothills across the eastern valley floor, their mineral concentration steadily increases. This increase in concentration is fairly uniform for each of the east side streams.

The reach from Gravelly Ford to Mendota Pool (about 17 miles) is frequently dry, except during flood control releases because all water released from Millerton Lake is diverted upstream to satisfy water rights agreements, or percolates to groundwater. As mentioned previously, flow in the reach between Friant Dam and Gravelly Ford is influenced by releases from Friant Dam, with minor contributions from agricultural and urban return flows.

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 Delta-Mendota Canal, 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. Between Sack Dam and the confluence with Salt Slough, the San Joaquin River is often dry. 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 progresses downstream from Fremont Ford, water quality generally improves at successive confluences, specifically at those with the Merced, Tuolumne, and Stanislaus rivers. In the relatively long reach between the Merced and Tuolumne rivers, mineral concentrations tend to increase due to inflows of agricultural drainage water, other wastewaters, and effluent groundwater (DWR, 1965). TDS in the San Joaquin River near Vernalis has historically ranged from 52 milligrams per liter (mg/L) (at high flows) to 1,220 mg/L from 1951 to 1962 (DWR, 1965). During the mid to late 1960s, San Joaquin River water quality continued to decline. In 1972, the SWRCB included a provision in D-1422 that Reclamation maintain average monthly concentrations of TDS in the San Joaquin River at Vernalis of 500 mg/L as a condition of the operating permit for New Melones Reservoir on the Stanislaus River.

Section 303(d) of the Clean Water Act requires the identification of waterbodies that do not meet or are not expected to meet water quality standards, or are considered impaired. An affected waterbody and associated pollutant or stressor is prioritized in the 303(d) list. The Clean Water Act further requires the development of a TMDL for each listing. The current 303(d) list, prepared in 2002 and approved by the USEPA, includes segments of the San Joaquin River, as listed in **Table 3-5**. TMDL and Basin Plan Amendments for portions of the San Joaquin River are under development by the Central Valley RWQCB for dissolved oxygen, organophosphate pesticide (diazinon and chloropyrifos), salinity (electrical conductivity) boron, and selenium.

In the higher elevation portions of the watershed within the SNF, USFS has identified sedimentation as the greatest threat for increasing turbidity, degrading water quality, and subsequently impacting aquatic habitat within the SNF (USFS, 1991).

### *Groundwater Resources*

The San Joaquin Valley groundwater basin is a structural trough up to 200 miles long and 70 miles wide filled with up to 32,000 feet of marine and continental sediments deposited during periodic inundation by the Pacific Ocean and erosion of surrounding mountains.

Continental deposits form an alluvial wedge that thickens from the valley margins toward the axis of the structural trough, which is generally oriented along a north-south alignment (DWR, 2003a). The top 2,000 feet of these sediments consist of continental deposits that generally contain freshwater (Page, 1986). As these sediments accumulated over the last 24 million years, large lakes periodically filled and drained, resulting in deposition of laterally extensive clay layers, which formed significant barriers to the vertical movement of groundwater in the basin (Westlands Water District, 1995). The most extensive of these is the Corcoran Clay (a member of the Tulare Formation, deposited about 600,000 years ago), which consists of a clay layer zero to 160 feet thick, found at depths of 100 to 400 feet below ground surface in the San Joaquin River region.

The Corcoran Clay divides the groundwater system into two major aquifers: a confined aquifer below the clay layer and a semiconfined aquifer above the layer (Williamson et al., 1989). **Figure 3-4** shows the locations of groundwater sub-basins underlying the San Joaquin Valley within the study area.

## TABLE 3-5.
## SAN JOAQUIN RIVER WATER QUALITY IMPAIRMENTS BY SEGMENT

| Waterbody / Reach | Pollutant/Stressor | Affected Area / Reach Length | Information Source |
|---|---|---|---|
| Mendota Pool[1] | Selenium | 3,045 acres | 2002 Clean Water Act §303(d) List |
| San Joaquin River: Mendota Pool to Bear Creek | Boron | 67 miles | 2002 Clean Water Act §303(d) List |
| | Chlorpyrifos | | |
| | DDT | | |
| | Diazinon | | |
| | Electrical Conductivity | | |
| | Group A Pesticides | | |
| | Unknown Toxicity | | |
| San Joaquin River: Bear Creek to Mud Slough | Boron | 14 miles | 2002 Clean Water Act §303(d) List |
| | Chlorpyrifos | | |
| | DDT | | |
| | Diazinon | | |
| | Electrical Conductivity | | |
| | Group A Pesticides | | |
| | Mercury | | |
| | Unknown Toxicity | | |
| San Joaquin River: Mud Slough to Merced River | Boron | 3 miles | 2002 Clean Water Act §303(d) List |
| | Chlorpyrifos | | |
| | DDT | | |
| | Diazinon | | |
| | Electrical Conductivity | | |
| | Group A Pesticides | | |
| | Mercury | | |
| | Selenium | | |
| | Unknown Toxicity | | |
| San Joaquin River: Merced River to South Delta Boundary | Boron | 43 miles | 2002 Clean Water Act §303(d) List |
| | Chlorpyrifos | | |
| | DDT | | |
| | Diazinon | | |
| | Electrical Conductivity | | |
| | Group A Pesticides | | |
| | Mercury | | |
| | Unknown Toxicity | | |
| Delta Waterways: Stockton Ship Channel | Chlorpyrifos | 952 acres | 2002 Clean Water Act §303(d) List |
| | DDT | | |
| | Diazinon | | |
| | Group A Pesticides | | |
| | Mercury | | |
| | Organic Enrichment / Low Dissolved Oxygen | | |
| | Unknown Toxicity | | |

Notes:
[1] Includes 3-mile reach of San Joaquin River and 8-mile reach of Fresno Slough upstream of Mendota Dam.


**FIGURE 3-4.**
**SAN JOAQUIN VALLEY GROUNDWATER SUB-BASINS**

## Hydrogeology

Recharge to the semiconfined upper aquifer generally occurs from stream seepage, deep percolation of rainfall, and subsurface inflow along basin boundaries. As agricultural practices expanded in the region, recharge was augmented with deep percolation of applied agricultural water and seepage from the distribution systems used to convey this water. Recharge of the lower confined aquifer consists of subsurface inflow from the valley floor and foothill areas to the east of the eastern boundary of the Corcoran Clay Member. Present information indicates that the clay layers, including the Corcoran Clay, are not continuous in some areas, and some seepage from the semiconfined aquifer above does occur through the confining layer.

Historically, the interaction of groundwater and surface water resulted in net gains to the streams. This condition existed on a regional basis through about the mid-1950s. Since that time, groundwater level declines have resulted in some stream reaches losing flow through seepage to the groundwater systems below. Where hydraulic connections have been maintained, the amount of seepage has varied because groundwater levels and stream flows have fluctuated. Areas in the San Joaquin River hydrologic region where these dynamics have changed include eastern San Joaquin and Merced counties, western Madera County, and other local areas. The largest stream losses have occurred during the drought periods of 1976 to 1977 and 1987 to 1992.

During predevelopment conditions, groundwater in the San Joaquin River hydrologic region flowed from the valley flanks to the axis, then north toward the Delta. Large-scale groundwater developments during the 1960s and 1970s, combined with the introduction of imported surface water supplies, have modified the natural groundwater flow pattern. Groundwater pumping and recharge from imported irrigation water has resulted in a change in regional flow patterns. Flow largely occurs from areas of recharge towards areas of lower groundwater levels due to groundwater pumping (Bertoldi et al., 1991). The vertical movement of water in the aquifer has been altered in this region as a result of thousands of wells constructed with perforation above and below the confining unit (Corcoran Clay Member), where present, providing a direct hydraulic connection (Bertoldi et al., 1991). This may have been partially offset by a decrease in vertical flow resulting from the inelastic compaction of fine-grained materials within the aquifer system.

## Groundwater Production

Groundwater is a major source of agricultural and urban water supplies in the study area. Expansion of agricultural practices between 1920 and 1950 caused declines in groundwater levels in many areas of the San Joaquin River hydrologic region. Along the east side of the region, declines have ranged between 40 and 80 feet since predevelopment conditions (1860) (Williamson et al., 1989). Groundwater levels declined substantially in the Madera County area, which depends heavily on groundwater for irrigation (Williamson et al., 1989). The cities of Fresno and Visalia are entirely dependent on groundwater supplies, with Fresno being the second largest city in the United States solely reliant on groundwater (DWR, 2003b). Typical groundwater production conditions for each sub-basin are listed in **Table 3-6** based on information from DWR Bulletin 160-98 (1998). 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 some land subsidence in the southwest portion of the region.

**TABLE 3-6.
PRODUCTION CONDITIONS IN SAN JOAQUIN VALLEY
GROUNDWATER SUB-BASINS**

| Basin Number[1] | Basin Name[1] | Extraction (TAF/year)[2] | Well Yields (gpm)[1] | Pumping Lifts (feet)[2] |
|---|---|---|---|---|
| **San Joaquin River Hydrologic Region** | | | | |
| 5-22.02 | Modesto | 230 | 1,000 – 2,000 | 90 |
| 5-22.07 | Delta-Mendota | 510 | 800 – 2,000 | 35 – 150 |
| 5-22.03 | Turlock | 450 | 1,000 – 2,000 | 90 |
| 5-22.04 | Merced | 560 | 1,500 – 1,900 | 110 |
| 5-22.06 | Madera | 570 | 750 – 2,000 | 160 |
| 5-22.05 | Chowchilla | 260 | 750 – 2,000 | 110 |
| **Tulare Lake Hydrologic Region** | | | | |
| 5-22.08 | Kings | 1,790 | 500 – 1,500 | 150 |
| 5-22.09 | Westside | 210 | 1,100 | 200 – 800 |
| 5-22.11 | Kaweah | 760 | 100 – 2,500 | 125 – 250 |
| 5-22.12 | Tulare Lake | 670 | 300 – 1,000 | 270 |
| 5-22.13 | Tule | 660 | 50 – 3,000 | 150 - 200 |
| 5-22.10 | Pleasant Valley | 100 | 35 – 3,300 | 350 |
| 5-22.14 | Kern County | 1,400 | 1,200 – 1,500 | 200 – 250 |

Key:
gpm – gallons per minute
TAF – thousand acre-feet
Note:
[1] – *Source: California Department of Water Resources Bulletin 118-03.*
[2] – *Source: California Department of Water Resources Bulletin 160-98.*

### Conjunctive Management

Groundwater has been used conjunctively with surface water to meet water needs since near the beginning of the region's agricultural development. The Friant Division of the CVP was developed as a conjunctive management project, with a contract structure designed to recognize the variability of water supplies that would be available for delivery in lieu of groundwater pumping or direct groundwater recharge. Groundwater is used when surface water is unable to fully meet demands. For several decades, conjunctive use was more incidental than formal in many areas of the San Joaquin Valley. Currently, the cities of Fresno, Bakersfield, and Visalia have groundwater recharge programs to sustain groundwater conditions for a viable water supply in the future. Extensive groundwater recharge programs also are in place in the south valley where water districts have recharged several MAF for future use and transfer through water banking programs. DWR is working with local agencies and stakeholders in the valley to develop partnerships and provide assistance for planning and developing locally controlled and managed conjunctive use programs and projects.

### Groundwater Quality

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, 2003b).

## Air Quality

Air quality in the San Joaquin Valley Air Basin (SJVAB) is regulated by the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD), 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 and State ozone ($O_3$) and particulate matter 10 microns in aerometric diameter or less ($PM_{10}$) standards, and the urban areas of Fresno, Modesto, and Stockton are nonattainment for the National and State carbon monoxide (CO) standards (ARB, 1996). A summary of recent air quality conditions for specific pollutants of concern in the SJVAB is provided below.

### Carbon Monoxide

The number of days each year that the SJVAB was over the national and State CO 8-hour standard declined in the mid- to late-1980s, was higher in 1989, and then declined to no exceedences in 1992 to 1994. The 1-hour standard is violated much less frequently. Mobile sources accounted for approximately 83 percent (1,351 tons/day) and 77 percent (1,178 tons/day) of total CO in 1980 and 1990, respectively. Agricultural sources (fuel combustion by farm equipment, waste burning, and range management) contributed approximately 8 percent (138 tons/day) and 10 percent (160 tons/day) of total CO emissions in 1980 and 1990, respectively. Waste burning was the single largest agricultural source (ARB, 1989).

### Ozone

National and State $O_3$ standards have been exceeded on a fairly regular basis. Precursors of $O_3$ (nitrogen oxides ($NO_x$), and reactive organic gases (ROG)) are almost evenly emitted by mobile and stationary sources in the SJVAB. Mobile sources contributed approximately 56 percent (315 tons/day) and 51 percent (292 tons/day) of total $NO_x$ in 1980 and 1990, respectively. Stationary sources contributed approximately 74 percent (695 tons/day) and 74 percent (435 tons/day) of total ROG in 1980 and 1990, respectively. Of all ROG stationary sources, agricultural operations contributed approximately 12 percent (115 tons/day) and 14 percent (85 tons/day) in 1980 and 1990, respectively. Pesticide application was the single largest agricultural source of ROG in both years (ARB, 1989).

### Nitrogen Dioxide

Average nitrogen dioxide ($NO_2$) concentrations have been consistently below the average annual national and 1-hour state standard. Petroleum processing was the largest stationary source of $NO_x$ in both years. The agricultural contribution of $NO_x$ was negligible.

### Particulate Matter and Total Suspended Particulates

Total suspended particulate concentrations generally declined between 1978 and 1987, with an exception in 1985. $PM_{10}$ concentrations show considerable variation between 1985 and 1994. Stationary sources contributed approximately 93 percent (459 tons/day) and 94 percent (580 tons/day) of total $PM_{10}$ emissions in 1980 and 1990, respectively. Of the total stationary source contribution, agricultural sources contributed approximately 37 percent (229 tons/day) of total PM emissions in 1990. The single largest agricultural source of particulate matter was farming operations (ARB, 1989).

#### Sulfur Dioxide

Maximum sulfur dioxide ($SO_2$) concentrations decreased considerably between 1978 and 1994. The State standard was exceeded frequently in the early 1970s, but this decreased to only a few times in the late 1970s, following the concentration trend. Stationary sources contributed approximately 82 percent (120 tons/day) and 67 percent (73 tons/day) of total sulfur oxides ($SO_x$) emissions. Oil and gas production was the largest stationary source of $SO_x$ (ARB, 1989).

#### Lead

The National and State lead standards were exceeded in the SJVAB in the late 1970s and 1980.

### Noise

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.

## Biological Environment

Elements of the biological environment for the upper San Joaquin River basin described in this section include vegetation, wildlife, aquatic and fishery resources, and special status species.

### Vegetation

Vegetation around Millerton Lake is mostly foothill woodland and grassland habitat, and riparian vegetation along the shoreline. Adjacent hillsides are foothill pine (*Pinus sabiniana*) - blue oak (*Quercus douglasii*) woodland with abundant grass/forb and shrub understory. Open grassland and savanna type habitat conditions also exist in some areas. Vernal pools and associated special status plant and animal species do not occur along this stretch of the San Joaquin River. Several large basalt tables known to have vernal pools surround the canyon, well above elevation 1,600.

Upland vegetation is dominated by foothill woodland with areas of open grassland and rock outcroppings. The predominant vegetation includes foothill pine, blue oak, and interior live oak (*Q. wislizeni*).

Montane coniferous forest constitutes the higher elevations upstream of Mammoth Pool. Habitat types in this area are meadow, riparian deciduous, lodgepole pine, mixed conifer, ponderosa pine, rock outcrop, and brush (USJRWPA, 1982c). Riparian deciduous vegetation comprises willows (*Salix sp.),* alder (*Alnus rhombefolia*), aspen (*Populus tremuloides*), dogwood (*Cornus stolonifera*), azalea *(Rhododendron occidentalis*), Indian rhubarb (*Peltiphyllum peltatum*), mountain spiraea (*Spiraea densiflora*), groundsel (*Senecio trangularis*) and tiger lily (*Lilium pardalinum*) (USJRWPA, 1982c). Meadow habitat is particularly prevalent in the Jackass and Chiquito watersheds (USJRWPA, 1982c).

Fine Gold Creek is surrounded by foothill pine–oak woodland habitat with pockets of grassland, wetland, and riparian habitat associated with numerous tributaries, hillside seeps and vernal pools. Varying degrees of riparian habitat occur along the stream. Riparian vegetation includes Oregon ash (*Fraxinus latifolia*), cottonwood (*Populus* sp.), willow (*Salix* sp.), and buttonwillow

(*Cephalanthus* sp.). Annual vegetation in the streambed includes monkeyflower (*Mimulus* sp.), rabbit's-foot grass (*Polypogon monospeliensis*), pennyroyal (*Mentha pulegium*), nutsedge (*Cyperus* sp.), and clover. Upland habitats have been seriously degraded due to cattle grazing.

Annual grassland, meadow, and possibly oak woodland habitats are found in Yokohl Valley. USGS mapping shows riparian vegetation along the upper stretches of Yokohl Creek. Adjacent foothills of Yokohl Valley are vegetated with grasslands, and foothill pine and oak woodland habitats. In addition, the possibility of vernal pools in the flatter valley bottoms is high.

### *Wildlife*

Millerton Lake hosts a diverse wildlife community, both resident and seasonal. The upper San Joaquin River area is a relatively rich wildlife region of the Sierra foothills. Forest canopy varies considerably by slope and aspect, while the shrub and ground cover layer is greatly affected by land uses such as cattle grazing. Wildlife in the higher elevation portions of the watershed is typical of the mid-elevation Sierra Nevada.

Important deer winter ranges and bear habitat exist in the Temperance Flat area. San Joaquin mule deer (*Odocoioleus hemionus*) are year-round residents of the area and mix with migratory herds from higher elevations (USFS, 2004). Generally, migratory deer move from summer range, elevation 5,000 to 8,000, to lower elevations from mid-October, or later with any significant winter storm (DFG, 2004). Four major river crossings used by mule deer during migration in the Mammoth reach of the San Joaquin River include near Chawanakee at Dam 6, below the confluence of Rock Creek and the river, the confluence of Shake Flat Creek and the river, and the Mammoth Pool area. Additionally, mule deer cross the San Joaquin River at the confluence of Jackass Creek (SCE, 2003).

Avian guilds comprise a number of bird species for oak woodland, and riparian habitats occur throughout the area (USFS, 2004). Along with mule deer, avian guilds are considered Management Indicator Species, or a group of species with special habitat requirements.

The Fine Gold Creek watershed is expected to have a diverse wildlife community. Yokohl Valley hosts a relatively well-developed mesic grassland habitat. Several special status wildlife species may be present in the project area and are addressed later in this chapter.

### *Aquatic and Fishery Resources*

Aquatic and fishery resources in the San Joaquin River upstream of Millerton Lake vary by river reach. (Refer to **Figure 3-2** and **Table 3-4** for descriptions of river reaches.)

#### Millerton Lake and Big Bend

Millerton Lake becomes thermally stratified during summer months and therefore supports a two-stage fishery with coldwater species residing in deep water and warmwater species inhabiting surface waters and areas near shore. Of the large number of fish species that inhabit Millerton Lake, most are introduced game species or forage species (USFWS, 1983). The principal warmwater game species are largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieui*), spotted bass (*M. punctulatus*), bluegill sunfish (*Lepomis macrochirus*), and striped bass (*Morone saxatilits*); the principal forage species is threadfin shad (*Dorosoma pretense*). Coldwater game species include rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*).

The only known landlocked population of American shad (*Alosa sapidissima*) is present in Millerton Lake. American shad spawn in the San Joaquin River upstream of Millerton Lake and in the portion of the reservoir upstream of Temperance Flat, which is the most riverine portion of the reservoir with turbulent flows (PG&E, 1990).

Several native species also reside in Millerton Lake, including Sacramento sucker (*Catostomus occidentalis*), Sacramento pikeminnow (*Ptychocheilus grandis*), Sacramento blackfish (*Orthodon microlepidotus*), hitch (*Lavinia exilicauda*), and hardhead (*Mylopharodon conocephalus*).

### *Temperance Flat and Millerton Bottoms*

Temperance Flat is the only substantial area in upper Millerton Lake with a gently sloping shoreline, shallow water, and well-developed shoreline vegetation. It is likely that this area provides good spawning and nursery habitat for important game fish species such as largemouth bass and spotted bass.

### *Patterson Bend*

With a relatively low channel gradient, and stream flow resulting from FERC-mandated flow releases for instream habitat, summer temperatures in the Patterson Bend reach increase sharply from Kerckhoff Dam to the powerhouses. This reach contains spawning habitat for American shad and striped bass. Fish species in the Patterson Bend reach include hardhead, Kern Brook lamprey (*Lamperta hubbsi)*, Sacramento pikeminnow, and Sacramento sucker, and of the non-natives, smallmouth bass and green sunfish (*Lepomis cyanellus*).

According to the California Natural Diversity Database (CNDDB, 2004), and Moyle and Ellison (1991), this area is designated as a Central Valley Drainage Rainbow Trout/Cyprinid Stream and Central Valley Drainage Hardhead/Squawfish Stream.

### *Kerckhoff Lake and Horseshoe Bend*

Kerckhoff Dam separates fish communities in Kerckhoff Lake and Horseshoe Bend from predatory centrarchid basses downstream. The upper portion of Kerckhoff Lake is shallow with a well-vegetated shoreline due to deposition of silt, which probably provides good fish habitat. The lower portion is in a steep-walled canyon with a shoreline consisting mostly of bedrock and with little useful habitat for fish. Kerckhoff Lake has many of the same native fish species as the Patterson Bend reach downstream, including hardhead, Sacramento pikeminnows, and Sacramento suckers. Additionally, the reservoir has native three-spined stickleback (*Gasterosteus aculeatus*), and an introduced smelt, wagasaki (*Hypomesus nipponensis*). Kerckhoff Lake does not contain American shad or striped bass, and because of its relatively cold water temperatures, it has no warmwater game species.

The fish fauna of Horseshoe Bend are mostly native species, with hardhead the most abundant. Temperatures in the lower portion of the Horseshoe Bend reach might rise to 70°F or more for much of the summer. These temperatures are too warm for coldwater species, but suitable for native coolwater species such as hardhead, Sacramento pikeminnow, and Sacramento sucker (SCE, 1997). CNDDB (2004) and Moyle and Ellison (1991) designate Horseshoe Bend as a Central Valley Drainage Resident Rainbow Trout Stream, Central Valley Drainage Rainbow Trout/Cyprinid Stream, and Central Valley Drainage Hardhead/Squawfish Stream.

### Mammoth Reach

Fish communities of the Mammoth reach segment of the San Joaquin River predominantly comprise Sacramento sucker. Rainbow and brown trout also are present, but less abundant (SCE, 2003).

### Granite Creek

Granite Creek provides excellent habitat for brown trout, rainbow trout, and brook trout (*Salvelinus fontinalis*). The simple communities present are maintained almost entirely by natural reproduction and represent a valuable recreational fishing source (USJRWPA, 1982c).

### Jackass Creek

Lower reaches of Jackass Creek are dominated by rainbow trout. Further upstream, brook trout dominate rainbow trout in Jackass Meadow (USJRWPA, 1982c).

### Chiquito Creek

Chiquito Creek hosts a productive population of brown trout, and is a popular fishing stream due to large numbers of fish and accessibility to roads and campgrounds (USJRWPA, 1982c). Steep bedrock sheets at the confluence of Mammoth Pool and Chiquito Creek are impassable for fish in the reservoir (USJRWPA, 1982c).

### Fine Gold Creek

The arm of Millerton Lake that presently inundates lower Fine Gold Creek channel is narrow and moderately steep-sided. Riparian vegetation is well developed, especially in the upstream end of the arm. Oaks, digger pines, and willows shade most of the stream, but many areas also are heavily grazed with collapsed banks. Native fishes include Sacramento sucker and hitch. California roach, with its San Joaquin Valley subspecies (or “form”) on the “Watch List” of the State of California Fish Species of Special Concern, also may be present. Nonnative fishes dominate most of the drainage, especially green sunfish, which invade from Millerton Reservoir. Little Fine Gold Creek is dominated by Sacramento hitch (Moyle et al., 1996).

The Fine Gold Creek watershed was designated as an Aquatic Diversity Management Area (ADMA) through the Sierra Nevada Ecosystem Project (Moyle et al., 1996). According to Moyle et al. (1996), an ADMA watershed has a high value for aquatic biodiversity because it is rich in native aquatic species and communities and/or contains a particularly rare or unusual biotic element. The Fine Gold Creek designation was made on the basis that roads, grazing, and Millerton Reservoir have reduced diversity in the watershed, but with efforts to restore the riparian habitats and pools of the creek, much of the drainage can be recolonized by native hitch (Moyle et al., 1996).

### Yokohl Valley

Yokohl Creek had little or no flow at the time of the May 2002 field reconnaissance, and is likely dry during summer months.

### *Special Status Species*

Federally listed and State-listed species and species of concern occur throughout the San Joaquin River watershed. **Attachment A** provides a catalog of species, their current listing status, and an indication of the geographic area where they are reported or potentially present. Habitat descriptions for each of the special status species are presented in **Attachment B**. **Tables 3-7** and **3-8** summarize findings and provide sums of special status plant, wildlife, and fishery species reported or potentially present in the geographic reaches of the study area, respectively, as reported by USFS and BLM through scoping comments and CNDDB search queries. Species information will be verified through consultation with Federal and State resource agencies.

#### Vegetation

Six special status plant species are known to occur in the Millerton Lake/Big Bend region. Hartweg's pseudobahia (a.k.a. Hartweg's golden sunburst, *Pseudobahia bahiifolia*) is reported present, and Federally listed as endangered. Federally listed threatened species include San Joaquin Valley Orcutt grass (*Orcuttia inaequalis*) and fleshy owl's-clover (a.k.a. succulent owl's-clover, *Castilleja campestris* ssp. *succulenta*). Tree anemone (*Carpenteria californica*) is an extremely localized species endemic to the region, and is California-listed as threatened and a USFS sensitive species. Bogg's Lake hedge-hyssop (*Gratiola heterosepala*), California-listed as an endangered species, along with San Joaquin Valley Orcutt grass and fleshy owl's clover, are found in vernal pools and lake margins. Several populations of Madera leptosiphon (*Leptosiphon serrulatus*, formerly Madera linanthus, *Linanthus serrulatus*), on the California Native Plant Society (CNPS) List 1B, are recorded along the shores of Millerton Lake, with one known population near Big Bend. Suitable conditions for this species probably exist in other parts of the study area also.

Many of the plant species of concern found near the Millerton Lake/Big Bend area are potentially present in Temperance Flat/Millerton Bottoms and Patterson Bend. In the Horseshoe Bend reach, one of the largest populations of tree anemone occurs along Backbone Creek near its confluence with the San Joaquin River, within the USFS Backbone Creek RNA. Other plant species of concern potentially present near Horseshoe Bend and Kerckhoff Lake include flaming trumpet (*Collomia rawsoniana*), orange lupine (*Lupinus citrinus* var. *citrinus*), mariposa pussypaws (*Calyptridium pulchellum*), and oval-leaved viburnum (*Viburnum ellipticum*).

Blue elderberry (*Sambucus mexicanus*), a shrub often associated with riparian habitat, occurs in the watershed from Big Bend upstream to Horseshoe Bend. Elderberry shrubs, including blue elderberry, are host plants for the valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), Federally listed as threatened.

## TABLE 3-7.
## SPECIAL STATUS SPECIES REPORTED PRESENT IN THE PRIMARY STUDY AREA

| | Millerton Lake/ Big Bend | Temperance Flat/ Millerton Bottoms | Patterson Bend | Kerckhoff Lake/ Horseshoe Bend | Mammoth Reach | Granite Creek | Jackass Creek | Chiquito Creek | Fine Gold Creek | Yokohl Valley |
|---|---|---|---|---|---|---|---|---|---|---|
| **PLANTS** | | | | | | | | | | |
| Federally Listed and/or State-Listed | 5 | | 1 | 1 | | | | | | 2 |
| Federal and/or State Rare | | | | | | | | | | |
| Species of Concern | 1 | | | | | 3 | 3 | 3 | | 2 |
| **WILDLIFE AND FISHERIES** | | | | | | | | | | |
| **Amphibians and Reptiles** | | | | | | | | | | |
| Federally Listed and/or State-Listed | 1 | | | | | | | | 1 | |
| Federal and/or State Candidate for Listing | | | | | | | | | | |
| Federal and/or State Candidate for Delisting | | | | | | | | | | |
| Species of Concern | 1 | 2 | 2 | 2 | | | | | 2 | 3 |
| **Birds** | | | | | | | | | | |
| Federally Listed and/or State-Listed | 1 | 1 | 1 | 1 | 1 | | | | | |
| Federal and/or State Candidate for Listing | 1 | 1 | 1 | 1 | 1 | | | | | |
| Federal and/or State Candidate for Delisting | 1 | 1 | 1 | 1 | 1 | | | | | |
| Species of Concern | 1 | 2 | 2 | | | 2 | 2 | 2 | | |
| **Fisheries** | | | | | | | | | | |
| Federally Listed and/or State-Listed | | | | | | | | | | |
| Federal and/or State Candidate for Listing | | | | | | | | | | |
| Federal and/or State Candidate for Delisting | | | | | | | | | | |
| Species of Concern | 1 | 1 | 1 | 1 | 1 | | | | | |
| **Invertebrates** | | | | | | | | | | |
| Federally Listed and/or State-Listed | 1 | 1 | 1 | 1 | | | | | | |
| Federal and/or State Candidate for Listing | | | | | | | | | | |
| Federal and/or State Candidate for Delisting | | | | | | | | | | |
| Species of Concern | | | | | | | | | | |
| **Mammals** | | | | | | | | | | |
| Federally Listed and/or State-Listed | | | | | | | | | | 1 |
| Federal and/or State Candidate for Listing | | | | | | | | | | |
| Federal and/or State Candidate for Delisting | | | | | | | | | | |
| Species of Concern | 1 | 1 | 1 | | | | | | | |
| **TOTAL WILDLIFE AND FISHERIES** | | | | | | | | | | |
| Federally Listed and/or State-Listed | 2 | 2 | 2 | 2 | 1 | | | | 1 | 1 |
| Federal and/or State Candidate for Listing | 1 | 1 | 1 | 1 | 1 | | | | | |
| Federal and/or State Candidate for Delisting | 1 | 1 | 1 | 1 | 1 | | | | | |
| Species of Concern | 4 | 6 | 6 | 3 | 1 | 2 | 2 | 2 | 2 | 3 |

# TABLE 3-8.
# SPECIAL STATUS SPECIES POTENTIALLY PRESENT IN THE PRIMARY STUDY AREA

| | Millerton Lake/ Big Bend | Temperance Flat/ Millerton Bottoms | Patterson Bend | Kerckhoff Lake/ Horseshoe Bend | Mammoth Reach | Granite Creek | Jackass Creek | Chiquito Creek | Fine Gold Creek | Yokohl Valley |
|---|---|---|---|---|---|---|---|---|---|---|
| **PLANTS** | | | | | | | | | | |
| Federally Listed and/or State-Listed | 6 | 6 | 6 | 2 | | | | | 6 | 3 |
| Federal and/or State Rare | | | | | | 1 | 1 | 1 | | |
| Species of Concern | 3 | 3 | 3 | 3 | 5 | 16 | 16 | 17 | 2 | 4 |
| **WILDLIFE AND FISHERIES** | | | | | | | | | | |
| **Amphibians and Reptiles** | | | | | | | | | | |
| Federally Listed and/or State-Listed | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | |
| Federal and/or State Candidate for Listing | | | | | | 1 | 1 | 1 | | |
| Federal and/or State Candidate for Delisting | | | | | | | | | | |
| Species of Concern | 2 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Birds** | | | | | | | | | | |
| Federally Listed and/or State-Listed | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | | 1 |
| Federal and/or State Candidate for Listing | 1 | 1 | 1 | 1 | 1 | | | | | |
| Federal and/or State Candidate for Delisting | 1 | 1 | 1 | 1 | 1 | | | | | |
| Species of Concern | 4 | 6 | 6 | | 2 | 6 | 6 | 6 | 1 | |
| **Fisheries** | | | | | | | | | | |
| Federally Listed and/or State-Listed | | | | | | 1 | 1 | 1 | | |
| Federal and/or State Candidate for Listing | | | | | | | | | | |
| Federal and/or State Candidate for Delisting | | | | | | | | | | |
| Species of Concern | 2 | 2 | 2 | 1 | 1 | | | | | |
| **Invertebrates** | | | | | | | | | | |
| Federally Listed and/or State-Listed | 3 | 3 | 3 | 1 | | | | | | 1 |
| Federal and/or State Candidate for Listing | | | | | | | | | | |
| Federal and/or State Candidate for Delisting | | | | | | | | | | |
| Species of Concern | 4 | 3 | 3 | 2 | | | | | | 1 |
| **Mammals** | | | | | | | | | | |
| Federally Listed and/or State-Listed | | | | 1 | 1 | 1 | 1 | 2 | | 2 |
| Federal and/or State Candidate for Listing | | | | | 1 | 1 | 1 | 1 | | 1 |
| Federal and/or State Candidate for Delisting | | | | | | | | | | |
| Species of Concern | 1 | 1 | 1 | 5 | 10 | 6 | 6 | 6 | | |
| **TOTAL WILDLIFE AND FISHERIES** | | | | | | | | | | |
| Federally Listed and/or State-Listed | 8 | 9 | 9 | 9 | 7 | 6 | 6 | 7 | 2 | 4 |
| Federal and/or State Candidate for Listing | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | | 1 |
| Federal and/or State Candidate for Delisting | 2 | 2 | 2 | 2 | 2 | | | | | |
| Species of Concern | 15 | 21 | 21 | 15 | 16 | 17 | 17 | 17 | 6 | 4 |

Five species of concern potentially occur through the Mammoth reach, including flaming trumpet, Madera leptosiphon, Mono Hot Springs evening-primrose (*Camissonia sierrae* ssp. *Alticola*), orange lupine, and Yosemite ivesia (*Ivesia unguiculata*, CNPS List 4).

Parasol (Bolander's) clover (*Trifolium bolanderi*, CNPS List 1B), Fresno mat (*Ceanothus fresnensis*, CNPS List 4), and Yosemite ivesia are known to be present near Granite, Jackass, and Chiquito creeks (USJRWPA, 1982c). Fourteen additional special status species are potentially present in the Granite, Jackass, and Chiquito creek areas.

Eight special status plant species may occur in the Fine Gold Creek watershed, including many species found near the Millerton Lake/Big Bend area.

Four special status species occur around Yokohl Valley. Tulare pseudobahia (a.k.a. San Joaquin Adobe sunburst, *Pseudobahia peirsonii*), Federally listed as threatened and State-listed as endangered, and Kaweah brodiaea (*Brodiaea insignis*), State-listed as endangered, have moderate to high probability of being present. Spiny-sepaled button-celery (*Eryngium spinosepalum*, CNPS List 1B), grows in Yokohl Creek downstream from the potential dam site. Recurved larkspur (*Delphinium recurvatum*), a BLM sensitive species, also may be present near vernal pools in the area. The presence of ultra basic and metagabbro rock makes serpentine-specific plants possible, although none were reported from the CNDDB query.

#### Wildlife

Several special status wildlife species are known to occur in the Millerton Lake/Big Bend region. Species include California red-legged frog (*Rana aurora draytonii), w*estern pond turtle (*Emys (=Clemmys) marmorata*), western spadefoot (*Spea (=Scaphiopus) hammondii*), northern harrier (*Circus cyaneus*), prairie falcon (*Falco mexicanus*), southern bald eagle (*Haliaeetus leucocephalus leucocephalus*), valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), and western (California) mastiff bat (*Eumops perotis californicus*). Similar wildlife species of concern occur in the Temperance Flat, Patterson Bend, and Horseshoe Bend reaches of the watershed.

Many special status species potentially occur in the higher elevation portions of the study area near Mammoth Reach, Granite, Jackass, and Chiquito creeks. Species confirmed present include the California spotted owl (*Strix occidentalis occidentalis*) and golden eagle (*Aquila chrysaetos*). Both birds are designated DFG species of concern, USFS sensitive, USFWS birds of conservation concern, BLM sensitive and California Department of Forestry and Fire Protection sensitive.

In the Fine Gold Creek area, California tiger salamander (*Ambystoma californiense*), western spadefoot, and western pond turtle are known to be present.

Foothill yellow-legged frog (*Rana boylii*), western pond turtle, western spadefoot, and San Joaquin kit fox are known to inhabit the Yokohl Valley area. The California condor nests in the Blue Ridge Reserve, several miles away.

#### Aquatic and Fishery Resources

Hardhead, classified as a State of California species of special concern and a USFS sensitive species, inhabits the San Joaquin River upstream of Millerton Lake. Hardhead can colonize reservoirs, but will persist only if exotic species, especially centrarchid basses, are not abundant.

Another State species of special concern, Kern Brook lamprey*,* may occur in the area. Data collected to date suggest this species is endemic to the San Joaquin drainage, with isolated populations thinly distributed in lower reaches of the Merced, Kaweah, Kings, and San Joaquin rivers (Moyle et al., 1995; Brown and Moyle 1992, 1993).

Vernal pool special status species California linderiella fairy shrimp (Linderiella occidentalis), Midvalley fairy shrimp (Branchinecta mesovallensis), vernal pool fairy shrimp (Branchinecta lynchi), and vernal pool tadpole shrimp (Lepidurus packardi) are potentially present in vernal pools on basalt tables that surround the canyon. These vernal pools are above elevation 1,600 and will likely be unaffected by the storage measures considered for the Investigation.

The SNF designated the Horseshoe Bend segment of the San Joaquin River as a Critical Aquatic Refuge (CAR). CARs contain localized populations of rare native species, at-risk native species, or both and have high priority for watershed restoration. The Horseshoe Bend designation is based on the presence of hardhead.

Further upstream, Lahonton cutthroat trout (Oncorhynchus clarki henshawi), a Federally listed threatened species, may be found in the Granite, Jackass, and Chiquito creeks watersheds (CNDDB 2004; USJRWPA, 1982c).

In Yokohl Valley, vernal pool fairy shrimp may be present in vernal pools in the flatter valley bottoms.

## Social and Economic Resources

This section describes social and economic resources in the primary study area of the Investigation.

### *Surface Water Resources in the Study Area*

The east side of the San Joaquin Valley includes numerous streams and rivers that drain the western slope of the Sierra Nevada Mountains 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 control, and hydropower generation. **Table 3-9** and **Figure 3-5** summarize major reservoirs in the eastern San Joaquin Valley and their purposes. With the exception of the San Joaquin River, the table lists only the largest water supply and flood control reservoir on each river.

#### *Friant Division of the CVP*

The Friant Division of the CVP provides water to over 1 million acres of irrigable land on the east side of the southern San Joaquin Valley, from near the Chowchilla River in the north to the Tehachapi Mountains in the south. Principal features of the Friant Division were completed in the 1940s, including Friant Dam and Millerton Lake northeast of Fresno on the San Joaquin River and the Madera and Friant-Kern canals, which convey water north and south to agricultural and urban water contractors. The dam is operated to supply water to agricultural and urban areas in the eastern San Joaquin Valley and to provide flood protection to downstream areas.

## TABLE 3-9.
## RESERVOIRS ON THE EAST SIDE OF THE SAN JOAQUIN VALLEY

| Name | River or Creek | Owner | Storage (TAF) | Year Built | Operational Objectives | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | FC | WS | HP | RF | WQ |
| **Reservoirs in the Upper San Joaquin River Watershed** | | | | | | | | | |
| Millerton | San Joaquin | Reclamation | 520 | 1942 | X | X | n/a | n/a | n/a |
| Kerckhoff | San Joaquin | PG&E | 4 | 1920 | n/a | n/a | X | X | n/a |
| Redinger | San Joaquin | SCE | 35 | 1951 | n/a | n/a | X | X | n/a |
| Florence | South Fork San Joaquin | SCE | 64 | 1926 | n/a | n/a | X | X | n/a |
| Huntington | Big Creek | SCE | 89 | 1917 | n/a | n/a | X | X | n/a |
| Shaver | Stevenson Creek | SCE | 135 | 1927 | n/a | n/a | X | X | n/a |
| Thomas Edison | Mono Creek | SCE | 125 | 1954 | n/a | n/a | X | X | n/a |
| Mammoth Pool | San Joaquin | SCE | 123 | 1960 | n/a | n/a | X | X | n/a |
| **Reservoirs in Other San Joaquin Valley Watersheds** | | | | | | | | | |
| New Melones | Stanislaus | Reclamation | 2,420 | 1978 | X | X | X | X | X |
| Don Pedro | Tuolumne | MID/TID | 2,030 | 1970 | x | X | X | X | n/a |
| Lake McClure | Merced | MID | 1,025 | 1967 | X | X | X | X | n/a |
| Eastman | Chowchilla | Corps | 150 | 1975 | X | X | n/a | n/a | n/a |
| Hensley | Fresno | Corps | 90 | 1975 | X | X | n/a | n/a | n/a |
| Pine Flat | Kings | Corps | 1,000 | 1954 | X | X | n/a | n/a | n/a |
| Kaweah[1] | Kaweah | Corps | 143 | 1962 | X | X | n/a | n/a | n/a |
| Success[1] | Tule | Corps | 82 | 1961 | X | X | n/a | n/a | n/a |
| Isabella | Kern | Corps | 568 | 1953 | X | X | n/a | n/a | n/a |

Key:
Owners

| | |
|---|---|
| Corps | U.S. Army Corps of Engineers |
| MID | Merced Irrigation District |
| MID/TID | Modesto Irrigation District/Turlock Irrigation District |
| PG&E | Pacific Gas and Electric |
| SCE | Southern California Edison |
| Reclamation | Bureau of Reclamation |

Operational Objectives

| | |
|---|---|
| FC | Flood control (these reservoirs have dedicated flood control storage space) |
| HP | Hydropower generation |
| RF | Downstream river instream flow requirements |
| WQ | Delta water quality |
| WS | Water supply for irrigation, domestic, municipal, and industrial uses |

n/a – operational objective not applicable TAF – thousand acre-feet

Notes:
[1] Enlargement of Kaweah and Success lakes has been authorized. Existing capacity listed.

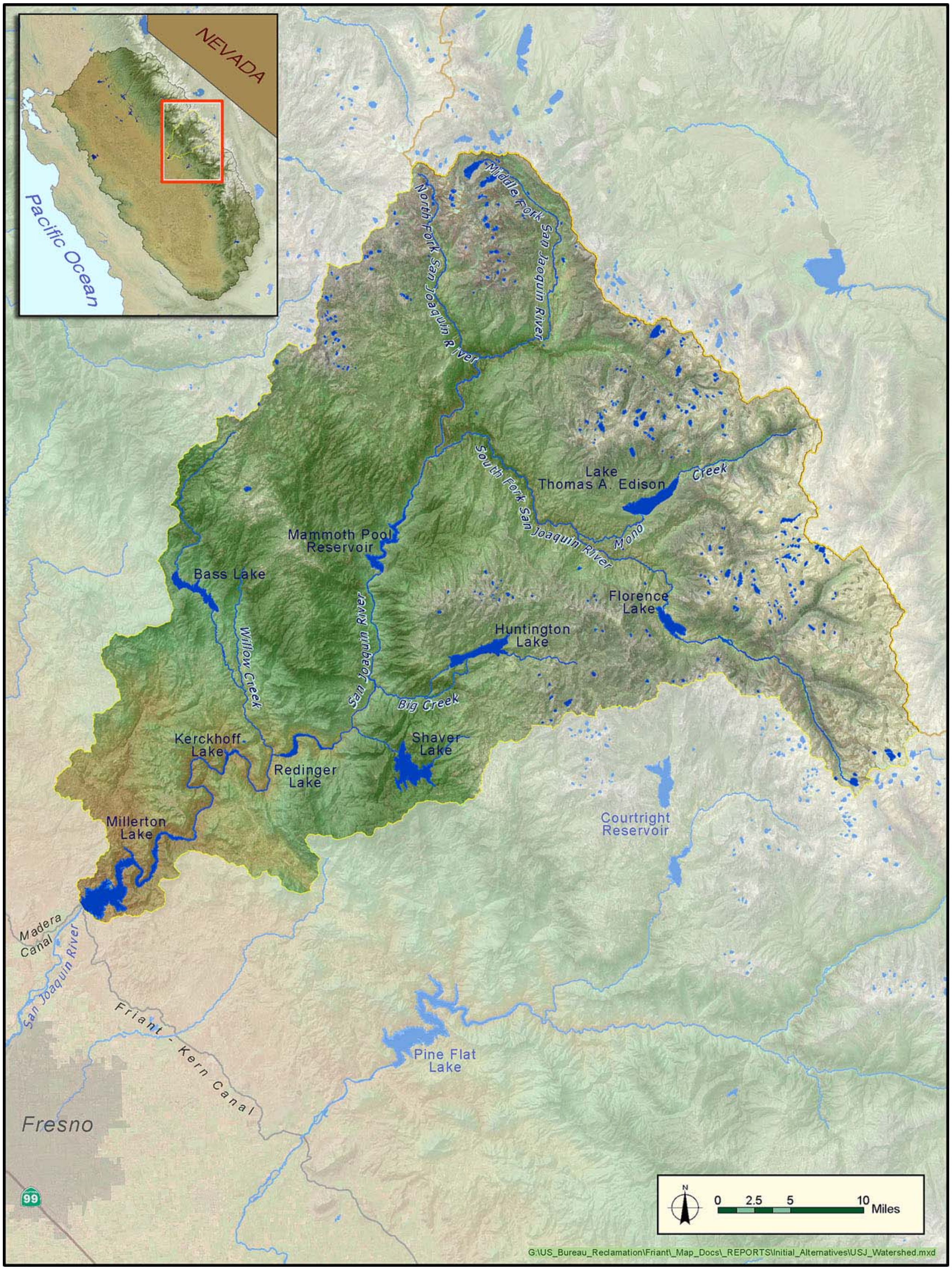



**FIGURE 3-5.**
**RESERVOIRS UPSTREAM FROM MILLERTON LAKE**

Millerton Lake has a storage capacity of 520.5 TAF. Minimum storage for canal diversion is about 130 TAF (135 TAF for the Friant-Kern Canal, 130 TAF for the Madera Canal), resulting in active conservation storage of about 390 TAF. During the flood season of October through March, up to 170 TAF of available storage space must be maintained for control of rain floods. Under present operating rules, up to 85 TAF of the flood control storage required in Millerton Lake may be provided by an equal amount of space in Mammoth Pool, as shown in **Figure 3-6.**

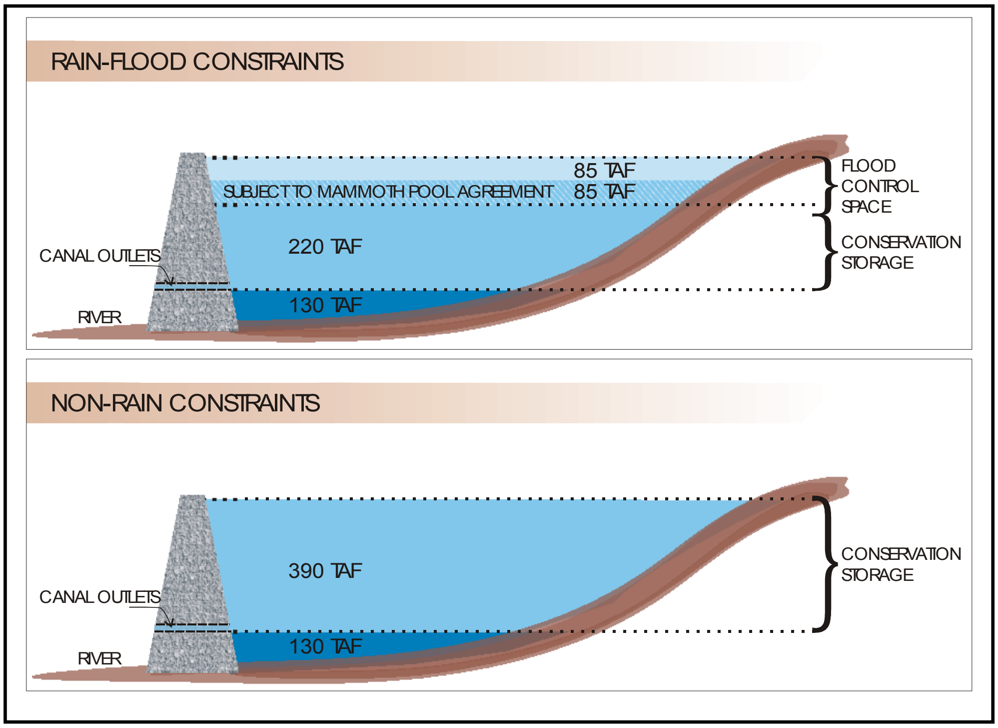



**FIGURE 3-6.**
**SCHEMATIC OF MILLERTON LAKE STORAGE REQUIREMENTS**

The limited active conservation storage and requirement for flood space reservation result in very little opportunity for carryover storage. Millerton Lake is operated as an annual reservoir with no specific provision for carryover storage. Annual water allocations and release schedules are developed with the intent of drawing reservoir storage to minimum levels by the end of September. When demands are lower or inflow is greater than typical, end-of-year storage may be above minimum levels, resulting in incidental carryover storage.

Reclamation obtained the majority of the water rights on the San Joaquin River, allowing for diversion of water at Friant Dam through purchase and exchange agreements with entities that held those rights at the time the project was developed. The agreement involving the largest amount of water requires annual delivery of approximately 840 TAF of water to Mendota Pool to water rights holders along the San Joaquin River. This obligation is met with water exported from the Delta via the Delta-Mendota Canal in accordance with San Joaquin River exchange contracts. If Delta water were not available to meet these commitments, Reclamation would be required to release water from Friant Dam to meet these water rights obligations. With the exception of flood control operations, water released from Friant Dam to the San Joaquin River is limited to that necessary to satisfy riparian water rights along the San Joaquin River between Friant Dam and Gravelly Ford.

### *Friant Division Contract Types and Water Deliveries*

The Friant Division was designed and is operated to support conjunctive water management in an area that was subject to groundwater overdraft prior to construction of Friant Dam, and which remains in a state of overdraft today. Reclamation employs a two-class system of water allocation to take advantage of water during wetter years. **Figure 3-7** shows the locations and acreage of the 28 long-term Friant Division water service contractors. **Table 3-10** lists Friant Division contract amounts for each contractor. 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. Lands served by Class 1 contracts primarily include upslope areas planted in citrus or deciduous fruit trees. During project operations, the first 800 TAF of annual water supply are delivered under Class 1 contracts.

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. Class 2 contractors typically have access to good-quality groundwater supplies and can use groundwater during periods of surface water deficiency. Many Class 2 contractors are in areas with high groundwater recharge capability and operate dedicated groundwater recharge facilities.

In addition to Class 1 and Class 2 water deliveries, Reclamation is authorized to deliver water that otherwise would be released for flood control purposes. Section 215 of the Reclamation Reform Act of 1982 authorizes the delivery of unstorable irrigation water that would be released in accordance with flood control 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.

Historically, the Friant Division has delivered an average of about 1,300 TAF of water annually. Since 1949, Reclamation has made annual releases of 117 TAF from Friant Dam to the San Joaquin River to meet downstream water rights diversions above Gravelly Ford. Additional flows occur during years when releases are made to the San Joaquin River for flood control purposes.

**Figure 3-8** shows the historical allocation of water to Friant Division contractors, estimated by applying historical allocation percentages to total Class 1 and Class 2 contracts amounts. As shown, annual allocation of Class 1 and Class 2 water varies widely in response to hydrologic conditions.

During the period from 1957 through 2002, annual allocations of Class 1 water were typically at or above 75 percent of contract amounts, except in three extremely dry years. In this same period, full allocation of Class 2 water supplies occurred in about one-fourth of the years. During the extended drought from 1987 through 1992, no Class 2 water was available and Class 1 allocations were below full contract amounts, except in one year. During this and other historical drought periods, water contractors relied heavily on groundwater to meet water demands.

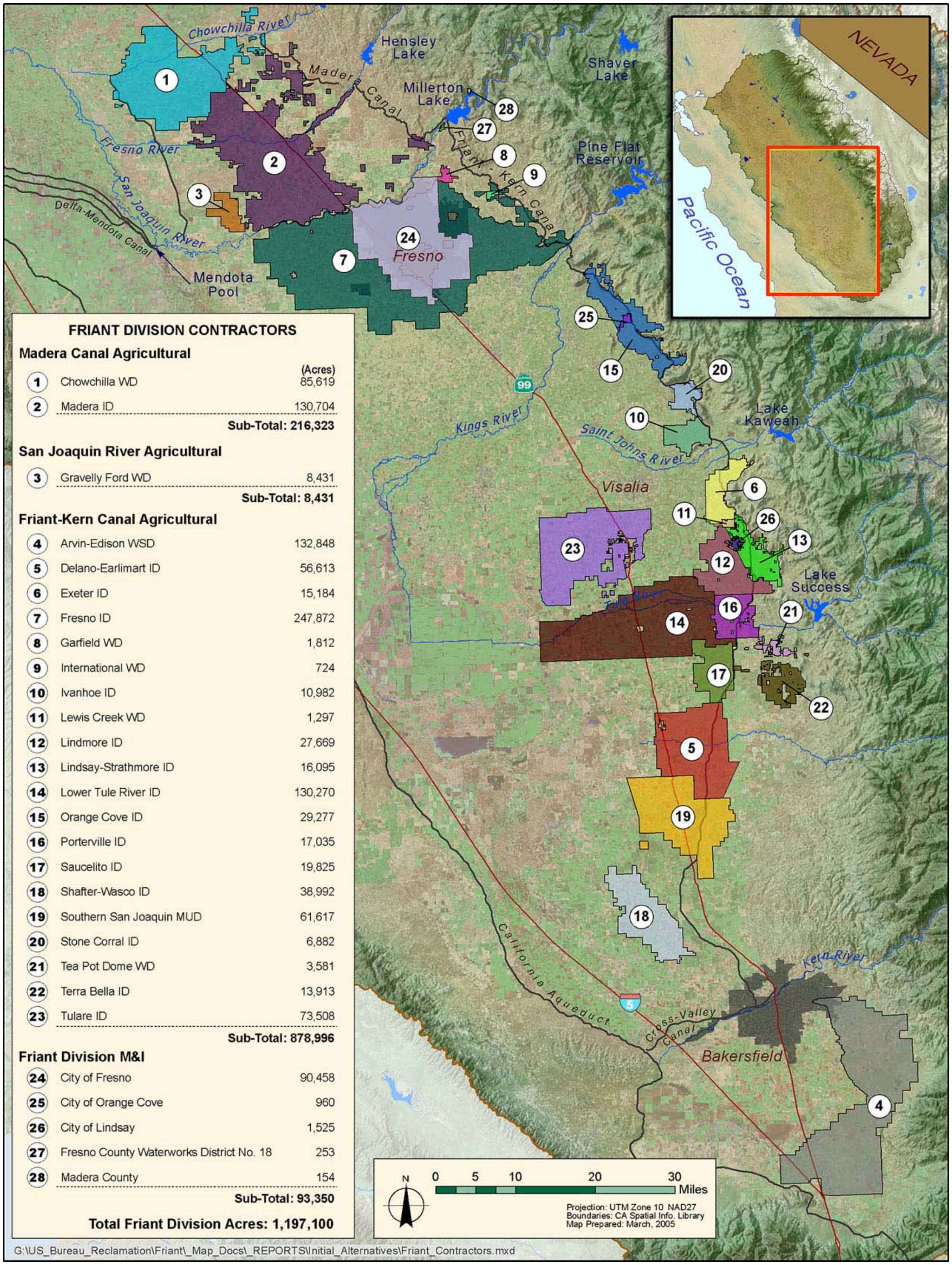



**FIGURE 3-7.**
**FRIANT DIVISION CONTRACTORS**

# TABLE 3-10.
# FRIANT DIVISION LONG-TERM CONTRACTS

| CONTRACT TYPE/CONTRACTOR | Class 1 | Class 2 | Cross-Valley |
|---|---|---|---|
| **Madera Canal Agricultural** | | | |
| Chowchilla WD | 55,000 | 160,000 | |
| Madera ID | 85,000 | 186,000 | |
| **Total Madera Canal Agricultural** | **140,000** | **346,000** | |
| **San Joaquin River Agricultural** | | | |
| Gravelly Ford WD | 0 | 14,000 | |
| **Friant-Kern Canal Agricultural** | | | |
| Arvin-Edison WSD | 40,000 | 311,675 | |
| Delano-Earlimart ID | 108,800 | 74,500 | |
| Exeter ID | 11,500 | 19,000 | |
| Fresno ID | 0 | 75,000 | |
| Garfield WD | 3,500 | 0 | |
| International WD | 1,200 | 0 | |
| Ivanhoe ID | 7,700 | 7,900 | |
| Lewis Creek WD | 1,450 | 0 | |
| Lindmore ID | 33,000 | 22,000 | |
| Lindsay-Strathmore ID | 27,500 | 0 | |
| Lower Tule River ID | 61,200 | 238,000 | |
| Orange Cove ID | 39,200 | 0 | |
| Porterville ID | 16,000 | 30,000 | |
| Saucelito ID | 21,200 | 32,800 | |
| Shafter-Wasco ID | 50,000 | 39,600 | |
| Southern San Joaquin MUD | 97,000 | 50,000 | |
| Stone Corral ID | 10,000 | 0 | |
| Tea Pot Dome WD | 7,500 | 0 | |
| Terra Bella ID | 29,000 | 0 | |
| Tulare ID | 30,000 | 141,000 | |
| **Total Friant-Kern Canal Agricultural** | **595,750** | **1,041,475** | |
| **Total Friant Division Agricultural** | **735,750** | **1,401,475** | |
| **Friant Division M&I** | | | |
| City of Fresno | 60,000 | | |
| City of Orange Cove | 1,400 | | |
| City of Lindsay | 2,500 | | |
| Fresno County Water Works District No. 18 | 150 | | |
| Madera County | 200 | | |
| **Total Friant Division M&I** | **64,250** | | |
| **Total Friant Division Contracts** | **800,000** | **1,401,475** | |
| **Cross-Valley Canal Exchange** | | | |
| Fresno County | | | 3,000 |
| Tulare County | | | 5,308 |
| Hills Valley ID | | | 3,346 |
| Kern-Tulare WD | | | 40,000 |
| Lower Tule River ID | | | 31,102 |
| Pixley ID | | | 31,102 |
| Rag Gulch WD | | | 13,300 |
| Tri-Valley WD | | | 1,142 |
| **Total Cross-Valley Canal Exchange** | | | **128,300** |

Key:
ID – Irrigation District  M&I – municipal and industrial  MUD – Municipal Utility District
WD – Water District  WSD – Water Storage District
*Source: Friant Water Users Authority Informational Report*

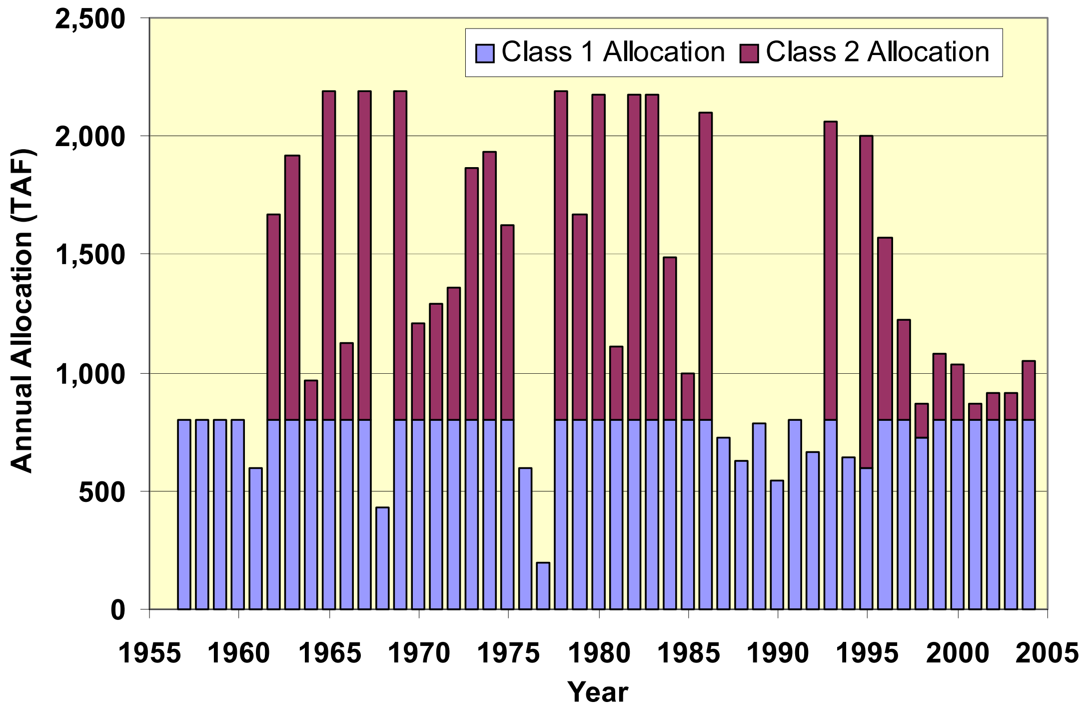



**FIGURE 3-8.**
**HISTORICAL ALLOCATION TO FRIANT DIVISION CONTRACTS**

In addition to the Class 1, Class 2, and conjunctive management aspects of Friant Division operations, a productive program of transfers between districts takes place annually. This program provides opportunities to improve water management within the Friant service area. In wet years, water surplus to one district's need can be transferred to other districts with the ability to recharge groundwater. Conversely, in dry years, water is returned to districts with little or no groundwater supply, thereby providing an ongoing informal groundwater banking program within the Friant Division.

The Cross-Valley Canal, a locally financed facility completed in 1975, enables delivery of water from the California Aqueduct to the east side of the southern San Joaquin Valley near the City of Bakersfield. A complex series of water purchase, transport, and exchange agreements allows the exchange of equivalent amounts of water between Arvin-Edison Water Storage District, near Bakersfield, and eight entities with contracts for CVP water exported from the Delta. When conditions permit, water is delivered to Arvin-Edison from the California Aqueduct in exchange for water that would have been delivered from Millerton Lake.

### *Power/Energy*

The San Joaquin River watershed upstream of Millerton Lake is extensively developed for hydroelectric generation. In this area, PG&E and SCE own and operate several hydropower generation facilities, as shown in **Figure 3-9**. Both the PG&E and SCE systems consist of a series of reservoirs that provide water through tunnels to downstream powerhouses. Hydropower also is generated by the Friant Power Authority at the Friant Power Project; water is released from Friant Dam to the Friant-Kern Canal, Madera Canal, and San Joaquin River. 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. **Table 3-11** summarizes generation capacity and date of installation for PG&E and SCE power facilities from Millerton Lake upstream to Redinger Lake. This table also summarizes annual reported energy generation from the PG&E and SCE facilities for 1994 through 2002. As indicated by minimum and maximum values, annual energy generation varies widely.

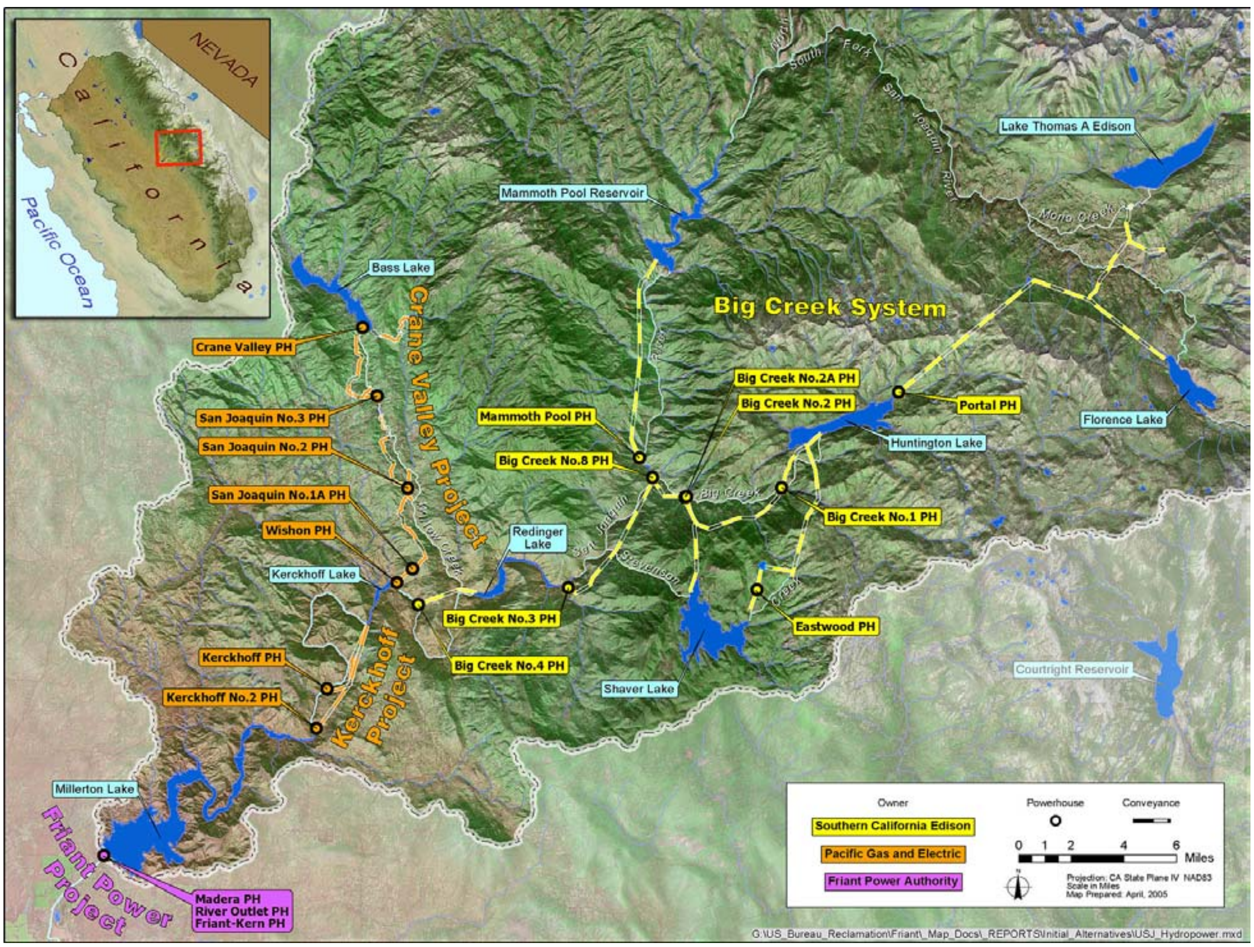



**FIGURE 3-9.**
**EXISTING HYDROPOWER FACILITIES AT AND UPSTREAM OF FRIANT DAM**

**TABLE 3-11.**
**RECENT HYDROELECTRIC GENERATION AT SELECTED FACILITIES UPSTREAM FROM MILLERTON LAKE**

| | Pacific Gas and Electric | | | Southern California Edison | | |
|---|---|---|---|---|---|---|
| | **Wishon** | **Kerckhoff** | **Kerckhoff No. 2** | **Big Creek No. 3** | **Big Creek No. 4** | **Mammoth Pool** |
| Number & Type of Units | 4 – Impulse | 3 – Francis | 1 – Francis | 5 – Francis | 2 – Francis | 2 – Francis |
| Capacity (MW) | 20 | 38 | 155 | 175 | 100 | 187 |
| Year Constructed | 1910 | 1920 | 1983 | 1923 | 1952 | 1960 |
| **Reported Annual Generation (MWh)**[1] | | | | | | |
| 1994 | 27,904 | 10,348 | 275,752 | 567,399 | 294,398 | 358,510 |
| 1995 | 113,411 | 115,930 | 803,490 | 1,195,652 | 623,186 | 819,824 |
| 1996 | 93,551 | 52,273 | 696,653 | 1,050,192 | 608,066 | 867,187 |
| 1997 | 45,475 | 72,350 | 695,775 | 898,483 | 589,812 | 835,857 |
| 1998 | 117,762 | 75,657 | 735,830 | 1,094,868 | 613,169 | 760,690 |
| 1999 | 73,369 | 31,959 | 410,567 | 539,673 | 435,868 | 604,340 |
| 2000 | 73,642 | 37,632 | 482,279 | 837,543 | 448,810 | 616,530 |
| 2001 | 47,942 | 10,768 | 316,602 | 570,805 | 301,216 | 428,951 |
| 2002 | 54,588 | 19,639 | 368,396 | 717,201 | 352,915 | 486,423 |
| **Min. 1994-2002** | **27,904** | **10,348** | **275,752** | **539,673** | **294,398** | **358,510** |
| **Max. 1994-2002** | **117,762** | **115,930** | **803,490** | **1,195,652** | **623,186** | **867,187** |
| **Avg. 1994-2002** | **71,960** | **47,395** | **531,705** | **830,202** | **474,160** | **642,035** |

Key:
FERC – Federal Energy Regulatory Commission
MW – megawatt
MWh – megawatt – hour
Note:
[1] Exclusive of plant use, data source – annual FERC licensee reports.

Developing new storage for water supply, water quality, ecosystem restoration, and flood damage reduction creates opportunities to add hydropower features and increase power generation in the basin. Developing new storage also has the potential to decrease power generation in the basin if existing facilities are impacted.

## *Land Use*

Land ownership around and upstream from Millerton Lake includes privately owned parcels, lands, and facilities owned by power utilities, public lands managed by the State, lands managed by the BLM, and lands managed by USFS, as shown in **Figure 3-10**. This section describes land management and use type in the primary study area. Descriptions are provided by reach.

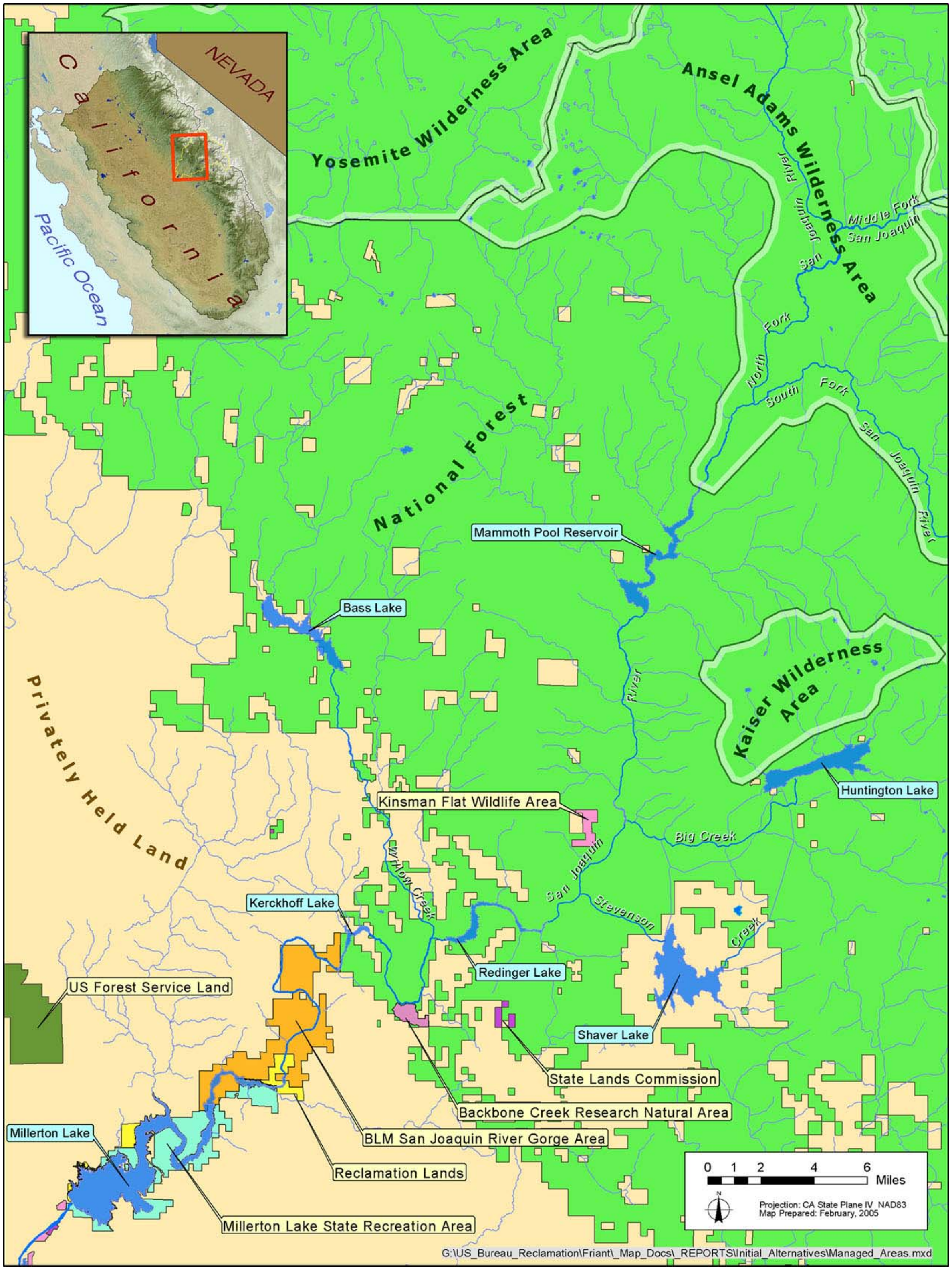



**FIGURE 3-10.**
**DESIGNATED MANAGEMENT LANDS IN THE UPPER SAN JOAQUIN RIVER BASIN**

### Millerton Lake and Big Bend

Much of the land surrounding Millerton Lake and in the Big Bend area is within the Millerton Lake State Recreation Area (SRA). A total of over 440 parcels surround Millerton Lake. Based on an initial inventory using aerial photography, it is estimated that over 150 structures exist below elevation 720, which corresponds to the elevation that would be inundated if Millerton Lake level were raised 140 feet.

### Temperance Flat and Millerton Bottoms

In the Temperance Flat area, a few residences and structures exist that may be affected by some of the storage measures. BLM manages lands in Temperance Flat and Millerton Bottoms as part of the San Joaquin River Gorge Management Area.

### Patterson Bend

Portions of the Patterson Bend reach of the San Joaquin River are managed by BLM as the San Joaquin River Gorge Management Area, and other portions by USFS as the SNF. Structures in the Patterson Bend reach include powerhouses and ancillary facilities associated with the PG&E Kerckhoff Project, and a footbridge over the San Joaquin River near RM 284 in the San Joaquin River Gorge Management Area.

### Kerckhoff Lake and Horseshoe Bend

Upstream of Kerckhoff Dam, the San Joaquin River is managed by the USFS as part of the SNF. The USFS Backbone Creek RNA represents 262 acres of chaparral and riparian habitat along the San Joaquin River to be preserved and protected in perpetuity (USFS, 2004). No known residences are present along the river upstream of Kerckhoff Dam. In the reach between Kerckhoff and Redinger dams, structures include powerhouses and ancillary facilities associated with the PG&E Wishon and SCE Big Creek projects. A bridge at Powerhouse Road spans the upper reach of Kerckhoff Lake.

Further upstream, and a short distance below Redinger Lake Dam, an improved road crossing traverses the channel of Willow Creek. Structures upstream of Redinger Dam include Big Creek No. 3 Powerhouse and ancillary facilities. Numerous structures of the Chawanakee community are upstream of Redinger Lake.

### Mammoth Reach

Near Mammoth Reach, SCE Dam 6 provides an afterbay for the Mammoth Pool Powerhouse. Structures include the Mammoth Pool powerhouse and ancillary facilities, and Mammoth Pool Dam.

### Granite, Jackass, and Chiquito Creeks

The remainder of the primary study area on the upper San Joaquin River is entirely within the SNF, with a small number of private properties interspersed (USJRWPA, 1982c). Land uses in the SNF include timber production, cattle grazing, mining, hydroelectric power generation, recreation, and fish and wildlife habitat (USJRWPA, 1982c).

### Fine Gold Creek

The Fine Gold Creek watershed appears to be largely undeveloped and grazed by cattle. Some scattered single-family homes, related farm structures, and access roads are present in the area. Road 210, Hidden Lake Boulevard, and Ralston Way traverse the watershed.

### Yokohl Valley

Land use in the Yokohl Valley area is predominantly grazing, including many substantial ranch houses with established vegetation along Yokohl Drive. Two parallel transmission lines traverse Yokohl Valley, and a large new hillside housing development would overlook the potential dam off Route 217.

## Traffic and Transportation

Several roads in the Millerton Lake area provide access to residential areas and recreation facilities. Millerton Road skirts the south side of the reservoir, connecting the community of Friant with Auberry Road. Winchell Cove Road and Sky Harbor Road extend from Millerton Road north into residential areas. Madera County roads 206 and 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 into the Hidden View residential area near the confluence of Fine Gold Creek and Millerton Lake. Sky Harbor Drive, on the south side of Millerton Lake, provides access to private property in the Sky Harbor development and to the South Fine Gold picnic area within the SRA.

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 San Joaquin River Gorge Management Area and to the PG&E Kerckhoff and Kerckhoff No. 2 powerhouses. Smalley Road, a paved road, provides access to the Kerckhoff Powerhouse and switchyard, the BLM primitive campground, and 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.

Redinger Lake Road spurs off Powerhouse Road, providing access to the Big Creek No. 4 Powerhouse, and winding to Redinger Lake. Italian Bar Road crosses over Redinger Lake and provides access to numerous structures of the Chawanakee community.

*Bridge over San Joaquin River at Kerckhoff Lake*

County roads 210 and 216 provide access from north of Millerton Lake into Hidden Lake Estates. Ralston Way and Hidden Lake Boulevard are other roads in the Fine Gold Creek watershed.

In Yokohl Valley, Yokohl Drive and private, unpaved roads provide access to grazing lands.

The Granite Creek area contains about 9 miles of unpaved roads that serve as access for recreation (USJRWPA, 1982c).

Mammoth Pool Road traverses the Chiquito Creek watershed, providing access to recreation and facilities.

### *Recreation and Public Access*

Recreation facilities around and upstream of Millerton Lake are shown in **Figure 3-11**. Recreational uses for each river reach are described in the following sections.

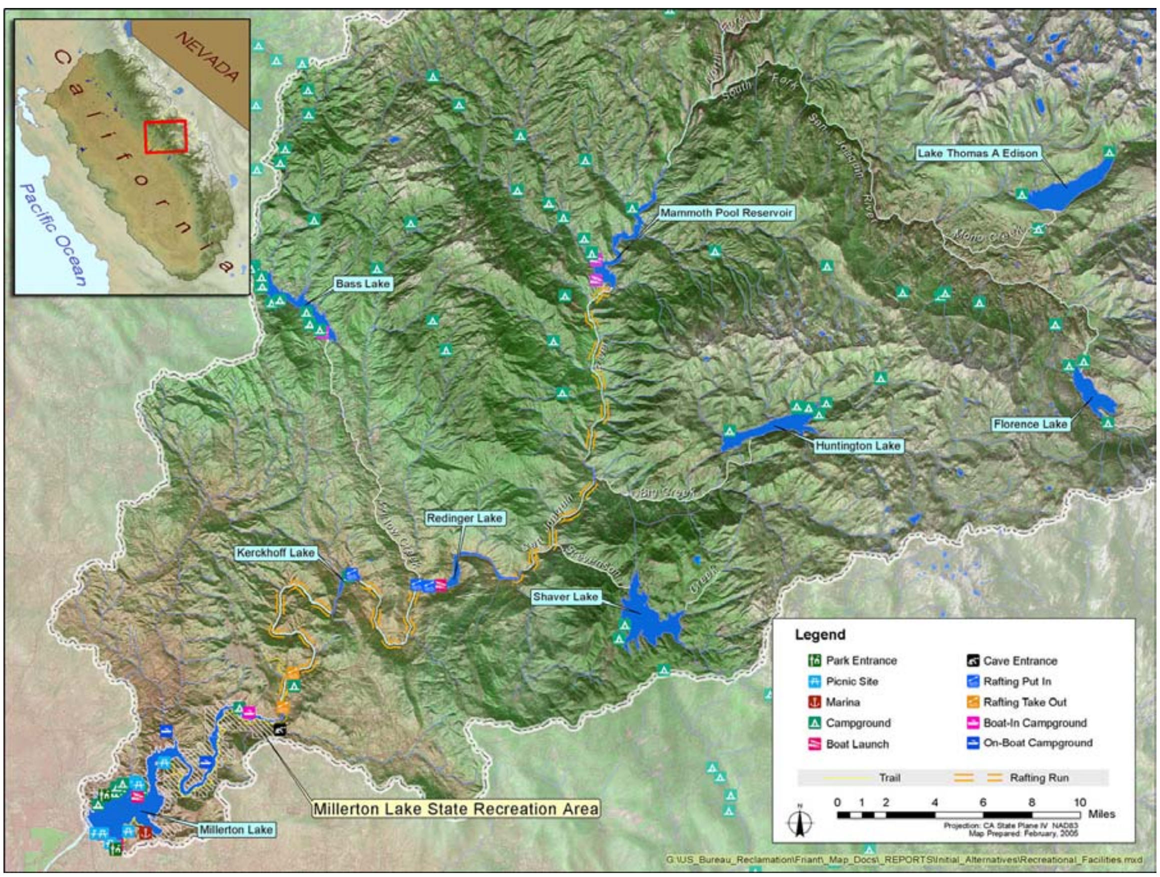



**FIGURE 3-11.**
**RECREATIONAL FACILITIES IN THE UPPER SAN JOAQUIN RIVER BASIN**

### Millerton Lake and Big Bend

Millerton Lake is a major low-elevation recreation destination in the region, providing a variety of recreation opportunities, including fishing, swimming, boating, and water skiing. Several developed recreation facilities associated with the Millerton Lake SRA are present along the reservoir margins, including boat launching areas, developed campgrounds and day use areas, and recreation residences. The primary launching area is located on the south side of the reservoir near Friant Dam. This launch area is accessible by paved road and includes large paved parking areas and several boat ramps. Smaller, less heavily used boat launches are located elsewhere on the lake. Paved and unpaved roads provide access to the lake's shoreline.

The area upstream of Big Bend, beginning at about RM 274.5, is relatively remote and accessible only by boat or unpaved roads. Dispersed use occurs along the entire shoreline and along the San Joaquin River upstream from Millerton Lake. The San Joaquin River Trail traverses the southern portion of Millerton Lake to Temperance Flat.

### Temperance Flat and Millerton Bottoms

The Temperance Flat area is relatively undeveloped and is accessible only by boat or a few mostly unpaved roads. Developed shoreline recreation areas are limited to the Hewitt Valley Environmental Camp and Temperance Flat Boat-In Camp, located on the north side of the lake between RM 280 and RM 281. In addition, a toilet facility is located at about RM 281. Several trails and four-wheel drive roads traverse both the north and south sides of the lake and provide access for dispersed activities such as fishing, hiking, horseback riding, and hunting.

The Millerton Lake SRA adjoins large tracts of public land managed by BLM. The majority of non-water-oriented recreation use in the area occurs within the boundaries of the BLM San Joaquin River Gorge Management Area, formerly known as the Squaw Leap Management Area. BLM has constructed and/or restored several buildings within the San Joaquin River Gorge Management Area, including a Native American village and presentation centers. These buildings are used as part of a program for school-aged children to learn about the natural and cultural resources of the area.

The Millerton Lake Caves, along Big Sandy Creek, are situated just above the high water mark of Millerton Lake. Sculpted by the creek, the cave system formed through scour and enlargement of fractures in the granite, continuous from the point where it captures the creek to the edge of the San Joaquin River (Snyder, 2004). Blocks have closed off two portions of the crevice, dividing it into three portions. The upper cave is listed as the sixth deepest and ninth longest granite cave in the US. Middle cave is listed as 20th longest. The Western Cave Conservancy regards the Millerton Lake Caves system as world class, and the most photogenic of its type in the United States, attracting the interest of cavers around the world (Snyder, 2004).

Millerton Bottoms run is a boatable portion of the river used in late summer and fall when Millerton Lake storage has dropped sufficiently to reveal up to 3 miles of riverbed. This section is classified as Class III and offers dependable whitewater recreation in late summer and fall, when no other local rivers have boatable flows (Martzen, 2004).

### *Patterson Bend*

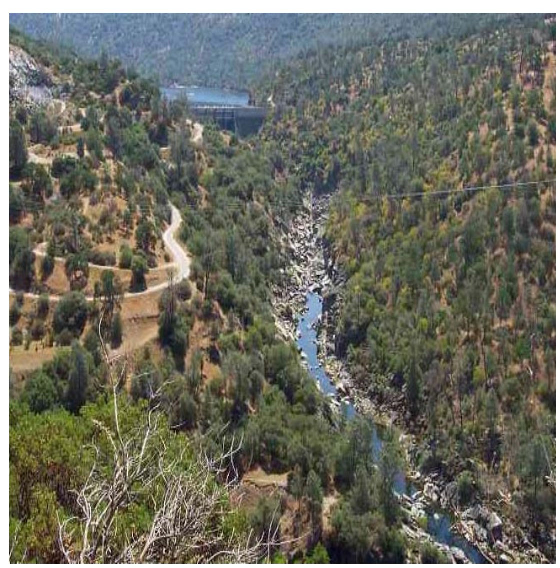
*San Joaquin River Trail near Temperance Flat, Madera County*

Portions of the Patterson Bend reach of the San Joaquin River are managed by BLM as the San Joaquin River Gorge Management Area, and other portions by the USFS as the SNF. The San Joaquin River Trail terminates within the Patterson Bend reach. No developed recreation facilities exist along the San Joaquin River between the Kerckhoff Powerhouse and Kerckhoff Lake.

Several unpaved roads and trails diverge from Smalley Road and provide access for hunting, fishing, mountain biking, hiking, and equestrian use. Off-road vehicle use is not allowed within the boundaries of the San Joaquin River Gorge Management Area. A four-wheel drive road provides river access at about RM 287 and another four-wheel drive road provides access to the river at about RM 290. The absence of roads and developed facilities limits recreation use, but both warmwater and coldwater fish species draw fishermen, particularly where four-wheel drive roads or trails provide river access.

Whitewater boating also occurs along the San Joaquin River between Kerckhoff Lake and the Kerckhoff No. 2 Powerhouse. This run is referred to as the Patterson Bend run and is rated Class V on the International Scale of Difficulty. Due to infrequent and erratic flows, Patterson Bend is not boated frequently. The last mile of Patterson Bend, known as Squaw Leap and considered Class IV+ to V, is boated in the fall of each year on the outflows of the Kerckhoff Powerhouse.

### *Kerckhoff Lake and Horseshoe Bend*



*San Joaquin River below Redinger Dam*

Most of the Horseshoe Bend area is situated within or bordered by the SNF. PG&E has developed recreation facilities at Kerckhoff Lake, including a car-top boat launch, a day-use area, and campground at Smalley Cove, on the north side of the lake, and a parking area at the BLM San Joaquin River Gorge Management Area. According to PG&E, these facilities are used primarily for picnicking, fishing, hunting, and primitive camping.

No developed recreation facilities exist between the Big Creek No. 4 Powerhouse and Redinger Lake. A primitive trail, referred to as the Horseshoe Bend Trail, traverses the north side of the San Joaquin River, providing access to upland areas for horseback riding, hunting, and hiking. An unpaved road provides river access where Willow Creek enters the San Joaquin River, about one-half mile downstream of Redinger Dam (Big Creek Dam No. 7).

The river between Redinger Dam and Kerckhoff Lake is used for whitewater boating. This run is known as the Horseshoe Bend run and is considered Class III-IV on the International Scale of Difficulty.

### Mammoth Reach

Situated in the SNF, Mammoth Reach hosts recreation activities such as fishing, hunting, hiking, horseback riding, and dispersed camping. Tied for First Run, a Class V whitewater run, is 7 miles long and starts at Mammoth Pool Dam. The take-out is at the Mammoth Pool Powerhouse. The run is reported to be an excellent whitewater run, and provides “pleasant wilderness scenery” (SCE, 2003).

### Granite Creek

The Granite Creek area serves as important staging and access for area wilderness users (USJRWPA, 1982c). Recreation activities include fishing, hunting, hiking, horseback riding, dispersed camping, off-road vehicle use, and gathering of forest products. Two developed campgrounds exist in the area.

*Granite Creek, Sierra National Forest*
*(Source: Yosemite-Madera County Film Commission)*

### Jackass Creek

One four-unit developed campground exists in the Jackass Creek area.

### Chiquito Creek

Mammoth Pool Campground near the Chiquito Creek inflow to Mammoth Pool has 47 camp units. Further upstream, Sweetwater and Placer campgrounds offer additional developed campsites, while the Upper Chiquito campground provides undeveloped sites. Chiquito Creek is a popular recreational destination due to its proximity to population centers, accessibility on good roads, and good fishing.

### Fine Gold Creek

Fine Gold Creek traverses private property. No developed recreation facilities are within the immediate site area. It is likely, however, that some recreation occurs in the area, particularly where unpaved roads provide access to undeveloped areas along Fine Gold Creek. Recreation activities may include angling, hiking, nature viewing, picnicking, camping, mountain biking, and off-highway vehicle use. Some recreational mining, such as gold dredging or panning, also may occur. Boaters using Millerton Lake can access the lower portion of Fine Gold Creek.

### Yokohl Valley

No developed recreation facilities are present in Yokohl Valley, and dispersed use along Yokohl Creek is unlikely owing to the predominance of private property.

## Cultural Environment

This section describes the archaeology, ethnography, and history of the primary study area, with particular emphasis on the Temperance Flat area upstream to Redinger Lake and its immediate vicinity. This reach is emphasized primarily because of previous work done in the area related to FERC relicense applications. Other portions of the primary study area are described based on available information from existing sources. No site-specific research was conducted for preparation of this section, but will be prepared for future reports.

### *Archaeology*

California is rich in archaeological remains. Archaeological sites can be found almost anywhere in the State, although some areas have more sites than others, often reflecting more favorable living conditions and more attractive natural resources. Due to California's relatively arid climate, archaeological sites tend to be concentrated near major rivers and reliable water supplies.

A recent archaeological records search by Reclamation archaeologists indicates the presence of 33 archaeological sites within or near the existing pool of Millerton Lake (Welch, 2002). Sites include habitation sites with housepits, sweathouses, and human burials, bedrock mortars (BRM), rock rings, and lithic scatters. Some of the sites are within the Squaw Leap National Register District. Three of the archaeological sites are associated with mining.

Farther upriver, portions of the area were surveyed for PG&E hydroelectric relicensing (Varner and Bernal, 1976; Varner, 1977) and documented as inhabited as early as AD 500 (Moratto, 1984). In Exhibit W of the relicensing application, PG&E stated that 13 archaeological sites were present, 2 of which were found to be significant (PG&E, n.d.). Later reports, reflecting additional survey efforts (Varner, 1983; Wren, 1994), identified 23 sites but only 1 property on the National Register of Historic Places (NRHP). It is likely that additional sites occur near Kerckhoff Lake at elevations higher than those surveyed in connection with PG&E relicensing, and additional sites are expected farther upstream.

Hindes (1962) gave early attention to the San Joaquin River canyon upstream from the Big Creek No. 4 Powerhouse, where ephemeral use sites are likely. Blue oak/foothill pines vegetation present diverse natural resources for use by former occupants of the area. Redinger Lake inundated 22 archaeological sites (Wallace and Lathrap, 1950; White, 1986). Known archaeological sites also are present in the vicinity of the SCE Big Creek No. 3 Powerhouse, including a small village known as Somhau (Theodoratus, 1978; McCarthy et al., 1985). According to surveys of the Big Creek No. 3 Powerhouse area (Varner and Beatty, 1980) and Big Creek No. 3 and No. 4 powerhouses (White, 1986), a high probability exists of archaeological sites, including BRMs, and hunting and fishing camps, throughout the area.

Archaeological sites near Granite Creek include suspected habitation areas, temporary and seasonal campsites, specialized resource procurement areas, trails, and lithic reduction stations (USJRWPA, 1982c).

A recent archaeological records search by Reclamation archaeologists indicates the presence of three known archaeological sites in the Fine Gold Creek watershed (Welch, 2002). Two of the sites have BRMs and lithics, and the third is a standing two-story house.

An archaeological survey of Yokohl Valley was undertaken in 1975 covering an area of approximately 5,000 acres below the elevation 800 contour. The survey documented polychrome pictographs at 2 sites and 33 gathering and processing sites, most of the latter being defined by bedrock milling features. The locations with pictographs were probably semipermanent occupation sites (Varner and Stuart, 1975). The sites have been badly damaged by agricultural activities (ibid.; Moratto, 1984).

### *Ethnography*

The San Joaquin River was a very important resource for the Native American people who lived along its reaches. Societies depended heavily on salmon and acorns for their subsistence, along with other plant foods, game, and other river fish. Foot trails along the San Joaquin River were important to the Mono people (Hindes, 1959). Western Mono had hamlets along major streams, including the San Joaquin, Kings, and Kaweah rivers, and traded across the Sierra Nevada for pine nuts.

Millerton Lake is at the approximate border between Foothill Yokuts traditional territory and traditional territory of the Western Mono or Monache people. Spier (1978a) indicated that the territory of the Northfork Mono extended into the upper part of Millerton Lake, but Spier also showed the area from Millerton to North Fork as territory of the Dumna Foothill Yokuts. Kroeber separated the Northfork Mono into two groups; an unnamed band north of the San Joaquin River and the Posgisa on Big Sandy Creek. He placed the Toltichi Foothill Yokuts along the San Joaquin River as far upstream as North Fork and identified another Foothill Yokuts group, the Kechayi, as having been on the south side of the San Joaquin River. Kroeber (1925) indicates that the village of Tsopotipau at the A. G. Wishon Powerhouse site belonged to Toltichi Yokuts. Rivers (1988), on the other hand, discusses the ethnography of the Millerton Lake area in some detail, and suggests that the Toltichi might have been Mono.

Yokuts currently live at the Table Mountain Rancheria in Friant. Northfork Mono now live primarily at the North Fork Rancheria, and the Posgisa live at the Big Sandy Rancheria in Auberry. The river at the SCE Big Creek No. 3 Powerhouse was a traditional fishing spot for Posgisa people from the Big Sandy Rancheria.

The lower portion of Fine Gold Creek is within traditional territory of either the Northfork Mono people (Spier, 1978a) or the Dumna/Toltichi Yokuts (Kroeber, 1925), while the upper portion of the drainage is in Chuckchansi Foothill Yokuts territory (Spier, 1978b). Some Northfork Mono hamlets are known to have been located on lower Fine Gold Creek (Gifford, 1932; Spier, 1978a). Chuckchansi people presently live on and around the Picayune Rancheria in Coarsegold.

Yokohl Creek is named after the Yokol or Yokod Yokuts, a band of Foothill Yokuts people who lived in the area. One of the most important natural resources for the Yokod was a diatomaceous earth used for white pigment, found on Rocky Hill (Hawshaw Shido, “Paint Place”) northwest of the potential dam site. Another important resource was steatite, mined near Lindsay Peak immediately south of the potential reservoir (Heizer and Treganza, 1944; Latta, 1949; Varner and Stuart, 1975). Von Werlhof (1961) documented information on Indian trails in the Yokohl Valley area. The majority of Southern Valley and Foothill Yokuts people now live on the Tule River Indian Reservation, near Porterville.

### History

Numerous archaeological sites testify to a long and varied use of the area by native peoples and indicate an important cultural, social, and economic link between the inhabitants of the western and eastern sites of the Sierra Nevada crest (USJRWPA, 1982c). American fur trappers entered the San Joaquin River drainage as early as 1827, and mining began along the river in 1850. In 1851, Fort Miller was established, and in 1852, a mining supply town called Rootville was settled. This later became Millerton, named after nearby Fort Miller. Millerton became County Seat in 1856 and held this status until 1874 when the County Seat moved to Fresno. Fort Miller was decommissioned in 1866 and became part of a cattle ranch. Friant Dam was constructed in the early 1940s.

One property of historic interest is a former State of California courthouse. This structure was relocated from an original site within present-day Millerton Lake when Friant Dam was constructed to its current location. Fairly diverse mining features occur around Temperance Flat. These features include remains from Chinese placer mining, an arrastra, and two mine portals associated with the Sullivan Mine, where mining began in 1853 and continued into the 1930s (Stammerjohan, 1979). On the north side of the river, the Patterson Mine presents an exceptionally diverse set of remains, including an arrastra, mine portals, remains of cabins, and can/equipment dumps. A two-stamp lift wheel and various other mining remains, including a ball mill, ore car, and rail tracks, are present near a contemporary cabin on the north side of the river a short distance upstream from the Patterson Mine. Wallace and Lathrap (1950) noted historic mining sites in the vicinity of Italian Bar, upstream of Redinger Lake.

The PG&E Kerckhoff Powerhouse, constructed in 1920, is a potentially significant historic property. The Wishon Powerhouse has been evaluated for eligibility on the NRHP, along with four other powerhouses associated with the PG&E Crane Valley Project. The structure is ineligible based on a loss of historic integrity (PG&E, 1986b). The SCE Big Creek Hydroelectric System long has been noted for its engineering significance (Redinger, 1949; Johnston, 1965; Myers, 1983) and may be eligible as a district for the NRHP (White, 1986; Shoup et al., 1988).

The general area of Granite, Jackass, and Chiquito creeks lies within 30 miles of the Casa Diablo Obsidian Source, one of the major sources of obsidian for populations living west of the Sierra Nevada crest and south of the Tuolumne River (USJRWPA, 1982c). The historic French Trail traverses across portions of the upper watershed, near Granite and Chiquito creeks (USJRP&WA, 1982).

Spanish soldiers and missionaries entered Yokohl Valley, and oral history suggests Spanish mining occurred in the area. Cattle and sheep were grazed in the valley as early as the 1850s, and permanent settlement began by the 1860s. Talc, magnetite, and granite were mined or quarried; oaks were cut and made into charcoal; and much historic activity occurred related to mixed farming and ranching (Varner and Stuart, 1975). During site reconnaissance in May 2002, a historic marker was seen noting that the Jordan Toll Trail ran through Yokohl Valley, providing access across the Sierra to Owens Lake and silver mines in the Coso Range. Rock walls were observed on the lower slopes of Rocky Hill, and piles of quarried granite and mounds of soil were seen closer to the stream.

## FUTURE WITHOUT-PROJECT BASELINES

Assessment of the magnitude of potential water resources and related problems and needs in the study area is not only based on the existing conditions described in this chapter, but also on an estimate of how these conditions may change in the future. Two baselines are being identified to help define the extent of potential resources problems/needs and for use in identifying the relative effectiveness of alternative plans to be formulated to address these problems/needs:

- **National Environmental Policy Act (NEPA) Baseline** – Under this without-project future condition, only actions reasonably expected to occur in the future would be included such as projects and actions that are currently authorized, funded, permitted, and/or highly likely to be implemented. The NEPA Baseline, commonly called the No-Action Alternative, includes the CEQA Baseline for existing conditions.
- **California Environmental Quality Act (CEQA) Baseline** – This baseline, commonly called the No-Project Alternative, is important for developing the EIR to meet requirements of CEQA. Under this baseline, future conditions are assumed to be similar to existing conditions.

Both the No-Action and the No-Project alternative will be defined in detail in the EIS and EIR. The projected effects of specific projects, actions, and policies in relationship to existing conditions will be developed in coordination with other CALFED programs through the Common Assumptions effort.

## FUTURE WITHOUT-PROJECT CONDITIONS

Summarized below are some of the expected physical, environmental, and socioeconomic conditions generally expected to occur in the future in the primary study area.

### Physical Environment

Physical conditions in the 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 (which are unlikely) hydrologic conditions will probably remain unchanged. Some speculation exists that regional hydrology would be altered should there be significant changes in global climatic conditions. Scientific work by others in this field of study is continuing.

Groundwater pumping, a major source of supply in the region, continues to increase in response to growing urban and agricultural demands. Over the long-term, groundwater extraction cannot continually meet the portion of water demands that are not met by surface water supplies without causing negative impacts on the groundwater basin. A serious consequence of long-term groundwater overdraft 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. 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 are expected to generally remain unchanged and similar to existing conditions.

Most of the air pollutants in the study area will 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.

## Biological Environment

Significant planning and management efforts are underway by numerous agencies and groups to protect and restore biological conditions throughout the primary study area. It is expected that significant efforts of Federal and State wildlife agencies will maintain populations of special status species in the study area at generally the same levels as existing conditions.

## Socioeconomic Environment

California's population is estimated to increase from about 34 million in 2000 to about 48 million by 2030. The population of the San Joaquin Valley is expected to increase from approximately 3.6 million people in 2000 to about 6.5 million people by 2030. In the San Joaquin River basin, the population is expected to nearly double from about 1.8 million to nearly 3.4 million by 2030. The ongoing rapid rate of urbanization in the region will generate significant land and water use challenges for the entire San Joaquin Valley.

One of the greatest current and future challenges is providing water in the right places at the right time. In the future, water management challenges will be more complex as demand patterns shift, environmental needs are better understood, and global climate change and other effects on the state's water resources and systems become more evident.

Water supply available for urban, agricultural, and environmental uses in any given year depends on rainfall, snow pack, runoff, carryover storage, pumping capacity from the Delta, regulatory constraints, and water management strategies implemented by water managers. Many different conditions or scenarios can develop, to which the water community will respond. Possible scenarios include two kinds of water use efficiency actions: those that water users take on their own (self-initiated water conservation), and those encouraged by water agency programs.

In the April 2005 Draft version of Bulletin 160, DWR describes the potential effects on future water demands that would result under three different future scenarios – a Current Trends scenario, a Less Resources Intensive scenario, and a More Resources Intensive scenario. Each scenario describes a different base condition for 2030 to which the water community would need to respond by implementing various management strategies. The Draft presents a portfolio of 25 resource management strategies that can be used to sustain California's communities, economy, and environment. New water storage is a critical component. Not only can new water storage improve water supply reliability and quality, it can enhance other strategies such as ecosystem restoration, conjunctive management, water transfers, and operation efficiency.

## Cultural Environment

Any cultural resources currently affected by erosion due to reservoir fluctuations would continue to be impacted. Fossils and artifacts located around the perimeter of existing reservoirs and other accessible locations within the primary study area will continue to be subject to collection by recreationalists.