# 5.6 Westside Groundwater Basin Resources

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This section describes the potential effects of the WSIP water supply and system operations and associated WSIP projects on the Westside Groundwater Basin and related water resources, including Lake Merced. The proposed water supply sources under the WSIP include 10 million gallons per day (mgd) of supply every year in all years (including nondrought periods) from implementation of conservation, water recycling, and groundwater supply programs in San Francisco; in addition, the proposed water supply option includes a long-term conjunctive-use program in the San Mateo County portion of the Westside Groundwater Basin, referred to as the South Westside Groundwater Basin, as part of the drought-year water supply for the regional system. The recycled water and groundwater components of this supply would be achieved through two WSIP projects, the Local and Regional Groundwater Projects (SF-2) and the Recycled Water Projects (SF-3), which are described in Chapter 3. The potential effects of the WSIP on the Westside Groundwater Basin and related resources are discussed in the context of ongoing activities in this area occurring among the SFPUC, City of Daly City, California Water Service Company (Cal Water, the municipal water purveyor to South San Francisco), and the City of San Bruno.

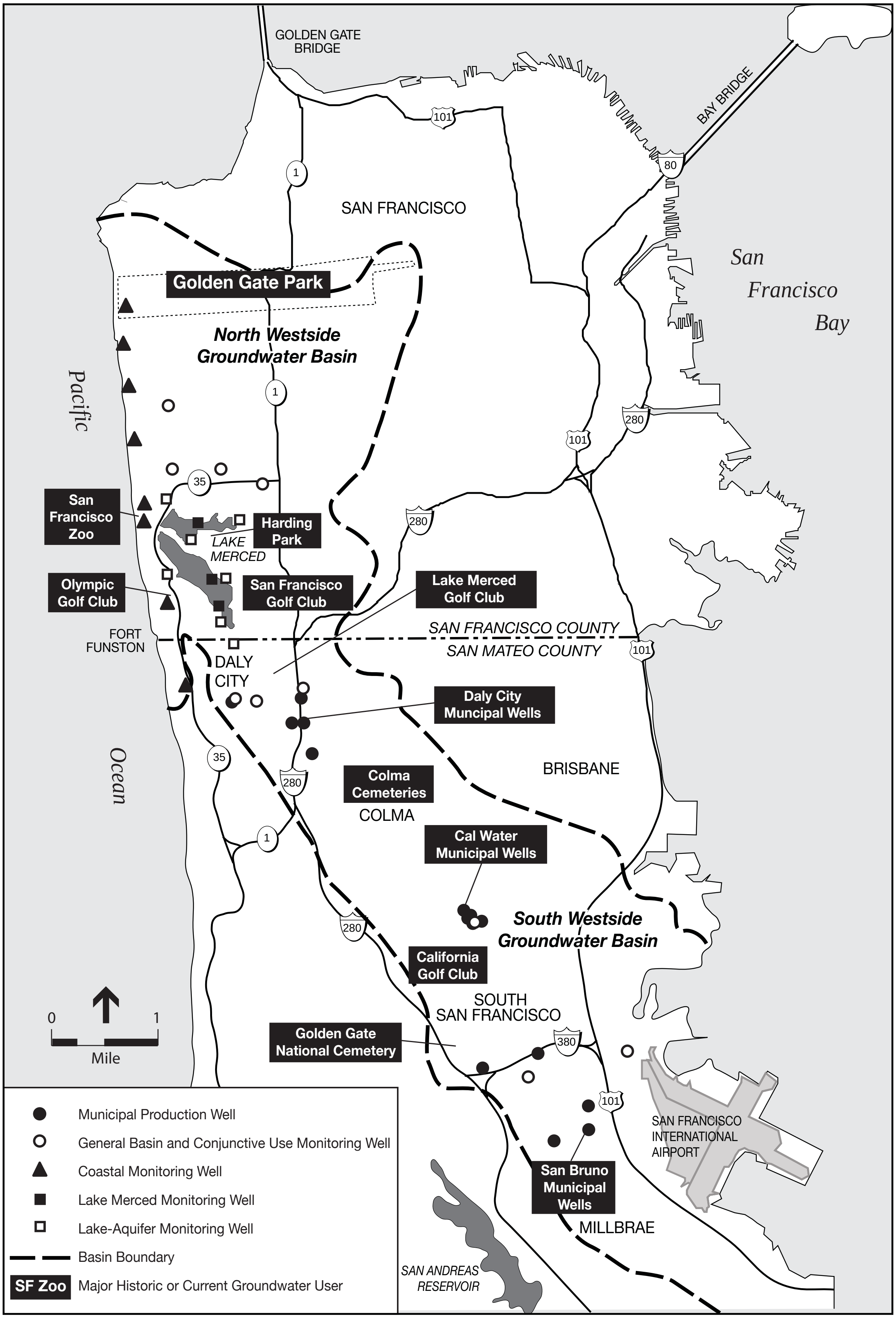
## 5.6.1 Setting

### 5.6.1.1 Westside Groundwater Basin

The Westside Groundwater Basin extends from San Francisco south to San Mateo County (**Figure 5.6-1**). With an area of about 45 square miles, this groundwater basin is the largest in San Francisco. The Westside Groundwater Basin is separated from the Lobos Basin to the north by a northwest-trending bedrock ridge through the northeastern part of Golden Gate Park (DWR, 2006). San Bruno Mountain and San Francisco Bay form the eastern boundary, and the San Andreas fault and Pacific Ocean form the western boundary. The southern limit of the Westside Groundwater Basin is defined by an area of high bedrock that separates it from the San Mateo Plain Groundwater Basin. The basin opens to the Pacific Ocean on the northwest and San Francisco Bay on the southeast. The portion of the Westside Groundwater Basin north of the San Francisco/San Mateo County line is referred to as the North Westside Groundwater Basin. The portion of the Westside Groundwater Basin south of the San Francisco/San Mateo County line is referred to as the South Westside Groundwater Basin.

#### *Geology*

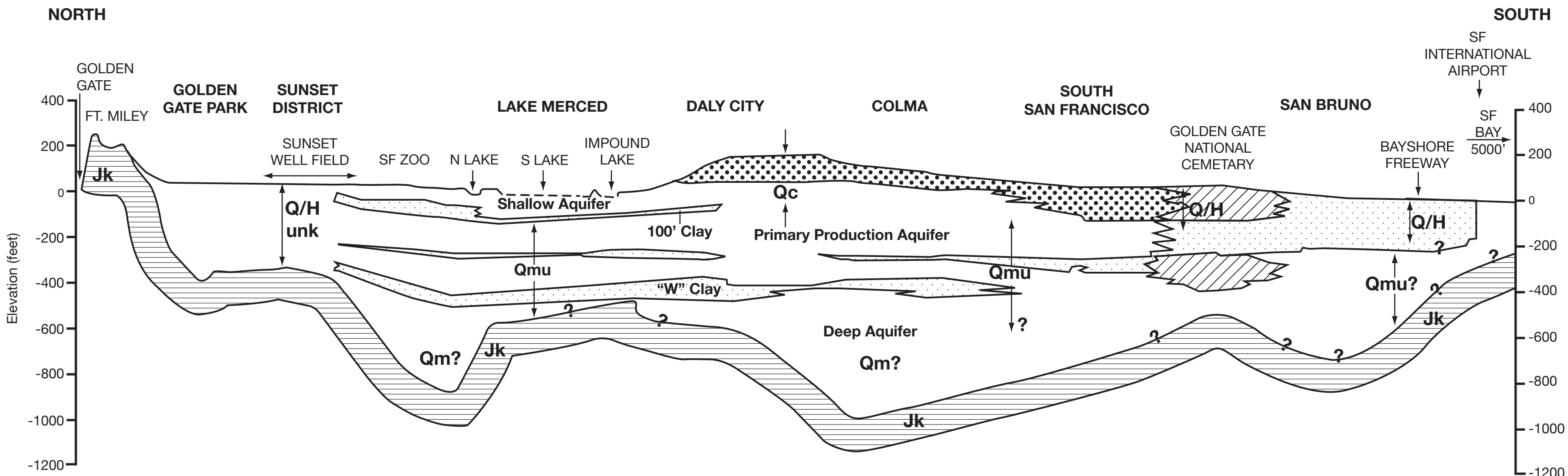
The four major geologic units in the Westside Groundwater Basin are the Mesozoic-age Franciscan Complex, Pleistocene-age Merced and Colma Formations, and the Pleistocene to recent Dune Sands, as illustrated in **Figure 5.6-2** (Luhdorff and Scalmanini, 2006). There are also minor but widespread units of recent alluvium along historical stream channels.




SFPUC Water System Improvement Program . 203287

SOURCE: Luhdorff & Scalmanini, 2006; ESA

**Figure 5.6-1**
Westside Groundwater Basin
Monitoring Network and
Major Production Areas



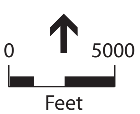

STRATIGRAPHIC UNITS*

| | |
|---|---|
| **Q/H** | Bay Clays |
| **Q/H unk** | Unknown Correlation |
| **Qc** | Colma Formation |
| **Qmu** | Upper Merced Formation |
| **Qm?** | Older Merced Formation-Middle, Lower |
| **Jk** | Franciscan Bedrock |

** Surficial units not shown*

CROSS SECTION LEGEND

- Blue Clay
- Blue & Gray Clay with Sand & Clay and Sand Beds
- Clay & Sand Red & Brown Soil Zone
- Sand, Sand & Gravel or Sandy Gravel
- Bedrock




Vertical Scale Exaggerated 12.5 times

SOURCE: Luhdorff & Scalamanini, 2006

SFPUC Water System Improvement Program . 203287

**Figure 5.6-2**
Regional Cross Section
Through Westside Groundwater Basin

Exposed in the low hills east and northeast of Lake Merced, the Franciscan Complex forms the basement rock for the aquifer system.[1] The surface of the bedrock slopes southwestward to Daly City, occurring at depths of almost 600 feet near the center of Lake Merced and nearly 1,000 feet beneath the southern portion of Daly City (SFPUC, 2005).

The Merced Formation comprises three units (lower, middle, and upper) and is the deepest water-bearing formation overlying the basement rock. The upper unit consists of a sequence of thin-bedded beach, dune, estuarine, and fluvial deposits of weakly consolidated fine sandstone with some gravel and mudstone beds. This unit is up to approximately 500 feet thick and is the primary water-producing aquifer in the basin (the primary production aquifer). The middle and lower units of the Merced Formation form the deep aquifer in the basin within the San Francisco and Daly City areas and are composed of fine sandstone, siltstone, and mudstone.

The majority of the surficial geologic units in the North Westside Groundwater Basin are composed of the Colma Formation and Dune Sands, which form the basin's shallow aquifer system. The Colma Formation is a surficial unit consisting of fine-grained sand with some clay, sand, and gravel beds of fluvial, floodplain, alluvial fan, and dune sand origin. Dune Sands are also a surficial unit of fine-grained sands with some clay soil horizons. The separation between these units and the Merced Formation is not clearly defined, thus preventing an accurate measurement of their thickness.

### *Aquifer System*

The portion of the Westside Groundwater Basin beneath San Francisco (the North Westside Groundwater Basin), has an area of approximately 14 square miles; it extends from Golden Gate Park to the San Francisco/San Mateo County line in the vicinity of Lake Merced and from the Pacific Ocean to inland bedrock exposures generally associated with Mount Sutro and Mount Davidson (SFPUC, 2005). This portion of the basin is characterized by relatively shallow depths to groundwater (5 to 60 feet) and, in the vicinity of Lake Merced and the San Francisco Zoo, is comprised of three aquifers[2] (see Figure 5.6-2). The shallow, unconfined aquifer in the Lake Merced area extends from the water table to the top of the "-100 ft clay" -- a clay layer at approximately 100 feet below sea level that separates the shallow aquifer from the underlying primary production aquifer in the Lake Merced area (Luhdroff and Scalmanini, 2006). The elevation of the water table in this area varies between 10 and 20 feet above mean sea level (msl).[3] The primary production aquifer (the main target for municipal and irrigation pumping in the basin) overlies the W-Clay, and the deep aquifer underlies the W-Clay. The -100-foot clay and W-Clay are aquitards[4] and appear to thin and pinch out beneath the Sunset District.

1 Basement rock is impermeable bedrock that restricts groundwater flow, forming the vertical boundaries of a groundwater basin, and sometimes the lateral boundary.

2 An aquifer is a geologic unit, typically composed of sand and gravel, that transmits and stores water and yields a substantial quantity of water to a well. In the Westside Groundwater Basin, aquifer materials are typically medium sand to fine sand.

3 Under a program of managed lake levels, future conditions are expected to be closer to the higher value in the range (i.e., 20 feet above msl).

4 An aquitard is a fine-grained unit (such as clay or silt) that restricts the vertical movement of groundwater. Where groundwater occurs beneath an aquitard, the aquifer is considered confined.

Two surface water features, Lake Merced and Pine Lake, are incised in the shallow aquifer. The lakes are in hydraulic continuity with the shallow groundwater, and water levels in the lakes generally reflect the shallow groundwater level. In the vicinity of Lake Merced, the primary production aquifer is confined. It is separated from the shallow aquifer by the -100-foot clay, and lower water levels in the primary production aquifer indicate the potential for flow from the shallow aquifer to the primary production aquifer.

The South Westside Groundwater Basin has an area of approximately 31 square miles (SFPUC, 2005) and is effectively the portion of the Westside Groundwater Basin that underlies Daly City, Colma, South San Francisco, San Bruno, Millbrae, and parts of Burlingame and Hillsborough. The northern portion of the South Westside Groundwater Basin which is beneath Daly City, Colma, South San Francisco, and San Bruno, is characterized by greater depths to groundwater (which can be over 300 feet). The -100-foot clay is absent in the Daly City area, and the aquifer system is composed of the primary production aquifer and deep aquifer (Luhdorff and Scalmanini, 2006). In the South San Francisco area, the W-Clay is absent, and the primary production aquifer is split into shallow and deep units separated by a fine-grained unit at an elevation of approximately 300 feet below mean sea level (msl). The primary production aquifer in the San Bruno area is at an elevation of less than 200 feet below msl and underlies a thick surficial fine-grained unit.

### 5.6.1.2 Monitoring Network and Program

There has been no regular historical analysis or reporting on groundwater conditions in the Westside Groundwater Basin (Luhdorff and Scalmanini, 2006). Over the last several years, however, the SFPUC, the City of Daly City, Cal Water, and the City of San Bruno have substantially increased data collection efforts and cooperative management of groundwater and interrelated surface water resources in the basin. Initial cooperative efforts among these four entities have included increased monitoring of groundwater and lake level elevations in the North Westside Groundwater Basin and the initiation of a semiannual basinwide monitoring program in the spring of 2000.

The San Mateo County Environmental Health Division managed the semiannual monitoring program until 2004, at which time the program was merged into the ongoing cooperative basinwide monitoring program. The basinwide monitoring program initially focused on the Lake Merced area, but has been expanded to include more of the basin as well as monitoring of coastal monitoring wells. The basinwide monitoring program currently includes semiannual to annual monitoring of the monitoring well network shown in Figure 5.6-1, which consists of 28 dedicated monitoring wells. Data from the monitoring program are used to evaluate coastal conditions and the potential for seawater intrusion, to define lake-aquifer interaction, and to assess general conditions in the basin resulting from ongoing pumping, the In-Lieu Recharge Demonstration Study (described in Section 5.6.1.9), and the recycled water program. Water-level measurements are collected manually on a quarterly or semiannual basis in some wells, or daily (or more frequently) through the use of electronic pressure transducers in other wells. The first comprehensive hydrogeologic report for the basin describes conditions in 2005 (Luhdorff and

Scalmanini, 2006), and further reports are intended to be prepared on an annual or biennial basis and serve as regular and complete reporting on all aspects of ongoing groundwater management activities in the Westside Groundwater Basin.

## 5.6.1.3 Groundwater Uses

While there has been some groundwater development in the North Westside Groundwater Basin (primarily for nonpotable irrigation), the South Westside Groundwater Basin has historically been the primary groundwater production area and continues to be used for a number of purposes. Major groundwater production areas in the Westside Groundwater Basin are shown in Figure 5.6-1 and discussed below.

### *North Westside Groundwater Basin*

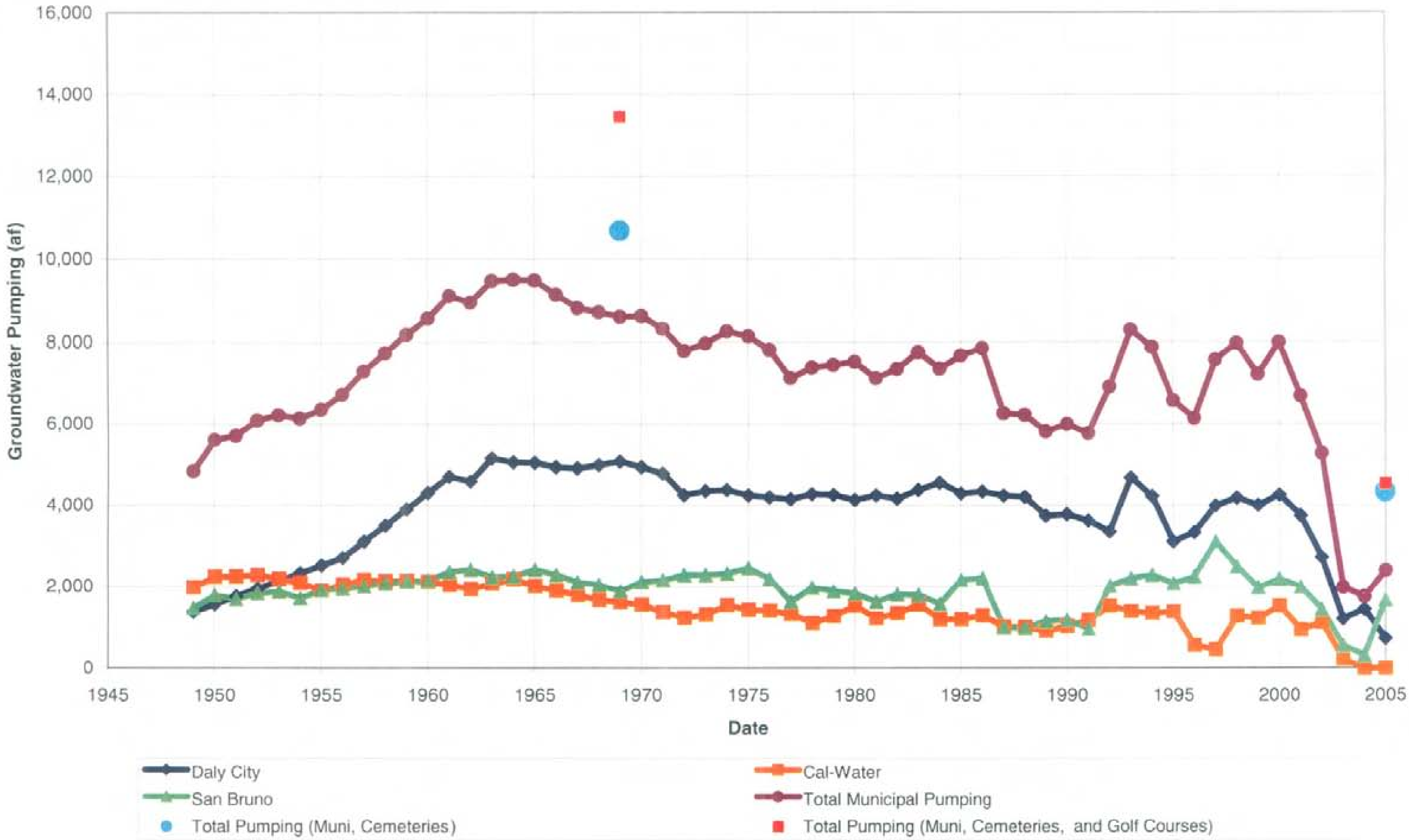
By the early 1900s, wells were drilled north, east, and south of Lake Merced for farming and drinking water supply (Luhdorff and Scalmanini, 2006). During that time, the Spring Valley Water Company had two wells located near the Lake Merced outlet that pumped about 0.1 mgd, or 100 acre-feet per year (afy).[5] At that time, the total of Lake Merced, Sunset District, and Golden Gate Park pumpage averaged 0.4 mgd (400 to 500 afy). In the early 1930s, the San Francisco Board of Public Works installed production wells in the Sunset District as an emergency water supply. Between 1930 and 1935, these wells pumped an average of 5 mgd (5,600 afy) from the Sunset District as an emergency water supply, but were discontinued after Hetch Hetchy water became available in the mid-1930s.

In 2005, groundwater in the North Westside Groundwater Basin was used for irrigation and other nonpotable uses, primarily 1.0 mgd (1,100 afy) at Golden Gate Park[6] and 0.4 mgd (400 afy) at the San Francisco Zoo. In addition, less than 0.02 mgd (13 afy) is used for other purposes, including 8 afy at the Edgewood School, and 5 afy in Stern Grove (Luhdorff and Scalmanini, 2006). As of 2005, there are no other substantial users of the North Westside Groundwater Basin.

### *South Westside Groundwater Basin*

Groundwater in the South Westside Groundwater Basin has been principally used for municipal and irrigation supply. Groundwater has been a source of water supply to Daly City, South San Francisco (through Cal Water), and San Bruno for about 50 years. Production well locations for each of these municipalities and other groundwater production areas are shown in Figure 5.6-1. Total pumping for metered municipal and estimated irrigation uses reached a combined maximum of approximately 12.8 mgd (14,300 afy) in the 1960s (Luhdorff and Scalmanini, 2006). As indicated in **Figure 5.6-3** and discussed below, total pumping from the South Westside Groundwater Basin (including municipal and irrigation uses) was about 4.1 mgd (4,600 afy) in

[5] One acre-foot is the volume of water required to cover one acre of land to a depth of 1 foot, or 325,851 gallons. The unit “acre-feet per year” is the number of acre-feet of water used in one year.
[6] Historical pumping rates for the Golden Gate Park wells are estimated. Recent installation of flow meters on two of the wells will allow more accurate measurement of the pumping rates of these wells in the future.




SOURCE: Luhdorff & Scalmanini, 2006

SFPUC Water System Improvement Program . 203287

**Figure 5.6-3**
Historical Pumping in the South Westside Groundwater Basin

2005. The major reasons for lower pumping in 2005 were that nearly all irrigation pumping around Lake Merced was replaced with recycled water and there was a temporary reduction in municipal pumping as part of the In-Lieu Recharge Demonstration Study (described in Section 5.6.1.9). In addition, there are some private wells within the basin, but the estimated amount of pumping by private well owners is small compared to municipal and irrigation pumping.

### Municipal Pumping

Historical municipal groundwater pumping by Daly City, Cal Water, and San Bruno, shown in Figure 5.6-3, reached a high of approximately 8 mgd (9,000 afy) in the mid-1960s and ranged between approximately 5.4 mgd (6,000 afy) and 7.1 mgd (8,000 afy) from the mid-1970s until 2001 (Luhdorff and Scalmanini, 2006). During implementation of the In-Lieu Recharge Demonstration Study from 2002 to 2005 (described in Section 5.6.1.9), total municipal pumping was decreased to an average of approximately 1.8 mgd (2,000 afy), as shown in **Figure 5.6-4**. Although the In-Lieu Recharge Demonstration Study has ended, Daly City continued to receive system water from the SFPUC in lieu of groundwater pumping under the conditions of a term sheet implemented in 2004 (SFPUC, 2004). In 2005, Daly City pumped approximately 0.6 mgd (700 afy) of groundwater. As of 2006, Cal Water had not resumed pumping and San Bruno had resumed pumping at rates of approximately 1.5 mgd (1,700 afy).

### Irrigation Pumping

Historical golf course and cemetery irrigation in the 1960s was previously estimated at about 4.7 mgd (5,300 afy) of groundwater,[7] and irrigation for three golf courses in the vicinity of Lake Merced (the Olympic Club, San Francisco Golf Club, and Lake Merced Golf Club) accounted for approximately 2.1 mgd (2,235 afy) of this amount (Luhdorff and Scalmanini, 2006). In 2005, irrigation pumping at these three golf courses was reduced to approximately 0.04 mgd (45 afy) when recycled water was made available from north San Mateo County (Daly City) as a substitute irrigation supply.

Other continued uses of irrigation pumping in the South Westside Groundwater Basin in 2005 were consistent with historical pumping rates and are estimated at up to 2.1 mgd (2,400 afy) of irrigation pumping for cemeteries in Colma, and 0.1 mgd (120 to 150 afy) of irrigation pumping for the California Golf Club[8] in South San Francisco (Luhdorff and Scalmanini, 2006). The Golden Gate National Cemetery in San Bruno has historically used groundwater for irrigation, but the cemetery has not been irrigated using groundwater for over 20 years (Schem, 2007).

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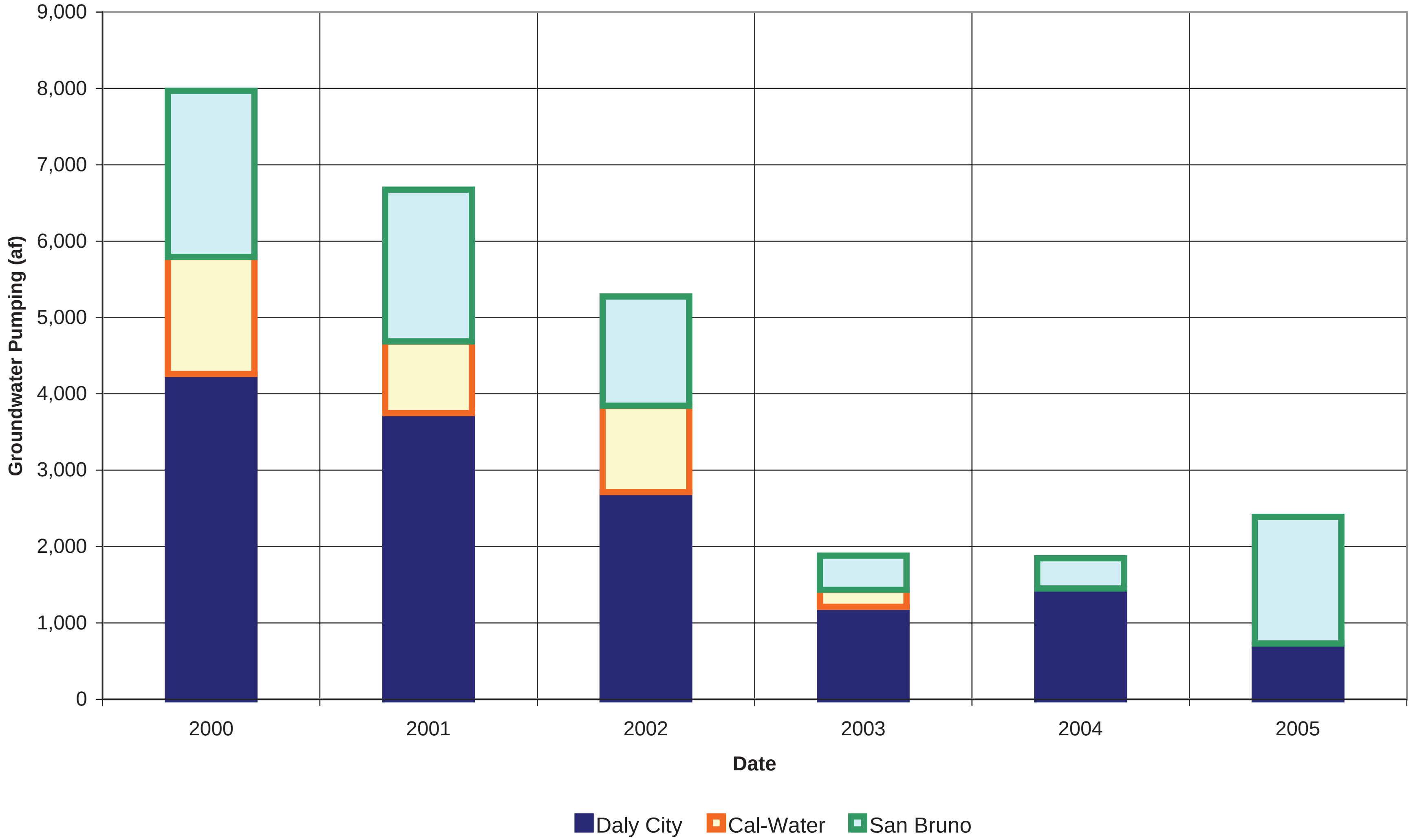
7 Historical irrigation pumping amounts were estimated. Recent metered use of recycled water at the Lake Merced area golf courses indicates that actual usage may have been less than previously estimated. Therefore, estimates of historical unmetered irrigation pumping may be high.

8 2005 estimated pumping rates for the California Golf Club were reduced from the historical estimate of 665 afy to 120–150 afy based on information on actual water use rates at the Lake Merced area golf courses obtained when metered recycled water was provided to these golf courses.




SOURCE: Luhdorff & Scalmanini

SFPUC Water System Improvement Program . 203287

**Figure 5.6-4**
Recent Municipal Pumping in
Westside Groundwater Basin

In all, irrigation pumping in the South Westside Groundwater Basin has recently been estimated at approximately 2.3 mgd (2,600 afy) in 2005 —a reduction of 2.4 mgd (2,700 afy) from a high of approximately 4.7 mgd (5,300 afy) in the 1960s. The principal reduction in irrigation pumping has been as a result of replacement of recycled water for irrigation purposes at the Lake Merced area golf courses.

#### Pumping from Private Wells

There are over 90 backyard wells in Hillsborough residential areas; most were installed during the 1987–1992 drought and serve multiple adjoining lots. In 2003, total pumping from these wells was estimated at 0.27 mgd (300 afy) (Yates, 2003). There are not likely a large number of private wells in the San Bruno to Daly City portion of the South Westside Groundwater Basin, which typically has small lot sizes with limited irrigation areas. Also, San Mateo County requires well setbacks from sewer lines, which make small lots more difficult to permit for water wells.

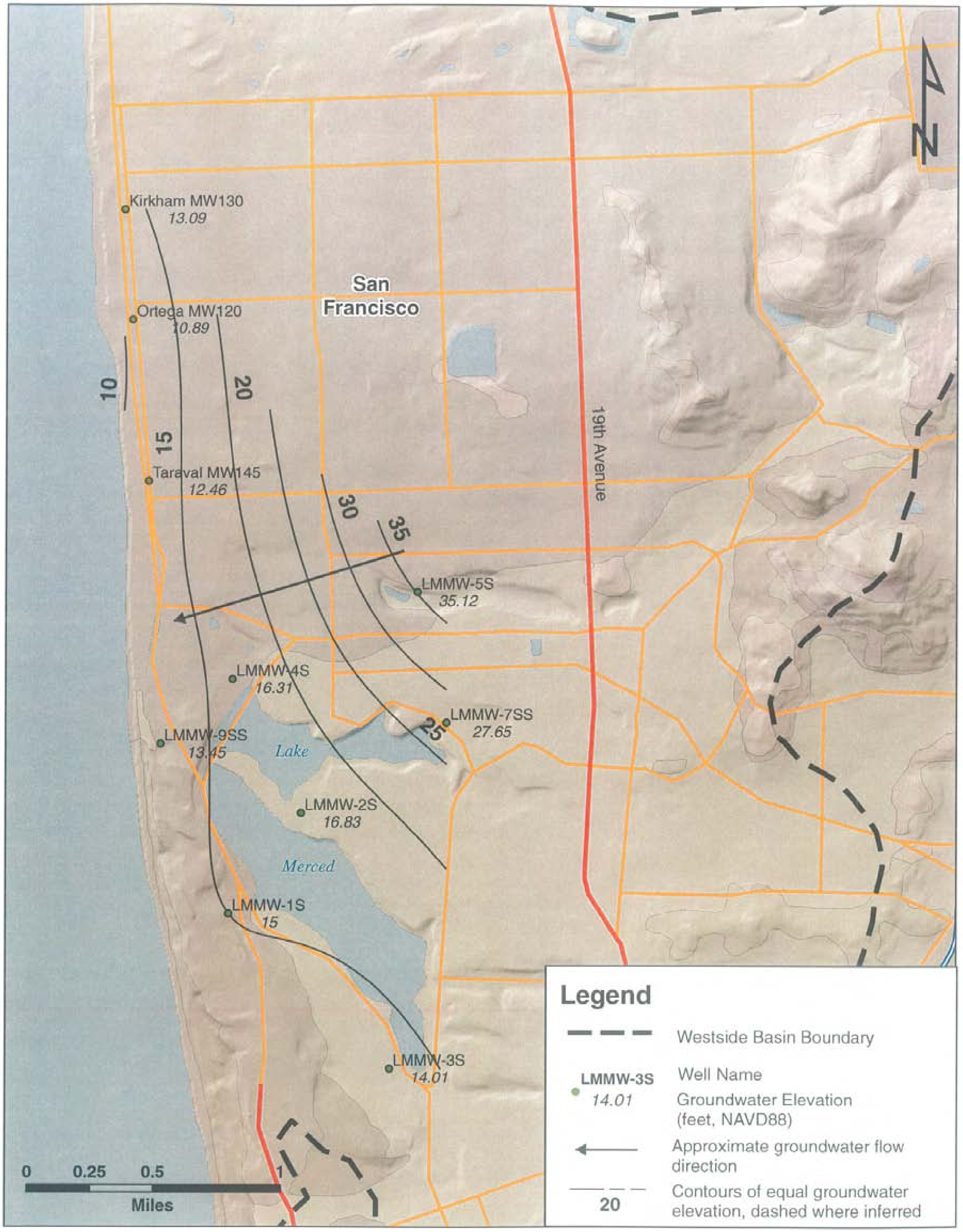
## 5.6.1.4 Groundwater Levels and Flow Directions

### *North Westside Groundwater Basin*

Prior to the early 1940s, water levels in the North Westside Groundwater Basin and in the northern portions of San Mateo County were above sea level, with a northwesterly gradient in the shallow and primary production aquifers (SFPUC, 2005). Based on regular monitoring of water levels in the North Westside Groundwater Basin since 2004 (see Section 5.6.1.2), groundwater levels remain above sea level in both aquifers, with the exception of primary production aquifer groundwater levels in the vicinity of the San Francisco Zoo. At the zoo, groundwater levels range from slightly above to slightly below sea level, probably due to pumping at the zoo (Luhdorff and Scalmanini, 2006).

Groundwater levels generally increased through 2005, most notably in the primary production aquifer in the vicinity of the zoo. The increase is possibly due to decreased pumping from this aquifer including reduced golf course irrigation pumping in the vicinity of Lake Merced and reduced municipal pumping in the South Westside Groundwater Basin under the In-Lieu Recharge Demonstration Study (discussed in Section 5.6.1.9). In 2005, the groundwater flow direction in both the shallow and primary production aquifers of the North Westside Groundwater Basin was westerly (see **Figures 5.6-5** and **5.6-6**); groundwater elevations ranged from 9 to 35 feet above msl in the shallow aquifer and from 5 to an estimated 100 feet above msl in the primary production aquifer.

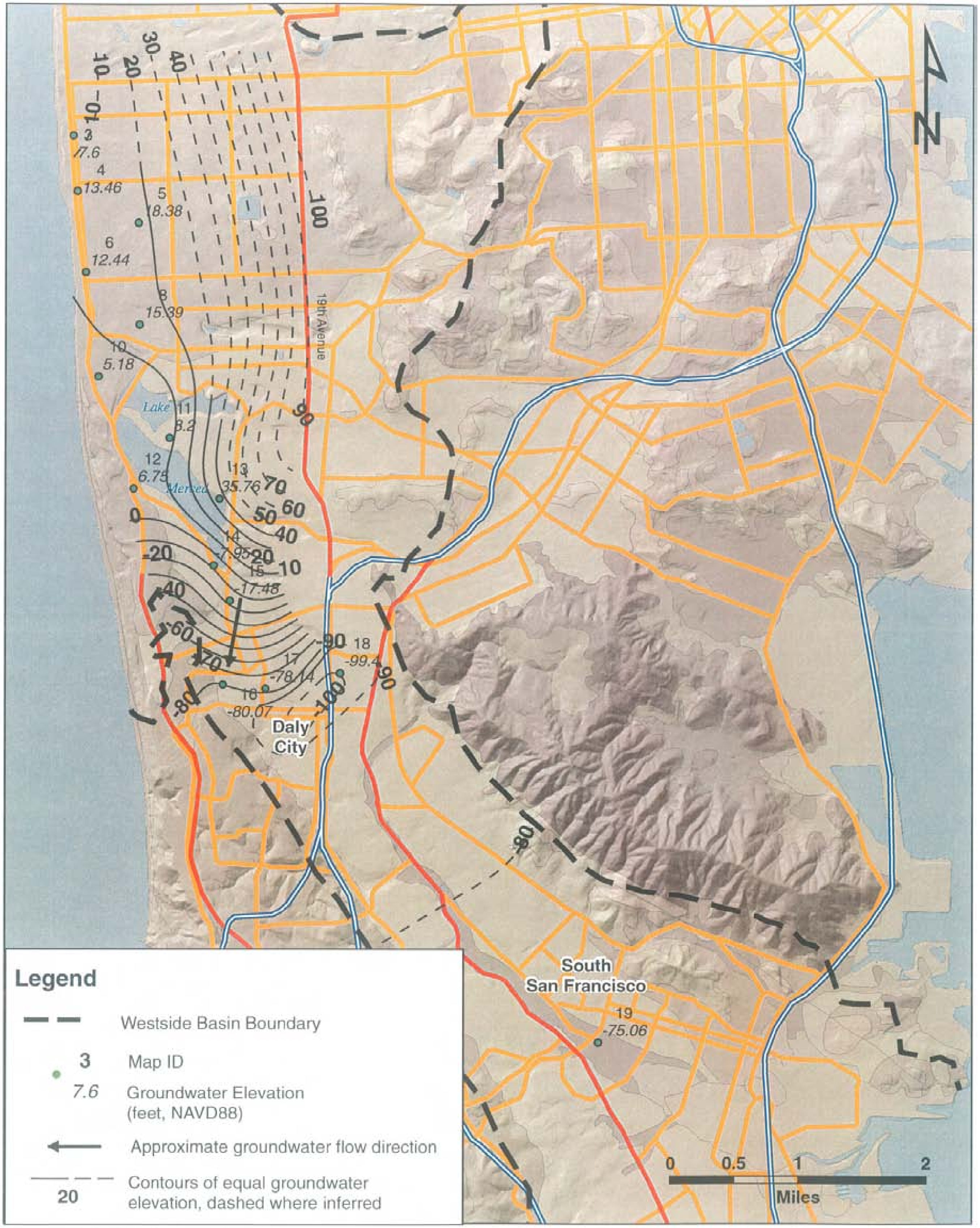
Coastal monitoring wells at Fort Funston and Thornton Beach indicate groundwater elevations above sea level in both the primary production and deep aquifer (the shallow aquifer is not present in this area). The aquifers at these locations appear to be hydraulically separated from the main portion of the Westside Groundwater Basin by faults and resultant steeply dipping geologic units, which act as hydraulic barriers to flow.




SOURCE: Luhdorff & Scalmanini, 2006

SFPUC Water System Improvement Program . 203287

**Figure 5.6-5**
Contours of Equal Groundwater Elevations
Shallow Aquifer, Spring 2005




SOURCE: Luhdorff & Scalmanini, 2006



**Figure 5.6-6**
Contours of Equal Groundwater Elevations
Primary Production Aquifer, Spring 2005

#### *South Westside Groundwater Basin*

Beginning in the 1950s and 1960s, groundwater levels in the South Westside Groundwater Basin declined to below sea level. This decline continued through the 1970s, after which groundwater levels stabilized at elevations of more than 100 feet below msl, resulting in vacated aquifer storage of up to 75,000 acre-feet in the Daly City, South San Francisco, and northern San Bruno areas (Kirker, Chapman & Associates, 1972; Luhdorff and Scalmanini, 2005).

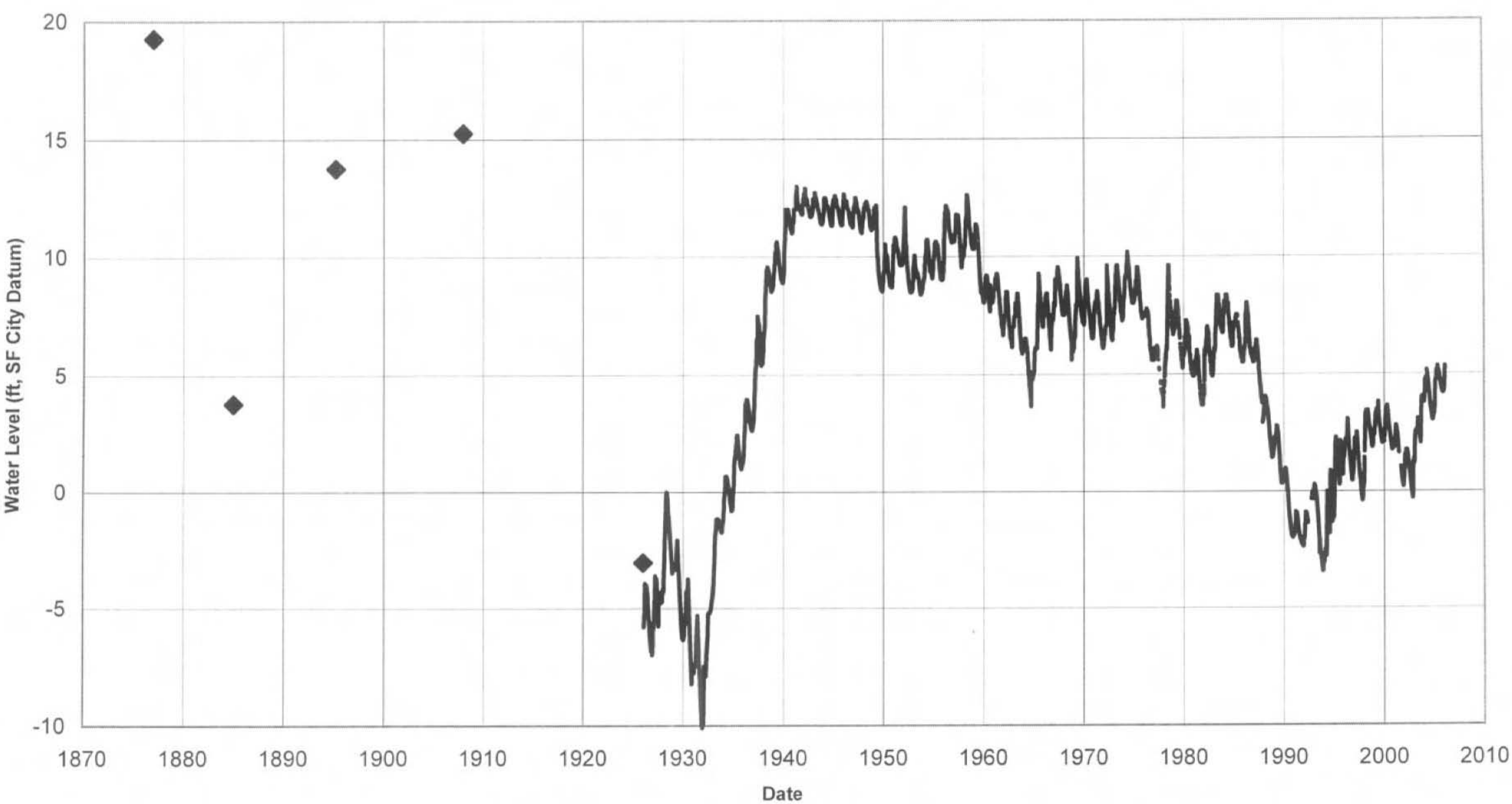
In 2005, groundwater elevations in the primary production aquifer in the South Westside Groundwater Basin ranged from approximately 8 feet below msl immediately south of Lake Merced to 102 feet below msl in Daly City and 75 feet below msl in South San Francisco (see Figure 5.6-6); groundwater flow in the vicinity of Lake Merced continued to be southerly and the steepest groundwater gradient was between Lake Merced and Daly City (Luhdorff and Scalmanini, 2006). On the bay side, groundwater levels in the primary production aquifer beneath San Bruno were approximately 180 feet below msl in 2005.

### 5.6.1.5 Lake Merced

The San Francisco Recreation and Park Department manages the recreational areas of the lake under a 1950 agreement with the SFPUC (SFPUC, 2007). The SFPUC manages the water aspects of the lake and has the ability to pump untreated water from South Lake into the SFPUC distribution system in an emergency. At one time, Lake Merced served as a municipal water supply source, with a water treatment plant on the north end of the Lake. The Lake has also served as an emergency water supply. However, Lake Merced has not been used as a potable water supply since the 1930s. Refer to Table 4.5-1 for a description of the existing beneficial uses of Lake Merced.

Lake Merced is now comprised of four lake bodies (North Lake, East Lake, South Lake, and Impound Lake), but until the early 1900s was one continuous body of water fed by local runoff and springs (Luhdorff and Scalmanini, 2006). The lake had an outlet to the Pacific Ocean through a stream at the northwestern end of North Lake. The primary sources of recharge to the lake bodies have historically been from spring discharge from the shallow aquifer, local runoff, and precipitation.

Lake Merced water levels have fluctuated greatly over the years and were substantially lowered by diversions in the 1920s and early 1930s during drought conditions (see **Figure 5.6-7**). Lake levels increased between the 1930s and 1960, but began declining again in 1960 and were experiencing an accelerated decline by the late 1980s. San Francisco and other stakeholders in the Westside Groundwater Basin have conducted investigations into the declining lake levels and concluded that the reduction in water levels since the 1960s is likely due to a number of factors, including groundwater pumping in the primary production aquifer and increased urbanization, which has reduced historical recharge to the lake from natural springs and diverted stormwater runoff from the lake to the combined sewer system (SFPUC, 2005).






SOURCE: Luhdorff & Scalmanini, 2006

SFPUC Water System Improvement Program . 203287

**Figure 5.6-7**
Long-Term Lake Level Hydrograph
Lake Merced (South Lake)

This reduction in subsurface recharge and runoff to the lake has resulted in a long-term decline in water levels and, in the short term, lake levels that are more sensitive to fluctuations in precipitation. In addition, lowered water levels in the shallow aquifer have caused a shift in the shallow groundwater flow direction (from northwesterly to southwesterly) and a corresponding reversal of current flow direction through the lake, away from the historical northwesterly lake outlet.

Public agencies and community members have generally agreed that higher water levels are desirable for Lake Merced. Between 2002 and the spring of 2004, water levels were restored to about 4 feet City Datum,[9] primarily through three additions of dechlorinated SFPUC system water (Luhdorff and Scalmanini, 2004). By December 2005, the lake elevation had further increased to about 5.5 feet City Datum, or nearly 17 feet above msl, due to above-average rainfall and the addition of a total of 34 acre-feet of treated stormwater delivered via the Vista Grande Canal as part of a Daly City pilot program to explore other potential sources for restoring lake levels. (Luhdorff and Scalmanini, 2006). Implementation of the In-Lieu Recharge Demonstration Study (described in Section 5.6.1.9) and local replacement of groundwater pumping with recycled water for irrigation at three Lake Merced area golf courses in the South Westside Groundwater Basin (described in Section 5.6.1.3) also indirectly contributed to the increase in Lake Merced water levels. The 2005 water level was the highest water level in almost 20 years. During the water additions, it was confirmed that Lake Merced is well connected to the shallow aquifer, but that large amounts of shallow groundwater did not percolate to the primary production aquifer (Luhdorff and Scalmanini, 2004).

The In-Lieu Recharge Demonstration Study and local replacement of groundwater pumping with recycled water for irrigation at three Lake Merced area golf courses in the South Westside Groundwater Basin have also resulted in an increase in groundwater levels in the primary production aquifer in the vicinity of Lake Merced. In 2005, groundwater levels in the shallow aquifer were in the range of 12 to 18 feet above msl; in the underlying primary production aquifer, groundwater elevations were deeper - in the range of 18 feet below to 8 feet above msl (Luhdorff and Scalmanini, 2006). Deeper groundwater levels in the primary production aquifer indicate a potential for flow from the shallow aquifer/lake system toward the underlying aquifer, from which nearby production wells withdraw water.

In July 2004, the SFPUC prepared the *Lake Level Management Plan*, which proposed to maintain the lake elevation between 3 and 5 feet City Datum through 2007 while a long-term plan is being developed to maintain the lake at an elevation (or range) to be determined. Since 2003, the SFPUC has maintained the lake levels between 3 and 5 feet City Datum through the activities described above. The SFPUC has not finalized all the details of the long-term plan, but has proposed 8.5 feet City Datum as the recommended lake elevation to be maintained by seasonal additions of supplemental water as required, allowing for seasonal lake level variations. Additional studies are underway under the Local Groundwater Projects (SF-2) to complete the evaluation of supplemental water sources to maintain the lake at the desired level.

9 San Francisco City Datum is a reference datum that has been used by San Francisco for surveying purposes since the early 1900s. To convert to the North American Vertical Datum of 1988 (approximately mean sea level), add 11.37 feet to City Datum.

## 5.6.1.6 Pine Lake

Pine Lake, one of San Francisco's few natural lakes, is located north/northeast of Lake Merced in the westernmost portion of Stern Grove and Pine Lake Park (Luhdorff and Scalmanini, 2006). It is a small, shallow lake approximately three acres in size. The lake has historically been overgrown with aquatic plants, which have been periodically removed. The San Francisco Recreation and Park Department is implementing a park improvement program for the Stern Grove and Pine Lake area. In November and December 2004, the San Francisco Department of Public Works augmented lake levels using groundwater pumped from a nearby well as part of a study to evaluate the rate of lake level decline following the addition of water. The study concluded that the lake level could be maintained at 31.5 feet by augmenting the lake with approximately 0.08 mgd of water from the existing well to make up for the loss of lake water, and that regular water additions might not be required in the rainy season (Bennett Consulting Group, 2005). During the test, the shallow groundwater elevation rose nearly 7 feet and stabilized at 31.6 feet msl, at which point it did not fluctuate in response to changes in lake levels. The Department of Public Works plans to begin full-scale replenishment of Pine Lake with groundwater from the primary production aquifer in May 2007 (Mosqueda, 2007).

## 5.6.1.7 Seawater Intrusion

Seawater or saltwater intrusion refers to the migration of higher density saltwater into a freshwater aquifer, which can occur when groundwater levels are lowered by pumping or other means. Seawater intrusion becomes an environmental problem when saltwater reaches a pumped well, making it unsuitable for its intended purpose, or when inland surface water features are affected by the saltwater, compromising habitats or beneficial uses of the surface water.

Coastal monitoring to the west of Lake Merced and north to Golden Gate Park indicates groundwater elevations above sea level and chloride concentrations of less than 40 milligrams per liter (mg/L), except near the zoo, where chloride concentrations are as high as 71 mg/L; based on these results, seawater intrusion is not occurring along the western boundary of the Westside Groundwater Basin (Luhdorff and Scalmanini, 2006). Even though the shallow aquifer in the North Westside Groundwater Basin is in direct connection with the ocean near the coastline, limited development of this portion of the groundwater basin and a groundwater gradient towards the ocean have prevented seawater intrusion in this area, with the exception of temporary effects on the shallow aquifer that occurred during dewatering for construction of the Oceanside Water Pollution Control Plant in the mid-1990s.[10]

Along the coastline to the south of Lake Merced, including Fort Funston and Thornton Beach, it appears that faulting and steeply dipping beds of the Merced Formation provide a physical barrier between the South Westside Groundwater Basin aquifer system and the Pacific Ocean; this barrier has prevented seawater intrusion, despite the fact that groundwater levels in Daly City

[10] Dewatering for construction of the Oceanside Water Pollution Control Plant resulted in a temporary reversal of groundwater gradients, allowing seawater to intrude into the shallow aquifer. However, once dewatering stopped, the induced landward gradient that allowed seawater to migrate into the shallow aquifer reversed, and the natural outflow of freshwater to the ocean resumed.

were lowered to over 120 feet below msl prior to implementation of the In-Lieu Recharge Demonstration Study (described in Section 5.6.1.9).

Seawater intrusion has not been documented along the bay side of the South Westside Groundwater Basin, although groundwater levels were over 200 feet below msl in the primary production aquifer prior to implementation of the In-Lieu Recharge Demonstration Study. It is understood that seawater intrusion in this area is impeded by a thick sequence of bay mud deposits that extend from San Francisco Bay into San Bruno and by a subsurface bedrock ridge below San Francisco International Airport that provides a further barrier to seawater intrusion. The City of San Bruno constructed two monitoring well clusters in 2006 along the bay side that have provided additional geologic information and allow for monitoring of groundwater levels and groundwater quality at different depths along the bay margin.

### 5.6.1.8 Groundwater Quality

With the exception of manganese and nitrate, groundwater quality in the Westside Groundwater Basin generally meets primary and secondary drinking water standards (Luhdorff and Scalmanini, 2006). In the North Westside Groundwater Basin, nitrate concentrations in the primary production aquifer have exceeded the primary maximum contaminant level of 45 mg/L in the Edgewood School production well and Elk Glen 2 well. In the South Westside Groundwater Basin, nitrate has exceeded this drinking water standard in the South San Francisco and Daly City areas.

In the North Westside Groundwater Basin, manganese concentrations have exceeded the secondary maximum contaminant level of 0.05 mg/L in the Edgewood School production well, the test well at the South Sunset Playground, in monitoring wells near the Central and Lake Merced Pump Stations, and in Golden Gate Park. In the South Westside Groundwater Basin, manganese has exceeded the secondary drinking water standard in San Bruno and Daly City in the untreated groundwater, but the water is treated to meet secondary standards prior to use in the water supply.

### 5.6.1.9 In-Lieu Recharge Demonstration Study

In the fall of 2002, Cal Water and the Cities of San Bruno and Daly City implemented the In-Lieu Recharge Demonstration Study in conjunction with the SFPUC to evaluate the potential increase in groundwater storage that could be achieved if groundwater pumping were replaced with system water from the SFPUC. As part of this project, each municipality reduced or stopped groundwater pumping. By the spring of 2005, groundwater levels in the primary production aquifer had risen but were still below sea level (Luhdorff and Scalmanini, 2005). The increased groundwater levels resulted in a flatter hydraulic gradient between Lake Merced and Daly City, and the total increase in groundwater storage was approximately 13,000 acre-feet through March 2005 (6,300 acre-feet in the Daly City area, 3,600 acre-feet in the South San Francisco area, and 3,000 acre-feet in the San Bruno area). These results indicate that in-lieu recharge can be employed to add water to storage in the northern part of the South Westside Basin, thus making use of the available aquifer storage for development of a large-scale conjunctive-use program.

## 5.6.1.10 Groundwater Management

### *Final Draft North Westside Groundwater Basin Management Plan*

In April 2005, the SFPUC prepared the *Final Draft North Westside Groundwater Basin Management Plan* (Groundwater Management Plan) (SFPUC, 2005) which addresses monitoring and stewardship of the groundwater basin and describes potential groundwater supply projects in the North Westside Groundwater Basin. At this time, the SFPUC does not propose to formally adopt the plan but is instead using the plan to help develop specific projects for implementation. The SFPUC is further developing the potential groundwater projects under the WSIP (local portion of Groundwater Projects, SF-2) through the preparation of a conceptual engineering report. The Groundwater Management Plan sets forth the following four management objectives, or goals, to address stewardship of the North Westside Groundwater Basin:

Goal 1: Development of Local Groundwater for San Francisco Water Supply
Goal 2: Avoidance of Overdraft and Saltwater Intrusion
Goal 3: Protection of Interrelated Surface Water Resources
Goal 4: Preservation of Groundwater Quality

The following 13 interrelated elements specified in the plan address these goals:

*Element 1: Monitoring of Groundwater Levels, Quality, Production, and Subsidence*. Expansion of the existing monitoring of groundwater levels, quality, and production to provide basic data on which to assess the condition of the groundwater basin and to assess the impacts of groundwater production on groundwater levels, groundwater quality, subsidence, and on surface waters.

*Element 2: Monitoring and Management of Surface Water Resources*. Continued and possibly expanded monitoring of surface water levels and quality, most notably at Lake Merced, to further the understanding of their interaction with groundwater.

*Element 3: Determination of Basin Yield and Avoidance of Overdraft*. Determination of the yield of the basin on both a regular (average annual) and an intermittent (dry year or emergency) basis in order to accomplish one of the primary objectives for the basin: that it be operated within its safe yield and thus not be overdrafted, and that it be effectively sustained as an ongoing reliable water supply without depletion of groundwater storage or degradation of quality.

*Element 4: Development of Groundwater to Augment SFPUC Municipal Water Supplies*. Exploration and development of groundwater for regular and dry period/emergency water supply, including possible development of water supply well sites in Golden Gate Park, in the Sunset District, near Stern Grove (Pine Lake), and in the vicinity of Lake Merced.

*Element 5: Initiation of Conjunctive-Use Operations*. Future pursuit of conjunctive-use program in the basin as a component or extension of the conjunctive use activities that have been initiated on a demonstration basis since late 2002 in the southern part of the basin, in Daly City, South San Francisco, and San Bruno, subject to agreement with these entities. A conjunctive use program would ideally take advantage of any vacated storage space by purposely recharging it with surplus surface water when it is available in wet years, and thus allowing the stored water to be recaptured by pumping during dry periods when surface supplies are decreased.

*Element 6: Integration of Recycled Water*. Incorporation of recycled water as a component of the nonpotable water supply in the basin, initially for recently initiated golf course irrigation and subsequently for other nonpotable uses, in order to reduce groundwater pumping for nonpotable uses and thus provide increased groundwater availability for regular as well as dry-period/emergency water supply.

*Element 7: Development and Continuation of Local, State, and Federal Agency Relationships*. Development and continuation of relationships with local, state, and federal agencies, primarily to continue cooperative efforts in the overall basin toward integrated data collection, initiation of conjunctive use, and development of supplemental water for augmentation of Lake Merced.

*Element 8: Continuation of Public Education and Water Conservation Program.* Continuation of public education and water conservation programs, primarily to inform interested groups on technical and related details about surface and groundwater details, to solicit public input to lake management and conjunctive-use planning, and to obtain community support for basin management actions.

*Element 9: Identification and Management of Recharge Areas and Wellhead Protection Areas*. Identification and management of recharge and wellhead protection areas.

*Element 10: Identification of Well Construction, Abandonment, and Destruction Policies*. Continued implementation of well construction, abandonment, and destruction policies, pursuant to the San Francisco Well Ordinance.

*Element 11: Identification and Mitigation of Soil and Groundwater Contamination*. Identification and mitigation of soil and groundwater contamination.

*Element 12: Groundwater Management Reports*. Preparation of regular and ad-hoc reports to complement a number of technical reports that have been prepared over the last decade on groundwater in the Westside Basin and its interrelationship with Lake Merced.

*Element 13: Provisions to Update the Management Plan*. Provisions to update the groundwater management plan, a recognition that the currently drafted plan reflects the most updated understanding of the occurrence of groundwater in the basin, but that the plan's elements could result in knowledge that suggests a change in currently planned management actions. This plan is intended to be a flexible document which can be updated to modify its existing elements and/or incorporate new elements as appropriate in order to recognize and respond to future groundwater and surface water conditions.

Maintenance of Lake Merced water levels and development of the North Westside Groundwater Basin as a municipal water supply under the Local Groundwater Projects (SF-2) would fulfill Elements 2 and 4 of the Groundwater Management Plan. Implementation of a long-term conjunctive-use program in the South Westside Groundwater Basin under the Regional Groundwater Projects (SF-2) would fulfill Element 5. Furthermore, implementation of the Recycled Water Projects (SF-3) would fulfill Element 6, increase groundwater availability in the North Westside Groundwater Basin, and alleviate demands on surface water supplies for irrigation purposes. The Groundwater Management Plan also contains elements specifying that the Groundwater and Recycled Water Projects would be implemented in a manner that preserves the quantity and quality of groundwater in the Westside Groundwater Basin, as well as requiring regular communication of results to the public, environmental groups, and local, state, and federal agencies, and obtaining input from these entities.

## 5.6.1.11 Regulatory Framework

### *Groundwater Quality*

The Porter-Cologne Water Quality Control Act (Division 7 of the California Water Code) provides the basis for water quality regulation in California. The act allows the state to adopt water quality control plans, which serve as the legal, technical, and programmatic basis of water quality regulation for a region. The *Water Quality Control Plan for the San Francisco Bay Basin*, known as the Basin Plan, was adopted in 1995 (with subsequent amendments) and is administered by the Regional Water Quality Control Board (RWQCB), San Francisco Bay Region (RWQCB, 1995).

The Basin Plan identifies the Westside Groundwater Basin as a "significant groundwater basin."[11] Agricultural water supply is identified as an existing beneficial use of the aquifer; municipal and domestic water supply, industrial process water supply, and industrial service water supply are identified as potential beneficial uses. However, groundwater has served municipal and industrial purposes in the Westside Groundwater Basin for decades. The beneficial uses serve as a basis for establishing water quality objectives and discharge prohibitions. The RWQCB is charged with protecting these uses from pollution and nuisance.

The Basin Plan also addresses groundwater protection and management. The groundwater program goals include: (1) identify and update beneficial uses and water quality objectives for each groundwater basin; (2) regulate activities that affect or have the potential to affect the beneficial uses of groundwater in the region; and (3) prevent future impacts on the groundwater resource through local and regional planning, management, and education.

California has adopted the "Statement of Policy with Respect to Maintaining High Quality of Waters in California," known as the Antidegradation Policy, which prohibits actions that tend to degrade the quality of groundwater. The San Francisco Bay RWQCB performs oversight of this policy. The policy requires the continued maintenance of existing high-quality water and outlines the conditions under which a change in water quality is allowable. The conditions for an allowable change in water quality include the following:

- A change must be consistent with maximum benefit to the people of the state.
- A change must not unreasonably affect present and anticipated beneficial uses of water.
- A change must not result in water quality less than that prescribed in water quality control plans or policies.

[11] The San Francisco Bay RWQCB adopted groundwater basin plan amendments at its April 19, 2000 board meeting. These amendments are still subject to approval by the State Water Resources Control Board and the State Office of Administrative Law. Designation as a significant groundwater basin is based on the adopted groundwater basin plan amendments.

### *Wellhead Protection*

In 1999, the California Department of Health Services established the Drinking Water Source Assessment and Protection (DWSAP) program to protect sources of drinking water, in accordance with Section 11672.60 of the California Health and Safety Code. The DWSAP program includes both a source water assessment program and a wellhead protection program as required by the federal Safe Drinking Water Act.

The DWSAP program includes two components: a mandated drinking water source assessment and a voluntary source water protection program. The drinking water source assessment is the first step and includes a delineation of the area around a drinking water source through which contaminants might move and reach that drinking water supply; an inventory of possible contaminating activities that might lead to a release of microbial or chemical contaminants within the delineated area; and a determination of possible contaminating activities to which the drinking water source is most vulnerable. Source water protection is not a mandated element of the DWSAP program, but is required for a complete wellhead protection program. To address this, the second step in the DWSAP program is the voluntary development and implementation of a source water protection program, which affords a public water system or community the opportunity to build on work performed for the drinking water source assessment.

### *Well Permitting Requirements*

The agencies responsible for permitting well construction within the Westside Groundwater Basin are the San Francisco Department of Public Health (North Westside Groundwater Basin) and the City of Daly City and San Mateo County Environmental Health Division (South Westside Groundwater Basin). San Francisco and San Mateo County well permitting regulations contain conditions to ensure that basin overdraft would not occur as a result of construction of a new well. Chapter 13.20 of the Daly City Municipal Code specifies well permitting requirements for Daly City. Although this code does not include provisions related to overdraft of the Westside Groundwater Basin, Section 13.20.070 allows for denial of a permit when the request is judged not to be in the public interest.

In accordance with Article 12B of the San Francisco Health Code, the Department of Public Health refers permit applications for water wells to the San Francisco Planning Department for an environmental determination under CEQA. Following CEQA review, the applicant must obtain approval from the SFPUC authorizing the withdrawal of groundwater. For the purposes of managing groundwater resources in San Francisco, the operator of the well must comply with any conditions or restrictions on use of the water well imposed by the SFPUC or as mitigation measures by the Planning Department. Failure to reach an agreement with the SFPUC for the operation of a proposed water well would result in denial of the water well permit application by the Department of Public Health, and failure to comply with the conditions or restrictions on use of the water well would result in revocation of the permit.

In accordance with Section 4.68.225 of the San Mateo County Code, the San Mateo County Environmental Health Division would not grant a well permit for a large well[12]

[12] A large well means any individual well that pumps an amount equal to or greater than 50 gallons per minute or 1,000 gallons per day, or multiple small wells on the same land use parcel which cumulatively pump an amount equal to or greater than 50 gallons per minute or 1,000 gallons per day.

that could potentially cause overdraft of the South Westside Groundwater Basin or be located in an area subject to a specific and localized groundwater problem. The Environmental Health Division could also deny, revoke, or suspend a permit for a large well to avoid pollution or contamination of water resources.

## 5.6.2 Impacts

### 5.6.2.1 Significance Criteria

The City and County of San Francisco has not formally adopted significance standards for impacts related to groundwater, but generally considers that implementation of the proposed program would have a significant impact on groundwater if it were to:

- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of preexisting nearby wells would drop to a level that would not support existing land uses or planned uses for which permits have been granted)
- Potentially result in onsite or offsite land subsidence that would cause substantial structural damage, increased flooding, or altered drainage patterns
- Violate any water quality standards or waste discharge requirements
- Otherwise substantially degrade water quality

Criteria for evaluating the depletion of groundwater resources are based on whether groundwater pumping would reduce groundwater levels to a degree such that adverse effects would occur, including saltwater intrusion, effects on surface water resources, or land subsidence. Criteria for evaluating groundwater quality are based on beneficial uses and water quality objectives established by the RWQCB in the Basin Plan, as authorized under the Porter-Cologne Water Quality Control Act and Clean Water Act. In addition, for groundwater to be used as a public water supply, groundwater quality evaluation criteria are based on the California Drinking Water Standards, as established by the state and federal Safe Drinking Water Acts.

### 5.6.2.2 Approach to Analysis

This section assesses program-level impacts of the proposed water supply option with respect to the recycled water and groundwater projects in San Francisco and the Westside Basin conjunctive use program on the groundwater resources of the Westside Groundwater Basin and associated surface water resources. The analysis is based on the WSIP proposed actions as implemented through Local and Regional Groundwater Projects (SF-2) and Recycled Water Projects (SF-3) based on project description information presented in Chapter 3 and Appendix C. It also identifies groundwater management activities planned as part of the projects or proposed as mitigation measures to ensure that impacts on groundwater and associated surface water resources are less than significant. Potential impacts and their significance determinations are summarized in

**Table 5.6-1**. More detailed analysis of the Groundwater and Recycled Water Projects will be conducted during subsequent, project-level environmental review. Chapter 4, Section 4.5 evaluates the program-level impacts related to construction and operation (not including long term operational effects on groundwater resources) of the Groundwater and Recycled Water Projects.

### *Impact Summary*

Table 5.6-1 presents a summary of the impacts on Westside Groundwater Basin groundwater and surface water resources that could result from implementation of the proposed water supply and system operations.

**TABLE 5.6-1**
**SUMMARY OF IMPACTS – WESTSIDE GROUNDWATER BASIN**

| | Significance Determination | |
|---|---|---|
| **Impact** | **North Westside Groundwater Basin** | **South Westside Groundwater Basin** |
| **Impact 5.6-1:** Basin overdraft due to pumping from the Westside Groundwater Basin | PSM | LS |
| **Impact 5.6-2:** Changes in water levels in Lake Merced and other surface water features, including Pine Lake, due to decreased groundwater levels in the Westside Groundwater Basin | PSM | N/A |
| **Impact 5.6-3:** Seawater intrusion due to decreased groundwater levels in the Westside Groundwater Basin | PSM | LS |
| **Impact 5.6-4:** Land subsidence due to decreased groundwater levels in the Westside Groundwater Basin if the historical low water levels are exceeded | LS | LS |
| **Impact 5.6-5:** Contamination of drinking water due to groundwater pumping in the Westside Groundwater Basin | PSM | PSM |
| **Impact 5.6-6:** Drinking water contaminants above maximum contaminant levels and adverse effects of adding treated groundwater to the distribution system | LS | LS |

LS = Less than Significant impact, no mitigation required
PSM = Potentially Significant impact, can be mitigated to less than significant
N/A = Not Applicable

### *Impact Discussion*

**Impact 5.6-1: Basin overdraft due to pumping from the Westside Groundwater Basin.**

Excessive groundwater pumping that results in a prolonged and continual lowering of groundwater levels is referred to as basin overdraft. Overdraft in the Westside Groundwater Basin could cause a number of deleterious effects, including decreased water levels in surface waters (such as Lake Merced), seawater intrusion, and/or land subsidence. Management of groundwater resources entails implementing an operating strategy that limits and/or spatially distributes groundwater pumping so that overdraft conditions and related adverse effects do not occur in the groundwater basin.

#### North Westside Groundwater Basin

The proposed water supply option would include installation of up to four primary production and deep aquifer production wells in San Francisco to provide a total of 2 mgd of annualized production rate, as implemented through Local Groundwater Projects (part of SF-2). Candidate well sites include the Lake Merced Pump Station, South Sunset Playground, West Sunset Playground, and Golden Gate Park. Alternate locations under consideration are the Central Pump Station and the Francis Scott Key Annex. In addition, other sites may be identified during project design and would be evaluated during project-level environmental review. Existing irrigation wells at the San Francisco Zoo, Golden Gate Park, and/or other locations would provide an additional production rate of 2 mgd of water supply for the regional system once recycled water is available to provide replacement irrigation water at these sites (to be developed under the Recycled Water Projects, SF-3). The San Francisco Zoo well was modified and commissioned for emergency use in 2006, and an existing well at Golden Gate Park could also be modified to provide emergency supply to local residents in the event of a major earthquake or other disaster. Once these projects are implemented, up to 0.5 mgd (560 afy) of pumping for nonpotable uses would continue in the North Westside Groundwater Basin for uses such as irrigation of sensitive plants in Golden Gate Park and water for some animal exhibits at the San Francisco Zoo.[13]

With full implementation of the WSIP, production of up to 4 mgd (4,500 afy) under the Local Groundwater Projects (SF-2) and continued nonpotable pumping of 0.5 mgd (560 afy) would be the major groundwater use in the North Westside Groundwater Basin once irrigation pumping is replaced with recycled water at the San Francisco Zoo and Golden Gate Park; thus, the maximum total annual pumping by 2030 is estimated to be 5,060 afy. Based on water years 1987 and 1988, the annual recharge to this basin was estimated at 4,850 afy (Phillips et al., 1993). However, this analysis was done during the first two-years of an on-going drought and therefore is considered to be a low estimate of groundwater recharge to the North Westside Groundwater Basin relative to average conditions. Estimates of recharge to the basin are being refined as part of ongoing groundwater modeling efforts on behalf of the SFPUC, and this analysis indicates that recharge to the basin could range from about 4,850 afy to 6,950 afy (Luhdroff and Scalmanini, 2007).

The total proposed pumping rate of 4.5 mgd (5,060 afy) would be within the range of recharge to the groundwater basin. However, because it exceeds the lower end of the range, and the studies indicating the range have not been completed at this program-level of analysis, potential impacts related to depletion of groundwater resources in the North Westside Groundwater Basin would be considered *potentially significant*. Under this program-level determination, implementation of Measure 5.6-1, Groundwater Monitoring to Determine Basin Safe Yield, would reduce this impact to a less-than-significant level. This measure requires determination of the basin’s yield on both a regular (average annual) and an intermittent (dry-year or emergency) basis, in accordance with Element 3 of the Groundwater Management Plan, as well as implementation of water level

[13] Pumping rates for nonpotable purposes may actually be less than estimated if recycled water is found to be of suitable quality for these uses.

and quality monitoring, as specified in Element 1 of the Groundwater Management Plan. The measure is designed to have the SFPUC monitor the effects of pumping from the North Westside Groundwater Basin, and to use the monitoring data to inform decisions regarding appropriate pumping patterns to avoid overdraft and the undesirable effects associated with overdraft. The SFPUC would undertake a more detailed analysis of the basin yield and may refine the mitigation as part of the project-level CEQA review on the Local Groundwater Projects (SF-2).

Emergency groundwater pumping rates could temporarily exceed the average sustainable yield of the aquifer. During emergencies, the potential for adverse pumping effects would depend on the magnitude and duration of the emergency event, but any effects on groundwater that did occur would be localized and short term. They would not be of a long-term nature that would result in overdraft. In addition, wells installed under the Local Groundwater Projects (SF-2) would be located and operated to avoid interference[14] with the operation of existing wells at Golden Gate Park, the San Francisco Zoo, Edgewood School, and Stern Grove (Pine Lake), the current users of groundwater in the North Westside Groundwater Basin. Ultimately, however, most of water supplied by the Golden Gate Park and San Francisco Zoo wells would be replaced with recycled water produced under the Recycled Water Projects (SF-3).

### South Westside Groundwater Basin

As discussed in the Setting, municipal and irrigation pumping has historically reduced groundwater levels in the South Westside Groundwater Basin to elevations of 100 to 200 feet below msl, resulting in an estimated 75,000 acre-feet of vacated aquifer storage in the Daly City, South San Francisco, and northern San Bruno areas. Under the WSIP's proposed water supply option (i.e., Regional Groundwater Projects, SF-2), the SFPUC would implement a long-term conjunctive-use program in coordination with Daly City, Cal Water, and San Bruno (referred to as the participating pumpers) to take advantage of this vacated aquifer storage and to increase groundwater levels in the South Westside Groundwater Basin.

Under this program, the SFPUC would provide potable water from the regional system to the participating pumpers during nondrought conditions when there are sufficient surface water supplies to substitute for groundwater currently used for municipal purposes. As a result, the participating pumpers would reduce their groundwater pumping by a comparable amount and allow the groundwater basin to recharge naturally. Therefore, during nondrought years, there would be a larger quantity of groundwater in the South Westside Groundwater Basin due to the in-lieu recharge resulting from deliveries of SFPUC system water and correspondingly reduced groundwater pumping. This increased quantity of groundwater basin during nondrought years is referred to as "banked" water. During drought conditions, the SFPUC would be able to reduce the quantity of SFPUC system water delivered to the participating pumpers, and the stored groundwater, or banked water, would be available for local use to supplement supplies from the regional water system.

As part of the proposed program, the SFPUC and the participating pumpers would enter into an operating agreement(s) specifying the terms and conditions of groundwater storage and

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[14] Well interference is the lowering of groundwater levels in one well due to pumping-induced drawdown in another well, thus reducing the capacity of the well or lowering water levels below the intake interval.

withdrawals (see Chapter 3, Section 3.14, Required Actions and Approvals) to ensure that adverse conditions do not occur under the Regional Groundwater projects (SF-2). Under the proposed agreement(s) the SFPUC would have a right to store up to 61,000 acre-feet of groundwater in the South Westside Groundwater Basin. The SFPUC would construct about 10 new groundwater production wells in San Mateo County with the capacity to develop about 7 mgd (or nearly 8,100 afy) of potable groundwater as a supplemental drought-year supply for the participating pumpers. [15] During drought conditions, the participating pumpers would be able to pump the amount of surface water delivered by the SFPUC during nondrought years, the banked quantity of groundwater. Because groundwater withdrawals would be restricted to the amount of water banked under the Regional Groundwater projects, groundwater levels as a result of implementation of the proposed conjunctive-use program would be expected to be consistently in a range higher than those that have resulted from long-term historical groundwater pumping.

The proposed operating agreement(s) would also specify that an operating committee be established to develop annual operating maintenance plans and an annual operating schedule projecting groundwater storage and/or extraction from the SFPUC's storage account. The operating committee would be composed of representatives from the SFPUC and the participating pumpers and would also provide an accounting of water stored in and extracted from the SFPUC storage account and confirm compliance with water delivery accounting.

The conjunctive-use program would consider the potential effects of all other pumpers in the South Westside Groundwater Basin, particularly the participating pumpers as well as irrigation pumping by cemeteries and golf courses. Monitoring and modeling would also be conducted to assess the conjunctive-use program's performance and to identify and avoid potential problems. Based on monitoring data and modeling results, conjunctive-use management strategies would be adjusted and implemented as necessary to avoid adverse conditions.

Overall, the conjunctive-use program under the Regional Groundwater Projects (SF-2) would be designed to take advantage of vacated aquifer storage that has become available as a result of historical groundwater pumping in the South Westside Groundwater Basin. An operating agreement(s) would be executed with the participating pumpers outlining allowable operating parameters for pumping during drought periods to avoid long-term adverse conditions; an operating committee would be formed to develop annual operating maintenance plans as well as an annual operating schedule; and groundwater monitoring and modeling would be conducted to identify the potential for adverse conditions and inform decisions to modify the recharge or pumping strategy in response to changing conditions over time. Therefore, programmatic impacts related to basin overdraft and associated adverse conditions are considered *less than significant* for the South Westside Groundwater Basin. The SFPUC would conduct a more detailed analysis

[15] As described in Chapter 3, Section 3.6, the proposed water supply option under the WSIP assumes the use of the extraction component of the conjunctive-use program during drought years. The program is being designed to provide an extraction capacity of approximately 8,100 acre-feet of water during a drought year (an equivalent of about 7 mgd). The initiation of the extraction component of the conjunctive use program occurs as the first response to an anticipated drought. However, the realization of a drought does not typically occur until the second year of a dry sequence, thus in the 8.5-year Design Drought groundwater pumping would only occur for 7.5 years. Although pumping over this 7.5 year period would be about 7 mgd, the equivalent amount of pumping over 8.5 years is 6 mgd.

of the conjunctive-use program as part of the project-level CEQA review on the Regional Groundwater Projects (SF-2).

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**Impact 5.6-2: Changes in water levels in Lake Merced and other surface water features, including Pine Lake, due to decreased groundwater levels in the Westside Groundwater Basin.**

### North Westside Groundwater Basin

As discussed in the Setting, water levels in Lake Merced have declined over the past 50 years, and Pine Lake has also experienced water level declines. Investigation by the SFPUC into the interrelationship between these lakes and groundwater has been a major focus over the past 5 to 10 years, and has included installation of dedicated monitoring facilities in the individual Lake Merced lakes as well as numerous monitoring wells around and near Lake Merced and Pine Lake. Analysis of the lake-aquifer system at Lake Merced to date indicates that the lake system can be separately managed by adding water to achieve a desired lake level, or range of levels, while also pumping from the underlying primary production aquifer (SFPUC, 2005).

The Local Groundwater Projects under SF-2 would include the addition of some combination of treated stormwater, recycled water, groundwater, and/or dechlorinated SFPUC system water to restore and maintain Lake Merced at the desired level(s). Maintenance of water levels would be expected to beneficially affect the North Westside Groundwater Basin by contributing additional recharge to the shallow aquifer. Furthermore, implementation of the long-term conjunctive-use project (the Regional Groundwater Projects under SF-2) and cessation of irrigation pumping in the vicinity of Lake Merced (already accomplished, as described in the Setting) would allow groundwater levels in the primary production aquifer to the south of Lake Merced to rise, which would reduce the long-term effects of historical groundwater pumping on groundwater levels in the shallow aquifer.

Because the primary production aquifer is not in direct hydraulic connection with the shallow aquifer in the Lake Merced vicinity or with Lake Merced, proposed pumping from the primary production aquifer under Local Groundwater Projects (SF-2) is not expected to have a direct effect on lake levels, but could potentially cause an indirect effect. Shallow groundwater levels could decline due to flow from the shallow aquifer under Lake Merced toward the primary production aquifer in which future production wells would be completed under the proposed program. Therefore, the potential to adversely affect water levels in Lake Merced and other surface water features would be *potentially significant*, but would be reduced to a less-than-significant level with implementation of Measure 5.6-1, Groundwater Monitoring to Determine Basin Safe Yield, and Measure 5.6-2, Implementation of a Lake Level Management Plan. Measure 5.6-1 includes groundwater and surface water monitoring as specified in Elements 1 and 2 of the Groundwater Management Plan to monitor the effects of groundwater pumping on surface water features. The monitoring data would be used to inform decisions regarding the alteration of pumping patterns to avoid undesirable effects on surface water features. Measure

5.6-2 includes development and implementation of a lake level management plan identifying strategies for altering pumping patterns or lake augmentation to maintain Lake Merced water levels within the desired long-term range, should monitoring conducted under Measure 5.6-1 indicate the potential for adverse effects on lake levels due to groundwater pumping. The SFPUC would coordinate the implementation of both measures. The SFPUC would undertake a more detailed analysis of the lake-aquifer relationship and may refine the mitigation as part of the project-level CEQA review on the Local Groundwater Projects.

### South Westside Groundwater Basin

There are no major surface features in the South Westside Groundwater Basin that would be affected by decreased groundwater levels. Therefore, impacts on the water levels of water surface features in the South Westside Groundwater Basin would *not apply*.

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**Impact 5.6-3: Seawater intrusion due to decreased groundwater levels in the Westside Groundwater Basin.**

Seawater intrusion (the movement of saline water into a freshwater aquifer) can occur in coastal aquifers such as the Westside Groundwater Basin, where shallow aquifers are hydraulically connected with the ocean or bay. Intrusion of saltwater into a freshwater aquifer degrades water quality for most beneficial uses and, depending on the degree of salinity, can render the aquifer unusable. Once freshwater aquifers are affected by saltwater intrusion, it is difficult and costly to reclaim the aquifer.

### North Westside Groundwater Basin

In the North Westside Groundwater Basin, the shallow aquifer is in direct connection with the ocean from approximately Lake Merced to the north, as discussed in the Setting. Dewatering of this aquifer during construction of the Oceanside Water Pollution Control Plant caused temporary seawater intrusion in the shallow aquifer; however, once the dewatering stopped, the induced landward gradient that resulted in seawater migration into the shallow aquifer reversed, and the natural outflow of freshwater to the ocean resumed.

Because the shallow aquifer is in direct connection with the ocean and groundwater pumping would lower groundwater levels, impacts related to the potential to cause seawater intrusion in the North Westside Groundwater Basin would be *potentially significant*, but would be reduced to a less-than-significant level through implementation of Measure 5.6-1, Groundwater Monitoring to Determine Basin Safe Yield. This measure requires groundwater level and quality monitoring in accordance with Element 1 of the Groundwater Management Plan, including monitoring of the coastal monitoring well network in the western part of the basin along the Old Great Highway (at Kirkham, Ortega, and Taraval Streets; the Oceanside Water Pollution Control Plant; and the San Francisco Zoo). This monitoring would provide an early indication of whether seawater intrusion is occurring and would be used to inform decisions regarding the alteration of groundwater pumping strategies to avoid seawater intrusion.

Although emergency groundwater pumping could temporarily lower groundwater levels in the primary production aquifer, the potential for seawater intrusion to occur would depend on the magnitude and duration of the emergency event, and any effects on groundwater would be short term. In the event that groundwater gradients were temporarily induced landward, they would be restored toward the ocean once pumping returned to normal levels, and the temporary reversal of gradient would not be likely to cause long-term seawater intrusion. The SFPUC will undertake a more detailed analysis of the potential for seawater intrusion and may refine the mitigation as part of the project-level CEQA review on the Local Groundwater Projects (SF-2).

#### South Westside Groundwater Basin

Although groundwater levels in the South Westside Groundwater Basin have been lowered to depths of up to 200 feet below msl in some areas over the past 50 years, seawater intrusion into the aquifer system has not been detected. As discussed in the Setting, this is attributed to faulting and folding of the Merced Formation along the western border with the Pacific Ocean and the presence of bedrock and bay mud along the eastern border with the bay. In-lieu recharge of groundwater resulting from deliveries of SFPUC system water under the long-term conjunctive-use program (the Regional Groundwater Projects under SF-2), and correspondingly reduced groundwater pumping when SFPUC system water is available, would result in higher groundwater levels in the South Westside Groundwater Basin during nondrought periods, which would further reduce the potential for seawater intrusion.

As discussed in Impact 5.6-1, an operating agreement(s) would be executed with each participating pumper involved in the long-term conjunctive-use program (the Regional Groundwater Projects under SF-2); under the proposed agreement(s), participating pumpers would be able to extract groundwater up to the amount of water stored via in-lieu recharge as a result of surface water previously delivered by the SFPUC during nondrought years. Because the participating pumpers would not pump more than the banked quantity of groundwater, groundwater levels would be expected to be consistently in a range higher than those that have resulted from long-term historical groundwater pumping. For this reason, and because historical pumping has not caused seawater intrusion into the primary production aquifer, seawater intrusion under the long-term conjunctive-use program is not expected. Therefore, programmatic impacts related to seawater intrusion in the South Westside Groundwater Basin are considered *less than significant*. The SFPUC would conduct a more detailed analysis of the conjunctive-use program as part of the project-level CEQA review on the Regional Groundwater Projects.

**Impact 5.6-4: Land subsidence due to decreased groundwater levels in the Westside Groundwater Basin if the historical low water levels are exceeded.**

The groundwater within aquifers and aquitards helps support the weight of the overlying sediments, because the water contained in the pore spaces of sediments creates an internal water pressure. Land subsidence (i.e., the lowering of ground surface elevations caused by the compaction of sediments) can occur if groundwater pumping reduces the water pressure within the pore spaces of the saturated sediments, causing them to compress. The type and degree of subsidence depends on the presence of fine-grained sediments and the extent that water pressure is reduced by groundwater pumping.

Under some conditions, this process would reverse when the groundwater is replenished and the pore pressure increases; this type of subsidence is known as elastic or temporary subsidence. Under conditions of elastic subsidence, the compaction is relatively small and is reversed when pore pressures increase with rising water levels. In general, subsidence in coarse-grained materials of aquifers is elastic.

Under certain conditions, however, groundwater pumping can result in a permanent change in the structure of the sediments, known as inelastic subsidence, and cause an unrecoverable compaction of the aquifer system. Inelastic subsidence occurs when the water pressure in fine-grained sediments (such as clay beds) separating groundwater aquifers is reduced beyond historical lows, resulting in a permanent change in the intergranular structure of the sediments that cannot be reversed when water levels recover. The compressibility of sediments under inelastic conditions is much greater than under elastic conditions, and the subsidence associated with inelastic conditions may require decades to millennia to complete.

In the event of permanent, inelastic subsidence, the ground surface elevation would gradually decrease over a widespread area overlying the affected groundwater basin. Depending on where inelastic subsidence occurred, potential effects could include increased flooding, greater backflushing of surface waters from the bay or ocean, saltwater intrusion in shallow aquifers, submergence of existing marshlands, or changes in gradients within canals and other gravity-flow features. Damage to infrastructure and public and private structures would not be expected, because subsidence effects would occur on a gradual, widespread basis. Subsidence has not been noted in the Westside Groundwater Basin despite heavy pumping in the South Westside Groundwater Basin in the past.

### North Westside Groundwater Basin

It is unlikely that inelastic subsidence would occur in the North Westside Groundwater Basin because the formations comprising the aquifers of the North Westside Groundwater Basin are primarily composed of sands and dewatering of the fine-grained aquitards separating the aquifers would not be expected. Therefore, impacts related to the potential for land subsidence are considered *less than significant.* The SFPUC will undertake a more detailed analysis of the potential for subsidence as part of the project-level CEQA review on the Local Groundwater Projects (SF-2).

#### South Westside Groundwater Basin

Land subsidence is not expected to occur with implementation of the Regional Groundwater Projects (SF-2) in the South Westside Groundwater Basin. During nondrought years, municipal groundwater pumping would be reduced by increased delivery of SFPUC system water, thereby increasing groundwater storage in the primary production aquifer as described in Impact 5.6-1. During drought years, groundwater withdrawals under the Regional Groundwater Projects would be limited to the banked quantity of water stored through in-lieu recharge. Therefore, because groundwater levels associated with the Regional Groundwater Projects would likely be higher than historical lows, the potential for land subsidence would be low, and impacts related to land subsidence in the South Westside Groundwater Basin would be *less than significant.* The SFPUC would conduct a more detailed analysis of the conjunctive-use program as part of the project-level CEQA review on the Regional Groundwater Projects (SF-2).

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**Impact 5.6-5: Contamination of drinking water due to groundwater pumping in the Westside Groundwater Basin.**

During operation, groundwater production wells constructed under the Local and Regional Groundwater Projects (SF-2) could induce migration of chemical or microbiological contamination from sources surrounding the wells, potentially resulting in an exceedance of drinking water standards in the groundwater. However, under the California Department of Health Services DWSAP program, described in the Setting, the SFPUC would develop a drinking water source assessment. At a minimum, the assessment would include a delineation of the area around the well(s) through which contaminants might move and reach the well(s), referred to as the groundwater protection zone; an inventory of possible contaminating activities that could lead to a release of microbiological or chemical contaminants within the delineated area; and a determination of the potentially contaminating activities to which the well(s) are most vulnerable. Groundwater protection zones would be established on the basis of average well discharge volumes and groundwater flow directions. In accordance with the DWSAP program, the drinking water source assessment would be updated every five years.

The second step in the DWSAP program is the voluntary development and implementation of a source water protection program. Development of this program is not mandated under the DWSAP program, but protection of water quality is an important component of a complete wellhead protection program for the protection of drinking water quality. Until production well locations are selected and a drinking water source assessment performed, the potential for contamination of a drinking water well cannot be fully evaluated. Therefore, impacts related to potential contamination of a drinking water source are considered *potentially significant* for the Local and Regional Groundwater Projects (SF-2); however, impacts would be reduced to a less-than-significant level with implementation of Measure 5.6-5, Drinking Water Source Assessments for Groundwater Wells, which would require development and implementation of a source water protection program for wells that are considered vulnerable to contamination. Implementation of the source water protection program would serve to prevent contamination of the drinking water supply. The SFPUC would undertake a more detailed analysis of the potential for contamination of a drinking water source and may refine the mitigation as part of the project-level CEQA review on the Local and Regional Groundwater Projects (SF-2).

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**Impact 5.6-6: Drinking water contaminants above maximum contaminant levels and adverse effects of adding treated groundwater to the distribution system.**

As discussed in the Setting, nitrate and manganese levels exceed primary and secondary drinking water standards in some areas of the Westside Groundwater Basin. However, as described in Chapter 3, the groundwater developed for potable uses under the WSIP would be treated or blended with system water to meet all primary and secondary drinking water standards. Therefore, programmatic impacts related to exceedances in drinking water standards would be *less than significant*. The SFPUC would undertake a more detailed analysis of the need for treatment and proposed treatment methods as part of the project-level CEQA review on the Local and Regional Groundwater Projects (SF-2).

Although treated groundwater from the Local and Regional Groundwater Project (SF-2) wells would meet all primary and secondary drinking water standards, including those for nitrate and manganese, the water quality would differ from that currently in the SFPUC regional water system. The blending of groundwater in the system could result in changes in water quality, such as changes in taste and odor; however, the potential for these effects would depend on the quality of the groundwater produced, treatment methods, and proposed blending operations. In any event, the SFPUC would continue to meet all drinking water standards in the use of groundwater to supplement its current supply during both nondrought and drought periods. Therefore, impacts related to the blending of treated groundwater with SFPUC system water are expected to be *less than significant.* The SFPUC would undertake a more detailed analysis of the potential water quality effects related to the blending of treated groundwater with SFPUC system water as part of the project-level CEQA review on the Local and Regional Groundwater Projects.

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# 5.7 Cumulative Projects and Impacts Related to WSIP Water Supply and System Operations

# 5.7 Cumulative Projects and Impacts Related to WSIP Water Supply and System Operations

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# 5.7.1 Introduction and Approach

## 5.7.1.1 CEQA Statutory Guidance

Cumulative impacts, as defined in Section 15355 of the CEQA Guidelines, refer to two or more individual effects which, when considered together, are "considerable" or which compound or increase other environmental impacts. The cumulative impact from multiple projects is the total change in the environment that could result from the incremental impact of the proposed project in combination with impacts of other closely related past, present, or reasonably foreseeable (i.e., probable) future projects. Pertinent guidance for cumulative impact analysis is given in Sections 15065(a) and 15130 of the CEQA Guidelines:

- An EIR [environmental impact report] shall discuss cumulative impacts of a project when the project's incremental effect is "cumulatively considerable" (i.e., the incremental effects of an individual project are significant when viewed in connection with the effects of past, current, and probable future projects, including those outside the control of the agency, if necessary).
- An EIR should not discuss impacts that do not result in part from the project evaluated in the EIR.
- A project's contribution is less than cumulatively considerable, and thus not significant, if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact.
- The discussion of impact severity and likelihood of occurrence need not be as detailed as for effects attributable to the project alone.
- The focus of analysis should be on the cumulative impact to which the identified other projects contribute, rather than attributes of other projects that do not contribute to the cumulative impact.

In accordance with CEQA Guidelines Section 15130(a), if a project has an incremental effect that is not cumulatively considerable, then that effect need not be considered significant; however, the EIR must describe the basis for determining that the incremental effect is not cumulatively considerable. The discussion of cumulative impacts must reflect the severity of the impacts and the likelihood of their occurrence, but need not provide as much detail as is provided for the effects of the project alone. The CEQA Guidelines require that the discussion of cumulative impacts include:

- Either: (1) a list of past, present, and probable future projects producing related or cumulative impacts; or (2) a summary of projections contained in an adopted general plan or similar document, or in an adopted or certified environmental document, that described or evaluated conditions contributing to a cumulative impact.
- A discussion of the geographic scope of the area affected by the cumulative impact.
- A summary of expected environmental effects to be produced by these projects.

- Reasonable, feasible options for mitigating or avoiding the project's contribution to any significant cumulative effects.

## 5.7.1.2 Approach

This analysis of cumulative effects addresses water resources and related environmental resources discussed in Chapter 5. This analysis employs the list-based approach, and the list includes other SFPUC projects or activities as well as other non-SFPUC projects or activities under the jurisdiction of various local agencies. The following factors were used to determine an appropriate list of projects to be considered in this cumulative analysis:

- *Geographic Scope and Location* – a relevant project is located within a defined geographic scope for the cumulative effect.

- *Similar Environmental Impacts* – a relevant project contributes to effects on resources that would also be affected by the proposed program. This analysis considers potential effects on water resources and the related environmental resources discussed in Chapter 5: hydrology, geomorphology, surface water quality, groundwater, fisheries, terrestrial biological resources associated with water resources (e.g., wetlands and riparian areas and the habitats and species they support), and recreational and visual resources.

### *Geographic Scope*

The potential effects of the WSIP on water resources and related environmental resources are discussed in Sections 5.3, 5.4, 5.5, and 5.6 for four distinct geographic areas within the overall regional system: the Tuolumne River system (and related downstream water bodies), the Alameda Creek watershed system, the Peninsula watershed system, and the Westside Groundwater Basin. This analysis of cumulative effects is organized by the same four geographic areas. Other past, present, and probable future projects within these geographic areas are considered in this analysis if those projects have had or could have similar impacts on water resources and related environmental resources in those areas.

### *Similar Environmental Impacts*

Past, present, and future projects or activities are considered in this analysis if they have contributed or would contribute to effects on resources also affected by the WSIP. The following environmental resources and geographic areas affected by the proposed program were used to screen potential projects for inclusion in the cumulative analysis. If a project would not contribute to effects on the resources analyzed in Chapter 5 (i.e., hydrology, geomorphology, surface water quality, groundwater, fisheries, terrestrial biological resources, recreational and visual resources or energy), it was not included in the cumulative analysis. In particular, the cumulative analysis focused on the following types of projects or activities:

- Projects or activities that would affect flow in a stream, creek, or river, including additional diversions or changes in diversions, removal or installation of obstructions/barriers or flow impediments, or flood or erosion control projects

- Projects or activities that would alter the volume, timing, or duration of releases from the reservoirs or otherwise affect water levels
- Projects or activities that would degrade, improve, restore, or protect water quality or degrade, improve, restore, or protect biological resources (including fisheries) along or in an affected stream, creek, river, or associated watershed
- Projects or activities that would alter groundwater withdrawal or recharge

### *Assessment of Cumulative Effects*

Cumulative impacts are analyzed based on the CEQA guidance described above in Section 5.7.1.1 and are organized by geographic area (i.e., watershed or subarea within a watershed or Westside Groundwater Basin). The cumulative analysis first describes relevant projects for each geographic area and includes the major past/present projects and activities on the water bodies within the watersheds or groundwater basin affected by the WSIP, followed by probable future projects in that same area. For each watershed, these projects include past and present activities related to water supply and hydropower development as well as probable future projects related to watershed restoration and enhancement; similarly, for the Westside Groundwater Basin, past, present, and future projects include activities related to groundwater withdrawal or replenishment. The analysis then describes the effects of past and present projects on each resource area within each geographic area. Since many of these past water system/water supply projects are still in operation today, the existing environmental conditions reflect the cumulative effects of these past projects and their present operations; these conditions also form the basis for the analysis of the WSIP impacts described in Sections 5.3 through 5.6 as well as the basis for assessing the effects of probable future projects and cumulative impacts.

The analysis then discusses the potential effects of probable future projects and describes the cumulative impacts of past, present, and probable future projects together with impacts of the WSIP. Finally, the analysis determines whether the additional contribution of WSIP impacts to the cumulative effects of past, present, and probable future projects on an environmental resource is cumulatively considerable. As described above, "cumulatively considerable" means that the incremental effects of the proposed program would be significant when viewed in combination with the effects of past, present, and probable future projects.

The WSIP's contribution to cumulative impacts is considered prior to mitigation, but the effects of recommended mitigation measures identified in Sections 5.3 through 5.6 and described in Chapter 6 are assessed in determining the significance of overall cumulative impacts. The incremental contribution of the program's residual effects after mitigation to the overall cumulative impact is then analyzed to determine if it would be cumulatively considerable. If the WSIP's contribution to cumulative effects is determined to be cumulatively considerable (i.e., significant) even with implementation of measures identified in Section 5.3 through 5.6, then additional mitigation measures are identified to reduce the WSIP's contribution to cumulative effects. In other words, the analysis assumes that the proposed measures identified in Sections 5.3 through 5.6 would be needed to address not only water supply and system operations impacts, but also the WSIP's incremental contribution to any significant cumulative effects.

For each geographic area, the cumulative impact analysis includes a summary table showing the components considered in the analysis as well as the results of the analysis for each resource area. For each resource topic the table first summarizes the effects of past and present projects without the WSIP and represents the existing condition against which all other impacts are compared. The effects of the past plus present projects and/or activities and operations are described as having either moderately or substantially altered natural environmental conditions as a relative measure of the change that has occurred over time. (There were no cases where there had been little or no change from natural conditions over time, thus these terms are not used.). Next, the table summarizes the findings of the WSIP impact analyses presented in Sections 5.3 through 5.6, both prior to and after mitigation. Then, the table presents a summary of the potential effects of probable future projects, followed by the cumulative impacts of past, present, and probable future projects combined with the WSIP impacts after mitigation. Finally, the table indicates whether the WSIP's contribution to cumulative impacts would be cumulatively considerable. In the case where no other future projects would contribute to cumulative impacts (other than the WSIP), there is no additional cumulative impact and the WSIP's contribution to cumulative impacts would not be applicable (since the cumulative impact would be the same as the direct impact of the program as analyzed in the previous sections of Chapter 5).

## 5.7.2 Cumulative Effects on the Tuolumne River System and Downstream Water Bodies

The effects of past, present, and future projects are described separately for the Tuolumne River corridor above and including Don Pedro Reservoir, the Tuolumne River corridor between Don Pedro Reservoir and the confluence with the San Joaquin River, and the San Joaquin River downstream to the Sacramento–San Joaquin Delta. The cumulative impacts of all projects including the WSIP, and the WSIP's contribution to cumulative impacts, are summarized at the end of each of these subsections.

### 5.7.2.1 Relevant Projects

#### *Tuolumne River – Hetch Hetchy Reservoir to Don Pedro Reservoir*

**Past and Present Projects**

Development of various components of the SFPUC regional water and power system has substantially affected environmental resources in the Tuolumne River corridor upstream of Don Pedro Reservoir. These facilities, built over a period ranging from 90 to 20 years ago, have been in continuous operation. Existing environmental conditions in this corridor reflect the past and ongoing operation of these facilities. These water system components, shown in Section 5.3, Figure 5.3.1, include:

- O'Shaughnessy Dam and Hetch Hetchy Reservoir
- Cherry Dam and Lake Lloyd
- Eleanor Dam and Lake Eleanor
- Holm and Kirkwood Powerhouses
- Cherry and Canyon Power Tunnels
- Mountain Tunnel

Lake Eleanor, Hetch Hetchy Reservoir, and Lake Lloyd were completed and put into service in 1918, 1923, and 1956, respectively. Various improvements to the reservoirs, tunnels, and powerhouses were made between the 1920s and the present. Use of the facilities has increased over the same time period to keep pace with the demand for water in the Bay Area.

Land use in the Tuolumne River watershed upstream of Don Pedro Dam has not changed considerably from conditions that existed prior to Euro-American settlement. Water projects developed by agencies other than the SFPUC on the South Fork of the Tuolumne River are small and do not have much effect on the river system beyond their immediate vicinity.

### Future Projects

Four future SFPUC projects/actions and two future non-SFPUC projects/actions could affect this reach of the Tuolumne River corridor:

- Hetch Hetchy Communications System Upgrade Project
- Hetch Hetchy Repair and Rehabilitation Program
- Discretionary fishery flow releases from Hetch Hetchy Reservoir
- SFPUC Watershed and Environmental Improvement Program
- Don Pedro Pumped Storage Project
- Tuolumne Wild and Scenic River Comprehensive Management Plan

In addition to the listed projects, the SFPUC would conduct routine maintenance on its facilities in the Tuolumne River corridor.

**Hetch Hetchy Communications System Upgrade Project.** The Hetch Hetchy Communications System Upgrade Project would replace and improve an aging communications system in Tuolumne and Stanislaus Counties and expand coverage to the O'Shaughnessy Dam, Lake Lloyd, and Lake Eleanor areas (SFPUC, 2007). Additionally, a Federal Communications Commission rule (Section 101.69 et seq.) requires SFPUC Power Enterprise (formerly part of Hetch Hetchy Water and Power Enterprise) to vacate use of its current operating frequencies in the 2-gigahertz band when an emerging technology licensee needs these frequencies. The SFPUC would undertake the project in partnership with the National Park Service and the U.S. Forest Service. The project would improve communication facilities at 26 developed sites and add communication facilities at three undeveloped sites. New communication towers and equipment shelters would be built at the three undeveloped sites: the Cherry Tower, Burnout Ridge, and Poopenaut Pass sites.[1] In addition, the proposed project would remove communications equipment at three locations.

**Hetch Hetchy Repair and Rehabilitation Program.** The SFPUC has developed the Repair and Rehabilitation Program for its facilities in the Tuolumne River corridor. Several projects have been scheduled for implementation between 2008 and 2012. They include repairing Early Intake Dam, lining Moccasin Reservoir, improving and enlarging the Lower Cherry Aqueduct, and

[1] Cherry Tower, Burnout Ridge, and Poopenaut Pass are not formal names adopted by the U.S. Forest Service, National Park Service, or any other local, state, or federal entity. These names were given solely to identify precise locations for project purposes.

expanding the Moccasin Creek bypass (SFPUC, 2006). Likely future projects that have not yet been scheduled include repair of existing roads and bridges and implementation of a vegetation management program for water and power rights-of-way and areas surrounding Priest and Moccasin Reservoirs.

**Discretionary Fishery Releases from Hetch Hetchy Reservoir.** As described in Chapter 2, Section 2.5.3, an agreement between the City and County of San Francisco (CCSF) and the U.S. Department of the Interior (DOI) provided for several supplemental releases of water from Hetch Hetchy Reservoir, in addition to the current required minimum releases (shown in Table 5.3.1-2), to support resident trout populations. As agreed, the SFPUC releases an extra 64 cubic feet per second (cfs) at Hetch Hetchy Reservoir on any day that flow in Canyon Tunnel exceeds 920 cfs. Also, the U.S. Fish and Wildlife Service (USFWS), an agency within the DOI, has the discretion to require this additional water to be released from Hetch Hetchy Reservoir in an amount varying from 4,400 to 15,000 acre-feet, depending on hydrologic conditions, for the benefit of resident trout. If shown to be necessary for fish habitat, the USFWS may also seek to have additional water released in wetter hydrologic year types under certain conditions (CCSF, 1987).

In March 1987, the CCSF and DOI agreed on the amounts and a procedure for determining whether supplemental flow releases were necessary. The agreement provided for a study of the relationship between the resident trout population and stream flow below O'Shaughnessy Dam. The study was intended to establish whether additional releases were actually needed and, if so, the appropriate timing of such releases. The SFPUC made supplemental releases as part of the experimental program to study the relationship between the flow rate in the river, the depth of water in the channel, and the extent of trout habitat. The USFWS produced a draft study in 1992 that called for the release of greater amounts of water, but did not provide guidance on the timing of releases. The CCSF provided comments on this draft study questioning the basis of some of the recommendations, and matters were left unresolved. Beginning in 2005, the SFPUC began working again with the USFWS to resolve issues regarding these additional releases (4,400 – 15,000 acre-feet). The SFPUC has produced two documents to supplement the 1992 draft study: the *Upper Tuolumne River: Available Data Sources, Field Work Plan and Initial Hydrology Analysis* (October 2005) and the *Upper Tuolumne River: Description of River Ecosystem and Recommended Monitoring Actions* (April 2007).

The SFPUC plans to build on this foundation and work collaboratively with the USFWS to pursue the recommendations in these reports; develop and test hypotheses by conducting field work; and reach agreement on these supplemental releases by 2009. For the purpose of this cumulative analysis, the supplemental or discretionary flow releases were modeled using the amounts from the 1987 release schedule (4,400 to 15,000 acre-feet, see Table 5.3.1-2) and conservation assumptions for the timing of releases in combination with full implementation of the WSIP under the 2030 conditions. These assumptions represent a potential worst-case scenario for use in the impact assessment, but may not reflect the ultimate release requirements if any are determined to be necessary.

**Watershed and Environmental Improvement Program.** The SFPUC is developing this program to protect and restore lands and natural resources critical to the operation of the SFPUC regional water system. As described in Chapter 3, the program could include ecosystem and habitat protection, improvements, and restoration and would address such issues as fish passage, riparian habitat degradation, and sensitive species recovery in the Tuolumne, Alameda, and Peninsula watersheds. Program planning is in progress, and initial activities include field surveys and information gathering on current ecological and geomorphic conditions in the Tuolumne River from O'Shaughnessy Dam to Don Pedro Reservoir, Cherry Creek downstream of Cherry Dam, and Eleanor Creek downstream of Eleanor Dam (McBain & Trush, 2006). However, no specific projects or actions affecting Hetch Hetchy Reservoir or the Tuolumne River below the reservoir have been identified.

**Don Pedro Pumped Storage Project.** The Turlock Irrigation District (TID) and Modesto Irrigation District (MID) are considering the possibility of constructing a pumped storage project. As envisaged, water would be pumped from Don Pedro Reservoir to a new adjacent reservoir at a higher elevation at times when electrical power is inexpensive. Water would be released from the new reservoir and conveyed back to Don Pedro Reservoir via a new hydroelectric power plant at times when the demand for electrical power is high and the value of the power is at its greatest. Two potential sites for the upper reservoir have been identified. Reservoir capacity would be 30,000 acre-feet or 14,000 acre-feet. If TID and MID choose to proceed with the project it would take ten years to complete (Morris, 2006).

**Tuolumne Wild and Scenic River Comprehensive Management Plan.** The National Park Service is currently preparing a plan for the 54 miles of the Tuolumne River designated as wild and scenic within Yosemite National Park. Even though Hetch Hetchy Reservoir and the lands immediately surrounding it would not be subject to the future management plan, the plan will include reaches of the Tuolumne River immediately upstream and downstream of the reservoir. This plan is currently under development, and no specific projects or actions affecting the reservoir or the Tuolumne River downstream of the reservoir have been identified. Therefore, this plan was not included in the modeling for the cumulative analysis, but it is assumed that implementation of the plan would result in beneficial effects on environmental resources.

### *Tuolumne River – Don Pedro Reservoir to the San Joaquin River*

#### Past and Present Projects

Projects and activities that have substantially affected environmental quality in the Tuolumne River corridor below Don Pedro Reservoir between La Grange Dam and the river's confluence with the San Joaquin River include:

- Don Pedro Reservoir
- La Grange Diversion Dam
- Modesto and Turlock Canals
- Historical dredging for gold
- Gravel mining
- River channelization and development of floodplains for agricultural and urban use

- 1995 Federal Energy Regulatory Commission Settlement Agreement (New Don Pedro Project, P-2299-024)

Beginning in 1871, diversion dams with minimal storage capacity were built on the Tuolumne River in the vicinity of the present La Grange Dam. La Grange Dam itself was completed in 1893. The original Don Pedro Reservoir, which was built upstream of La Grange Dam, was put into service in 1923 and expanded to its current capacity in 1971. Since the 1870s, TID and MID have diverted water from the Tuolumne River into canals at or near the site of La Grange Dam. The canals deliver water to farmers for agricultural irrigation. In the last decade, MID began treating some canal water and providing it for municipal water supply. The canal system has been progressively expanded and improved since the 1870s. The volume of diverted water increased over many decades, but is now stable and unlikely to increase in the future.

Flow in the reach of the Tuolumne River between La Grange Dam and the San Joaquin River confluence is not only affected by Don Pedro Reservoir and the diversions into the Modesto and Turlock Canals, but also by upstream components of the SFPUC regional water system described above. They include O’Shaughnessy Dam and Hetch Hetchy Reservoir, Cherry Dam and Lake Lloyd, Eleanor Dam and Lake Eleanor, Holm and Kirkwood Powerhouses, Cherry and Canyon Power Tunnels, and Mountain Tunnel.

The Federal Energy Regulatory Commission (FERC) regulates most hydropower projects. The New Don Pedro Project includes both a reservoir and a hydropower component and operates in accordance with a FERC license. In 1996, FERC ordered new minimum releases, which are shown in Table 5.3.1-3.

Gold mining in the mid-19th century and gravel mining in the 20th century occurred throughout the Tuolumne River corridor. Gravel mining in the riverbed itself was discontinued in the 1970s but continues in the floodplain. Levee construction and conversion of floodplain lands to agricultural and urban use occurred primarily in the last 50 years.

### Future Projects

Future plans, projects, and regulatory changes that could affect the Tuolumne River between Don Pedro Reservoir and the confluence with the San Joaquin River include:

- TID Infiltration Gallery Project
- TID Regional Surface Water Supply Project
- 1995 FERC Settlement Agreement
- New Don Pedro Project FERC relicensing
- Expansion of MID municipal water treatment plant

**TID Infiltration Gallery Project.** TID began development of the Infiltration Gallery Project in the 1990s. The project consists of an infiltration gallery, a raw water pump station, and a pipeline to TID’s Ceres Main Canal. The infiltration gallery is an array of perforated pipes installed in the Tuolumne River bed just west of the Geer Road Bridge. The infiltration gallery was built in 2003 with a capacity of 100 cfs, but the pump station and pipeline have not yet been built. Once completed, the project would move the point of diversion for some of TID's Tuolumne River water downstream from La Grange Dam to the infiltration gallery near the Geer Road Bridge. Water that would otherwise be diverted at La Grange Dam would flow downstream to the infiltration gallery and be pumped into the Ceres Main Canal. The purpose of the project is to increase flow in the 26-mile reach of the Tuolumne River between La Grange Dam and Geer Road Bridge in order to improve conditions for aquatic life (EIP Associates, 2006).

**TID Regional Surface Water Supply Project.** TID is currently proposing a Regional Surface Water Supply Project, which would consist of a water treatment plant and about 20 miles of treated water pipeline to deliver water to the cities of Ceres, Hughson, Keyes, South Modesto, and Turlock. The treatment plant would be located adjacent to the existing infiltration gallery (see above) and would obtain water from it. Up to 66 cfs, or 42.5 million gallons per day (mgd), of water would be released from La Grange Dam and diverted from the Tuolumne River at the infiltration gallery for treatment and municipal use. The releases would be above and beyond already required flow releases to the lower river. The treatment plant would provide the base load water supply to cities in the TID service area. Peak daily and seasonal water demand would be met by supplementing water from the treatment plant with water from wells. By 2030, it is expected that the treatment plant would run continuously at 42.5 mgd (Brown and Caldwell, 2003; Selsky, 2006).

In 2030, 66 cfs would be released from La Grange Dam year-round to supply water to the downstream infiltration gallery and the treatment plant. An additional 34 cfs could be released from La Grange Dam during the irrigation season, diverted at the infiltration gallery, and conveyed to the Ceres Main Canal for agricultural use. The release for agricultural purposes would likely extend from mid-March to mid-October.

**1995 FERC Settlement Agreement.** The 1995 FERC Settlement Agreement included provisions intended to improve conditions in the Tuolumne River below La Grange Dam. Although some improvement projects have been completed, others would be completed in the future.

TID and MID, the owners and operators of Don Pedro Reservoir, have a legal and historical role as managers of flow in the lower Tuolumne River. Sharing in the responsibility for stewardship of the river's natural resources are several state and federal resource agencies, public utilities, and private organizations that are signatories to the 1995 FERC Settlement Agreement. The signatories are TID, MID, the California Department of Fish and Game (CDFG), the USFWS, FERC, the National Marine Fisheries Service, the CCSF, the San Francisco Bay Area Water Users Association (now the Bay Area Water Supply and Conservation Agency), Friends of the Tuolumne, the Tuolumne River Preservation Trust, Tuolumne River Expeditions, and the California Sports Fishing Protection Alliance.

The FERC Settlement Agreement created the Tuolumne River Technical Advisory Committee (TRTAC) to coordinate and administer restoration and management activities on the lower Tuolumne River. The TRTAC includes the FERC Settlement Agreement signatories and other interested groups. The TRTAC developed the *Habitat Restoration Plan for the Lower Tuolumne River Corridor* (TRTAC, 2000) to identify and implement high-priority restoration projects focused on improving conditions for the Chinook salmon population. The restoration plan is a technical resource designed to help the TRTAC fulfill its obligations under the FERC Settlement Agreement.

The restoration plan accepts that the Tuolumne River is a managed system, and that it is not possible to return the river to its pre-Euro-American settlement condition. Instead, the plan seeks to reverse more than a century of environmental degradation by identifying and implementing various improvement projects to restore the ecological health and integrity of the lower Tuolumne River. Plan recommendations include establishing a minimum 500-foot-wide riparian corridor along the river, removing levees and non-native vegetation, and reconstructing the river channel and terraces to match the current flow regime. Other recommendations involve reducing sand input to the river, providing additional spawning gravel, and restoring riparian vegetation. The plan identified 14 high-priority restoration projects, of which two have been implemented (see Section 5.2 for further description of the plan) (TID and MID, 2005).

**New Don Pedro FERC Relicensing.** The FERC will need to relicense the New Don Pedro Project in 2016 (see Chapter 2, Section 2.5 for a description of the New Don Pedro Project). Data gathered as required under the 1995 FERC settlement agreement, and the effectiveness of restoration measures, will be considered during the relicensing process. The current minimum flow requirements will also be reevaluated. Although the conditions of the new license are not known, it is likely that the minimum flow requirements will remain the same or will increase.

**Expansion of MID Municipal Treatment Plant.** MID owns and operates a 40-mgd municipal water treatment plant that obtains water from Modesto Reservoir. Modesto Reservoir is located north of the Tuolumne River and is supplied with water from the Tuolumne River via the Modesto Canal. Tuolumne River water is diverted into the Modesto Canal at La Grange Dam, and treated water is delivered to the city of Modesto. MID intends to increase the capacity of the treatment plant to 60 mgd in the near future (Jones and Stokes, 2004).

### *Downstream Water Bodies: the San Joaquin River, Stanislaus River, and Delta*

This section discusses the projects that affect flow contributions to the San Joaquin River and the Delta downstream of the Tuolumne River or otherwise have or might affect water quality and/or aquatic ecosystem resources (i.e., species or habitats) in these water bodies.

#### Past and Present Projects

Past and present actions that have substantially affected the San Joaquin and Stanislaus Rivers include local water diversions, major water supply and flood control projects, gravel mining operations, and agricultural activities.

**San Joaquin River.** Friant Dam, which created Millerton Lake, was completed in 1942 as part of the federal Central Valley Project. The Central Valley Project's Friant-Kern and Madera Canals convey most of the runoff from the San Joaquin River drainage above Millerton Reservoir to agriculture and urban water users. The U.S. Bureau of Reclamation (USBR) releases enough water from the dam to maintain a flow of 5 cfs past Gravelly Ford, which is 35 miles below the dam, to meet downstream riparian water rights. The reach of the river between Gravelly Ford and Mendota is essentially dry, except when flood releases are being made.

As described in Section 5.3.1, the San Joaquin River gains waters as it flows toward the Sacramento–San Joaquin Delta from agricultural irrigation return flows and tributaries (see Figure 5.3.1-7). Stream flow gaging records for the period 1942 to 2004 indicate that flow in the San Joaquin River at Newman, upstream of the river's confluence with the Tuolumne River, averaged 1,789 cfs, and that flow in the San Joaquin River at Vernalis, upstream of the Delta and downstream of the Tuolumne River confluence, averaged 4,328 cfs. A substantial proportion of the increase in San Joaquin River flow between Newman and Vernalis is contributed by the Tuolumne River, which has an average annual flow of 1,265 cfs as measured at Modesto.

**Stanislaus River.** New Melones Reservoir was completed by the U.S. Army Corps of Engineers (Corps) in 1978 and approved for filling in 1983. The reservoir has a storage capacity of 2.4 million acre-feet per year (afy) and provides for both water supply and flood control. New Melones Reservoir, located approximately 60 miles upstream from the confluence of the Stanislaus and San Joaquin Rivers, is operated by the USBR as part of the Central Valley Project. The USBR provides water to Central Valley Project water supply contractors from this river. Flow in the lower Stanislaus River is primarily controlled by releases from the reservoir. The USBR makes releases from New Melones Reservoir to meet senior water-right obligations to Oakdale Irrigation District and South San Joaquin Irrigation District, to satisfy downstream riparian water rights, and to meet instream requirements for water quality, fisheries, and wildlife.

Under Section 3406 (b)(2) of the Central Valley Project Improvement Act (enacted by Congress in 1992), the DOI has the responsibility to dedicate and manage 800,000 afy of Central Valley Project water for fishery, wildlife, and habitat restoration purposes. Program objectives include improving habitat conditions for anadromous fish[2] in Central Valley Project rivers, streams, and the Bay-Delta to help meet the Anadromous Fish Recovery Program doubling goals. The Stanislaus River is one of the rivers controlled by the Central Valley Project. Under this program, the USBR releases water to the lower Stanislaus River to assist anadromous fish. The USBR has initiated an effort to revise its current interim plan of operation for New Melones Reservoir in consideration of changing conditions that have occurred in the basin and other directives.

**Sacramento–San Joaquin Delta.** One hundred fifty years ago, a network of levees was developed in the Sacramento–San Joaquin Delta to prevent flooding of the fertile farmland. While most of these islands continue to be used for agriculture, residential development is also occurring within and around the Delta. Delta farmers divert water directly from the Delta channels to irrigate their land. A portion of the diverted water is returned to the Delta channels as agricultural return.

California's two largest engineered water systems, the Central Valley Project and the State Water Project, also divert water from the Delta. The Central Valley Project diverts water from Old River

2 Anadromous fish hatch (rear) in freshwater, migrate to the ocean (saltwater) to grow and mature, and migrate back to freshwater to spawn and reproduce.

in the south Delta at the Tracy Pumping Plant and exports it to Central Valley Project contractors via the Delta-Mendota Canal. Contra Costa Water District, a Central Valley Project contractor, diverts its water from Old River and Rock Slough in the south Delta and Mallard Slough in the west Delta. The State Water Project diverts water from Old River at the Banks Pumping Plant and exports it to customers via the California Aqueduct, the South Bay Aqueduct, and the Central Coast Aqueduct. The State Water Project diverts smaller amounts of water from Barker Slough in the north Delta to serve customers in Napa and Solano Counties. Between 1995 and 2004, the State Water Project diverted an average of 2.6 million afy from the Delta. The Central Valley Project diverted an average of 2.5 million afy from the Delta.

### Future Projects

There are numerous proposed programs and projects that, if implemented, could affect the San Joaquin or Stanislaus Rivers and/or the Delta and contribute to either beneficial and/or adverse cumulative effects on the water resources and/or the associated ecosystem resources. **Table 5.7-1** summarizes these programs and projects. These programs and projects are categorized by whether they would affect one or more of the three environmental issues affected by the WSIP: water supply/supply reliability, water quality, and/or aquatic resources (habitat and species). A few of these proposed programs and projects have been approved and are being implemented; many more are under study and may or may not be approved for implementation. As noted in the table, many of these programs are specifically designed to improve environmental conditions in the rivers or Delta and most of them could contribute to both beneficial and adverse cumulative effects on environmental resources in these rivers or the Delta.

**San Joaquin River.** As shown in Table 5.7-1, there are almost a dozen proposed future programs, projects, and actions that would directly affect surface waters, water quality, and related aquatic resources in the San Joaquin River, as well as others listed under the Delta Region that might indirectly affect the river depending on how they are implemented. As summarized in the table, several of these programs are intended to improve conditions in the river with respect to water quality and aquatic habitats, and some are also intended to improve water supply management and supply reliability. Notable among these potential projects is the recently established San Joaquin River Restoration Settlement, which is described in more detail below.

In September 2006, a settlement agreement among the USBR, the Friant Water Users Authority (Friant), and the Natural Resource Defense Council was approved to restore flows and salmon habitat in the San Joaquin River between Friant Dam and the confluence with the Merced River and to improve water reliability for water users. The settlement agreement provides opportunities for Friant Division long-term water contractors to mitigate water supply impacts resulting from water releases called for under the agreement. The settlement agreement requires specific releases of water from Friant Dam to the confluence of the Merced River, designed primarily to meet the various life-stage needs of spring- and fall-run Chinook salmon (USBR, 2007). The release schedule assumes continuation of the current average Friant Dam releases of 116,741 acre-feet, with additional flow requirements depending on the hydrologic year type. For example, approximately 247,000 acre-feet would be released in most dry years, whereas about 555,000 acre-feet would be released in wet years.

**TABLE 5.7-1**
**PROJECTS THAT COULD CONTRIBUTE TO CUMULATIVE EFFECTS ON THE SAN JOAQUIN RIVER AND/OR DELTA**

| Project Name | Description | Project Sponsor / Partners | Areas of Potential Effect Relevant to the WSIP (Adverse and/or Beneficial) | | | Potential Effects / Status |
|---|---|---|---|---|---|---|
| | | | Water Supply / Reliability | Water Quality | Habitat / Species | |
| San Joaquin River Watershed | | | | | | |
| San Joaquin River TMDL for salt and boron | Basin Plan amendment for control of salt and boron discharge into the lower San Joaquin River. Water quality objectives and implementation are yet to be completed. | Central Valley RWQCB | | X | | Would likely reduce saline discharges to the San Joaquin River, but may be deleterious to flow and salinity concentration conditions. Technical TMDL Report completed in January 2002. Notice of Determination (NOD) for the San Joaquin River at Vernalis Salt and Boron TMDL and Basin Plan Amendment submitted in 2006. Schedule has been deferred. (Central Valley RWQCB, 2007) |
| San Joaquin River TMDL for Dissolved Oxygen in the Stockton Deepwater Ship Channel | Basin Plan amendment containing a dissolved oxygen TMDL that apportions responsibility to parties attributable to the factors of cause. Implementation yet to be completed. | Central Valley RWQCB | | X | | Beneficial water quality effect. Removal of oxygen demanding substances, aeration and flow augmentation will likely be tools to meet TMDL. |
| New Melones Revised Operation Plan | Modify current interim operational plan in consideration of evolving San Joaquin and Stanislaus River conditions, directives and requirements. | USBR | X | X | X | May change priorities of New Melones Reservoir operation. |
| San Joaquin Valley Drainage Implementation Program | Management of agricultural drainage discharge to the San Joaquin River. Incorporated into the San Luis Drainage Feature Re-evaluation Program. | San Joaquin River Exchange Contractors, Panoche, Westlands and Broadview Water Districts | | X | | Intended to reduce water quality impacts on the San Joaquin River. Final report released in 2000 followed by a new Drainage Management Strategy in 2000 to implement the updated recommendations (DWR, 2007a). |
| San Luis Drainage Feature Re-evaluation Program | Intended to address drainage management and disposal from the San Luis Unit. | USBR | X | X | | Will reduce various constituent discharges to the San Joaquin River. Final report released in 2006. Record of Decision (ROD) released in 2007 (USBR, 2007b). |
| Upper San Joaquin River Basin Storage Investigation (CALFED Program) | Evaluation of potential for increasing storage in the Upper San Joaquin Watershed to increase water supply, storage capacity, and flood control, as well as improve water quality and wildlife habitat. | USBR, DWR and partners | X | X | X | Could contribute to both beneficial and adverse environmental effects on the San Joaquin River. Environmental document and feasibility study anticipated in 2009 (USBR and DWR, 2006). |

**TABLE 5.7-1 (Continued)**
**PROJECTS THAT COULD CONTRIBUTE TO CUMULATIVE EFFECTS ON THE SAN JOAQUIN RIVER AND/OR DELTA**

| Project Name | Description | Project Sponsor / Partners | Areas of Potential Effect Relevant to the WSIP (Adverse and/or Beneficial) | | | Potential Effects / Status |
|---|---|---|---|---|---|---|
| | | | Water Supply / Reliability | Water Quality | Habitat / Species | |
| San Joaquin Valley Water Transfers | San Joaquin River Exchange Contractors Water Authority 2005 – 2014 transfer program of up to 130 TAF/year of substitute water to other CVP contractors. Water to be also transferred for delivery to San Joaquin Valley wetland habitat areas and/or to the EWA program as replacement water for CVP contracts. | USBR, San Joaquin River Exchange Contractors Water Authority | X | X | X | Could benefit Central Valley and Delta ecosystems. As of 2003, the feasibility studies and project identifications were still underway (CALFED, 2003). |
| San Joaquin River Restoration Settlement (Friant Settlement Legislation) | Agreement restoring water flow for salmon along with channel improvements in San Joaquin River downstream of Friant Dam to the confluence with the Merced River. Goal is to maximize flows for fish survival while meeting the supply obligations to San Joaquin River water users. Projects to restore flow will be implemented in phases. | USBR, DWR, Friant Users Water Authority, Natural Resources Defense Council | X | | X | Intended to have a beneficial effect on fish habitat and fishery resources in the San Joaquin River. May incidentally increase Delta inflow and thus benefit Delta resources. Depending on how management goal is met, projects under this program might contribute in some ways to adverse effects on the Delta. |
| Delta-Mendota Canal Recirculation Feasibility Study | Feasibility study of recirculating/augmenting water from the Delta through CVP facilities to the San Joaquin River to enhance flow, reduce salinity, and reduce reliance on New Melones Reservoir for meeting water quality and fishery flow objectives. | USBR, DWR | | X | X | This project is intended to contribute to beneficial effects on San Joaquin River water quality and fish habitat. A NOI/NOP was released in March 2007. The final feasibility report and EIS/EIR is expected in 2009 (USBR, 2007d). |
| Stockton Delta Water Supply Project | New supplemental water supply for Stockton diverted from the San Joaquin River. The project includes a new intake structure, pipelines and water treatment plant as well as a groundwater recharge / conjunctive use element. | City of Stockton | X | X | | Would contribute to cumulative adverse effects of water diversion on the Delta. Stockton certified the Final EIR in 2005, and is currently designing and permitting the project for construction. |
| Lower San Joaquin River Flood Improvement Project | Improve flood control capacity on the lower San Joaquin River and enhance ecosystem structure and function on the lower river and south Delta. | DWR, USBR, South Delta Water Agency | | | X | Intended to provide environmental benefits to lower the San Joaquin River and south Delta; could also involve potential adverse effects on habitat depending on the nature of proposed actions. Project plan development to occur in 2007/2008. Environmental documents and feasibility study scheduled for completion in 2010. |

**TABLE 5.7-1 (Continued)**
**PROJECTS THAT COULD CONTRIBUTE TO CUMULATIVE EFFECTS ON THE SAN JOAQUIN RIVER AND/OR DELTA**

| Project Name | Description | Project Sponsor / Partners | Areas of Potential Effect Relevant to the WSIP (Adverse and/or Beneficial) | | | Potential Effects / Status |
|---|---|---|---|---|---|---|
| | | | Water Supply / Reliability | Water Quality | Habitat / Species | |
| Delta Region | | | | | | |
| Shasta Reservoir Enlargement | Expand Shasta Reservoir to increase storage upstream of the Delta. Alternatives range from reservoir reoperation, and dam modification to raising the dam 6.5 feet. Project could increase water supplies available for export | USBR | X | X | | Could contribute to both beneficial and adverse effects on the Delta by providing greater flexibility to release additional water from the reservoir for water quality and/or habitat or species benefit and by increasing potential supply exports from the Delta. Project is in the planning stages; environmental document anticipated in 2008. |
| Upstream of Delta Off-stream Storage (Sites Reservoir) | Develop new off-stream storage reservoir upstream of the Delta to increase water supply reliability, improve water quality in the Delta, and improve fish migration on the Sacramento River | DWR, USBR | X | X | X | Could contribute to both beneficial and adverse effects on the Delta by providing greater flexibility to release additional water from the reservoir for water quality and/or habitat or species benefit and by increasing potential supply exports from the Delta. NOP/NOI issued in November 2001; environmental document anticipated in late 2008. |
| In-Delta Storage Program (Delta Wetlands Project) | Develop storage in the Delta (on Delta islands). This could reduce flows in the Delta by capturing peak flow through the Delta during high flow periods and releasing it later in the year when exports are needed. | CALFED and DWR | X | X | X | Could contribute to both beneficial and adverse effects on the Delta by providing additional flexibility to release additional water from the reservoir for water quality and/or habitat or species benefit and by increasing potential supply exports from the Delta. EIR/EIS for Delta Wetlands Project completed in 2000. DWR issued 2004 Feasibility Report and 2006 supplemental report. |
| Los Vaqueros Reservoir Expansion Project | Expand the existing Los Vaqueros Reservoir to improve water supply reliability and water quality for Bay Area water users, while enhancing the Delta environment. | CCWD, USBR, DWR | X | X | X | Could contribute to both beneficial and adverse effects on the Delta by reducing impacts of water diversions on fish, providing environmental water, and improving water supply reliability. NOP/NOI released in 2006; Draft EIS/EIR anticipated early 2008. |

**TABLE 5.7-1 (Continued)**
**PROJECTS THAT COULD CONTRIBUTE TO CUMULATIVE EFFECTS ON THE SAN JOAQUIN RIVER AND/OR DELTA**

| Project Name | Description | Project Sponsor / Partners | Areas of Potential Effect Relevant to the WSIP (Adverse and/or Beneficial) | | | Potential Effects / Status |
|---|---|---|---|---|---|---|
| | | | Water Supply / Reliability | Water Quality | Habitat / Species | |
| South Delta Improvements Program (SDIP) | Series of actions: physical/structural improvements and operational changes to maximize SWP diversion capacity and improve conditions for fish, increase supply for downstream agriculture, and improve water quality and reliability of supply. | DWR, USBR | X | X | X | Could contribute to both beneficial and adverse effects on the Delta by increasing Delta water diversions and, at the same time, reducing impacts of water diversions on fish and improving water quality. Final EIS/EIR released in 2006. Stage 1 physical/structural improvements to be considered for approval first; then Stage 2 to consider increasing water deliveries. |
| Rock Slough and Old River Water Quality Improvement Projects | Two projects relocating agricultural drainage discharge points to improve water quality. | CALFED, CCWD | | X | | Would contribute to cumulative beneficial effects on Delta water quality. |
| Delta Cross Channel Reoperation and Through-Delta Facility (TDF) | Study of whether changes in operation of the Delta Cross Channel could benefit fish and water quality. Includes looking at a screened Through-Delta Facility for conveyance of up to 4,000 cfs. | CALFED, USBR, DWR | X | X | X | Could contribute to both beneficial and adverse effects on the Delta by altering Delta diversions and flow patterns to benefit fish and water quality and improve water supply reliability. A final report is anticipated in fall 2008 (Bagheban, 2007). |
| North Delta Flood Control and Ecosystem Restoration Project | Feasibility study of floodway improvements in the North Delta to provide conveyance, flood control, and ecosystem benefits. | DWR, U.S. Army Corps of Engineers | | | X | Would provide flood control and ecosystem benefits but could also contribute to some adverse effects on the Delta associated with construction of proposed projects such as bridge replacement, dredging, or island bypass systems. DWR and the Corps are conducting a feasibility study. An NOI/NOP was released in 2003. Final EIR/EIS anticipated in late spring 2008. Construction is expected to be complete by 2011 (DWR, 2007b). |
| Delta-Mendota Canal/California Aqueduct Intertie | Connection between the two facilities would increase water supply reliability for SWP and CVP. | DWR, USBR | X | | | Could increase average daily pumping for Delta water diversions into the Delta Mendota Canal. Project included in the USBR's Operations Criteria and Plan; Draft EIS anticipated in 2007 (USBR, 2007b). |

**TABLE 5.7-1 (Continued)**
**PROJECTS THAT COULD CONTRIBUTE TO CUMULATIVE EFFECTS ON THE SAN JOAQUIN RIVER AND/OR DELTA**

| Project Name | Description | Project Sponsor / Partners | Areas of Potential Effect Relevant to the WSIP (Adverse and/or Beneficial) | | | Potential Effects / Status |
|---|---|---|---|---|---|---|
| | | | Water Supply / Reliability | Water Quality | Habitat / Species | |
| Bay Area Water Quality and Supply Reliability Program | Program to work towards creating coordinated water delivery operations and regional exchange projects to improve water quality and supply reliability. | Various Bay Area water agencies | X | X | | Several projects in various stages of development, as described in the *Bay Area Integrated Regional Management Plan*, released November 2006. Projects could contribute to both beneficial and adverse cumulative effects on the Delta. |
| South Bay Aqueduct Improvement and Enlargement Project | Project to upgrade and increase the size of the South Bay Aqueduct water delivery infrastructure. | DWR | X | | | Not expected to contribute to cumulative adverse Delta effects. Project EIR confirmed in June 2005; project under construction (DWR, 2005). |
| Sacramento Valley Water Management Program (Phase 8) | Program to resolve water quality and water rights issues arising from need to meet the flow-related water quality objectives of the 1995 Bay-Delta Water Quality Control Plan and the SWRCB's Phase 8 Water Rights hearing process. Short-term program includes actions and projects that would also improve water management and develop additional supplies. | USBR, DWR and agencies representing Sacramento River and Delta water users | X | X | X | Intended to benefit water quality in the Delta, and, in turn, ecosystem resources. This project would contribute to beneficial cumulative effects to the Delta. An NOI/NOP and Scoping Report were published in 2003 (DWR, 2007c). |
| Long-Term CVP and SWP Operations Criteria and Plan (OCAP) - ESA Reconsultation | Sets standards for operation of the integrated SWP and CVP. OCAP and associated Biological Opinions set operating terms and conditions, including the instream habitat conditions to be maintained. Due to both environmental and regulatory changes since the last OCAP update in 2004, the USBR has requested reinitiation of the Section 7 Endangered Species Act consultation with the USFWS and NMFS. | DWR, USBR | X | X | X | Could contribute to both beneficial and adverse cumulative effects on the Delta. The Biological Opinions are expected to be complete by mid-2008 (MWD, 2007). |
| Central Valley Project Long-Term Contract Renewals | Renewal of the CVP long-term service contracts. Process includes a current water needs assessment for each contractor. Decisions issued to date for Sacramento Division, Sacramento River Settlement Contracts, Delta-Mendota Canal Division, Friant Division and several individual contracts. Others ongoing, to be completed after the Long-term OCAP. | DWR, USBR | X | | | Could contribute to both beneficial and adverse cumulative effects on the Delta and San Joaquin River. |

**TABLE 5.7-1 (Continued)**
**PROJECTS THAT COULD CONTRIBUTE TO CUMULATIVE EFFECTS ON THE SAN JOAQUIN RIVER AND/OR DELTA**

| Project Name | Description | Project Sponsor / Partners | Areas of Potential Effect Relevant to the WSIP (Adverse and/or Beneficial) | | | Potential Effects / Status |
|---|---|---|---|---|---|---|
| | | | Water Supply / Reliability | Water Quality | Habitat / Species | |
| Sacramento River Water Reliability Study | Implementation of a water supply consistent with the Water Forum objectives of establishing a Sacramento River diversion to meet the Placer-Sacramento region's water supply needs and to promote ecosystem preservation along the American River. | Reclamation, Place County Water Agency (PCWA), cities of Roseville and Sacramento, Sacramento Suburban Water District | X | | X | Could contribute to both beneficial and adverse cumulative effects on the Delta. Reclamation and PCWA issued NOI/NOP in 2003; environmental documentation in preparation. |
| Environmental Water Account (EWA) Water Purchase Program | The EWA provides protection to the fish of the Bay-Delta estuary at no uncompensated water cost to CVP or SWP water users. The program involves water supplies to replace water supply otherwise lost through changes in CVP or SWP operations | CALFED | X | X | X | Intended to contribute to beneficial effects on Delta fisheries. In a transitional phase as the short-term part sunsets at the end of 2007. Exploration of a transitional phase or long-term phase is underway. EIS/EIR is in preparation on the Long-term EWA program. Intended to contribute to cumulative beneficial effects on the Delta resources. |
| Freeport Regional Water Project | Partnership between the two agencies to build infrastructure for sharing of regional supply with a Sacramento River diversion. The project will supply EBMUD customers in dry years. | EBMUD and Sacramento County Water Agency (SCWA) | X | | | Could contribute to adverse effects on the Delta. The Final EIR certified in 2004; the USBR issued the ROD in 2005. Project beginning construction. |
| Oroville Facilities FERC Relicensing | Process required to renew the existing FERC license that expires in 2007 for DWR's Oroville Facilities (part of the SWP), operated primarily for water supply but also for power generation, flood control, environmental protection, recreation, and salinity control in the Delta. | DWR | X | X | X | This project has mitigation and license conditions intended to benefit fish and wildlife habitat and resources such that continued facilities operation should not contribute to adverse cumulative effects in the Delta. FERC issued Draft EIS in 2006. Final EIS issued in May 2007 (DWR, 2007d). |
| Monterey Amendment/Settlement Agreement | Amendments to DWR's SWP contracts. Notably, the Monterey Agreement revised water allocation procedures during shortages, transferred water from agricultural to municipal contractors and transferred the Kern Water Bank lands from state to local ownership. | DWR | X | | X | Could contribute to adverse cumulative effects on the Delta. NOP was issued in 2003 and Draft EIR is expected to be released in 2007. |
| CVPIA Water Acquisition Program | This program provides water to protect federal wildlife habitat/reserves in the Central Valley. | USBR | | | X | Contributes to cumulative beneficial effects on fish and wildlife habitat in the Central Valley – wildlife refuges. |

**TABLE 5.7-1 (Continued)**
**PROJECTS THAT COULD CONTRIBUTE TO CUMULATIVE EFFECTS ON THE SAN JOAQUIN RIVER AND/OR DELTA**

| Project Name | Description | Project Sponsor / Partners | Areas of Potential Effect Relevant to the WSIP (Adverse and/or Beneficial) | | | Potential Effects / Status |
|---|---|---|---|---|---|---|
| | | | Water Supply / Reliability | Water Quality | Habitat / Species | |
| Delta Improvements Package | A set of programs under CALFED to improve water supply reliability, improve water quality, and increase environmental protection. It outlines the conditions under which the SWP would be allowed to increase permitted export pumping to 8,500 cfs. | CALFED | | X | X | Intended to contribute to beneficial effects on the Delta and San Joaquin River. |
| Contra Costa Water District Alternative Intake Project | Drinking water quality project to relocate some of CCWD's existing water diversions to a new intake on Victoria Canal, which provides better water quality. No diversion increase. | CCWD | | X | | Project would not result in significant adverse effects on the Delta resources. Final EIS/EIR completed in 2006. This project is in the permitting and design phase. |
| CALFED Ecosystem Restoration Program | Program with actions to improve habitat and water quality in various regions of the Sacramento-San Joaquin water system. | CALFED | | X | X | Could contribute to cumulative benefits for fish and wildlife species, habitats, and ecological processes. |
| Bay Delta Habitat Conservation Plan | Conservation planning process underway to develop a habitat conservation plan/natural resources conservation plan to cover species in the Bay-Delta region and secure permits from agencies. | Resources Agency | | | X | Intended to protect Delta species. A MOA was issued in 2006. The plan is expected to be complete by 2009 (Resources Agency, 2007). |
| Trinity River Mainstream Fishery Restoration Program | Program to alleviate fish impacts due to CVP deliveries from the Trinity River, by increasing flow in the Trinity River, resulting in less water being imported to the Central Valley | USBR | | | X | Intended to benefit fishery resources in the Trinity River. This program could contribute to adverse cumulative effects on the Delta. Final EIS and ROD were issued in 2000; following resolution of litigation the ROD is now being implemented. |
| Isolated Delta Facility | Facility to convey water around the Delta for local supply and export through a hydraulically isolated channel. Represents substantial changes in CVP/SWP operations to benefit Delta environmental resources, water quality and water reliability | | X | X | X | This project includes elements intended to benefit the Delta environment, such as eliminating flow reversals in the south Delta. It could contribute to both beneficial and adverse effects on the Delta and San Joaquin River. |

**TABLE 5.7-1 (Continued)**
**PROJECTS THAT COULD CONTRIBUTE TO CUMULATIVE EFFECTS ON THE SAN JOAQUIN RIVER AND/OR DELTA**

| Project Name | Description | Project Sponsor / Partners | Areas of Potential Effect Relevant to the WSIP (Adverse and/or Beneficial) | | | Potential Effects / Status |
|---|---|---|---|---|---|---|
| | | | Water Supply / Reliability | Water Quality | Habitat / Species | |
| Dry Year Water Purchase Program | Instituted in 2001 to facilitate dry year water transfers among the CVP, SWP and third parties to reduce the hardship of water shortages and help public agencies throughout the state supplement their water supplies in dry years. The DWR provided transfers of 138.8 TAF from willing sellers in 2001, 22 TAF in 2002 and very little in 2003 and 2004. Mandatory reductions in California's use of Colorado River water could increase demand for water south of the Delta and increase acquisitions under the Dry Year Program | DWR | X | | | Could contribute to adverse effects in the Delta as a result of increased supply deliveries during dry years that would, in turn, reduce Delta inflow. |
| Davis-Woodland Water Supply Project | Provide a reliable water supply for future needs, improve water quality for drinking water purposes, and improve the quality of treated wastewater effluent discharged by the project partners. Project partners would divert up to 46.1 TAF/year of surface water from the Sacramento River and convey it for treatment and use in the cities of Davis and Woodland. | City of Davis, City of Woodland, University of California, Davis | X | X | | Could contribute to adverse effects. The additional water provided by this project would be commingled with the cities' existing groundwater supply, which would subsequently improve drinking water quality. The DEIR was released April 2007. |
| Yuba River Accord | Three separate but interrelated agreements that would establish higher instream flow requirements to protect lower Yuba River fish species. Improved water supply reliability for the DWR and USBR, including a commitment of 60,000 acre-feet per year for the EWA and up to an additional 140,000 acre-feet of water in dry years for the SWP and CVP. Improved water supply reliability for Yuba County's farmers. | USBR, DWR, Yuba County Water Agency | X | | X | Pilot program for 2007 is underway. NOI/NOP issued in 2005. Draft EIS/EIR due in 2007. (Yuba County Water Agency, 2007). |

CCWD = Contra Costa Water District
CVP = Central Valley Project
CVPIA = Central Valley Project Improvement Act
DEIR = Draft Environmental Impact Report
DWR = California Department of Water Resources
EBMUD = East Bay Municipal Utility District
EIR/EIS = Environmental Impact Report / Environmental Impact Statement
EWA = Environmental Water Account
FERC = Federal Energy Regulatory Commission
NMFS = National Marine Fisheries Service
NOA = Notice of Availability
NOI = Notice of Intent
NOP = Notice of Preparation
OCAP = Operations Criteria and Plan
ROD = Record of Decision
RWQCB = Regional Water Quality Control Board
SWP = State Water Project
SWRCB = State Water Resources Control Board
TAF = thousand acre-feet
TMDL = total maximum daily load
USBR = U.S. Bureau of Reclamation
USFWS = U.S. Fish and Wildlife Service

Modeling studies completed by Friant concluded that implementation of the settlement agreement would be expected to reduce deliveries to Friant Division long-term water contractors by an average of about 170,000 afy (15 percent). Friant plans to develop and implement tools as part of the agreement to reduce or avoid water supply impacts by utilizing surplus water primarily to enhance groundwater programs, and also by developing programs to return water to Friant water users through recapture, recirculation, transfers, and exchanges. Thus, in the future, the San Joaquin River will carry more flow downstream toward the Delta than it does today, although some of the proposed releases might be recaptured and recirculated before they reach the Delta or even the confluence with the Tuolumne River.

The parties to the settlement agreement have filed a joint motion seeking U.S. District Court approval to implement the agreement. In addition, because the DOI will have primary responsibility for implementing the agreement, federal legislation is being proposed to authorize the DOI to implement the settlement agreement.

**Stanislaus River.** The USBR will continue to operate New Melones Reservoir for water supply and flood control purposes and to implement Central Valley Project Improvement Act Section 3406 (b)(2) water releases to improve habitat conditions for anadromous fish. Although no specific future projects were identified on this river, as noted in Table 5.7-1, projects such as the Delta-Mendota Canal Recirculation Feasibility Study might affect the Stanislaus River by reducing the need for the USBR to make releases from New Melones Reservoir to meet water quality and/or fisheries objectives downstream on the San Joaquin River or in the Delta.

**Sacramento–San Joaquin Delta.** As Table 5.7-1 illustrates, numerous future projects and activities affecting the Delta have been proposed—many sponsored under state and federal programs to improve and enhance the Delta for multiple objectives, including habitat and species protection and restoration, improved water quality, increased water supply and supply reliability, and Delta levee protection. Approximately 16 of these projects include enhancement of the Delta ecosystem resources as one of the key objectives. Twenty-seven of these programs target improving conditions to support water supply uses and reliability, while 26 projects are also specifically intended to improve water quality. Select relevant projects from among those listed on Table 5.7-1 are referenced below in the impact discussion to represent how these future projects might affect cumulative conditions in the Delta.

## 5.7.2.2 Cumulative Impacts

### *Significance Criteria*

The CCSF has not formally adopted significance standards for impacts related to cumulative effects, but generally considers that implementation of the proposed program would have significant cumulative impacts if it were to:

- Have impacts that would be individually limited, but cumulatively considerable (“cumulatively considerable” means that the incremental effects of a project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)

Impacts associated with the proposed program that would be "individually limited" are based on the impact analyses presented in Section 5.3 and the significance criteria presented in that section for the various environmental resource topics.

### *Approach to Analysis and Impact Summary*

Cumulative impacts are analyzed based on the CEQA guidance and approach described above in Section 5.7.1. Cumulative impacts are discussed below, and impact significance determinations are summarized in **Table 5.7-2**.

**TABLE 5.7-2**
**SUMMARY OF CUMULATIVE IMPACTS IN THE TUOLUMNE RIVER SYSTEM AND DOWNSTREAM WATER BODIES RELATED TO WSIP WATER SUPPLY AND SYSTEM OPERATIONS**

| | Significance Determination | | | | | | |
|---|---|---|---|---|---|---|---|
| **Impact** | Hydrology | Geomorphology | Surface Water Quality | Groundwater | Fisheries | Terrestrial Biology | Recreation / Visual Quality |
| 5.7.2-1: Cumulative impacts on the Tuolumne River from Hetch Hetchy Reservoir to Don Pedro Reservoir | LS | LS | LS | LS | LS | LS | LS |
| 5.7.2-2: Cumulative impacts on the Tuolumne River from Don Pedro Reservoir to the San Joaquin River | LS | LS | LS | LS | LS | LS | LS |
| 5.7.2-3: Cumulative impacts on the San Joaquin River, Stanislaus River, and Delta | LS | LS | LS | LS | LS | LS | LS |

NOTE: Significance determinations presented in this table assume implementation of all mitigation measures presented in Chapter 5, Section 5.3, and described in Chapter 6.

LS = Less than Significant, no mitigation required

Because impacts on stream flow and reservoir levels are related to effects on other environmental resources (see Section 5.1), the cumulative impacts in this section are organized by geographic area rather than by environmental topic in order to characterize the overall effects on the affected water body. In determining the significance of cumulative impacts, it is assumed that mitigation measures identified in Section 5.3 and described in Chapter 6 would be implemented, and any residual effects after mitigation are considered in combination with the effects of past, other current and probable future projects. The incremental contribution of the program's residual effects to the overall cumulative impact is then examined to determine whether it would be "cumulatively considerable."

## *Tuolumne River – Hetch Hetchy Reservoir to Don Pedro Reservoir*

**Impact 5.7.2-1: Cumulative impacts on the Tuolumne River from Hetch Hetchy Reservoir to Don Pedro Reservoir.**

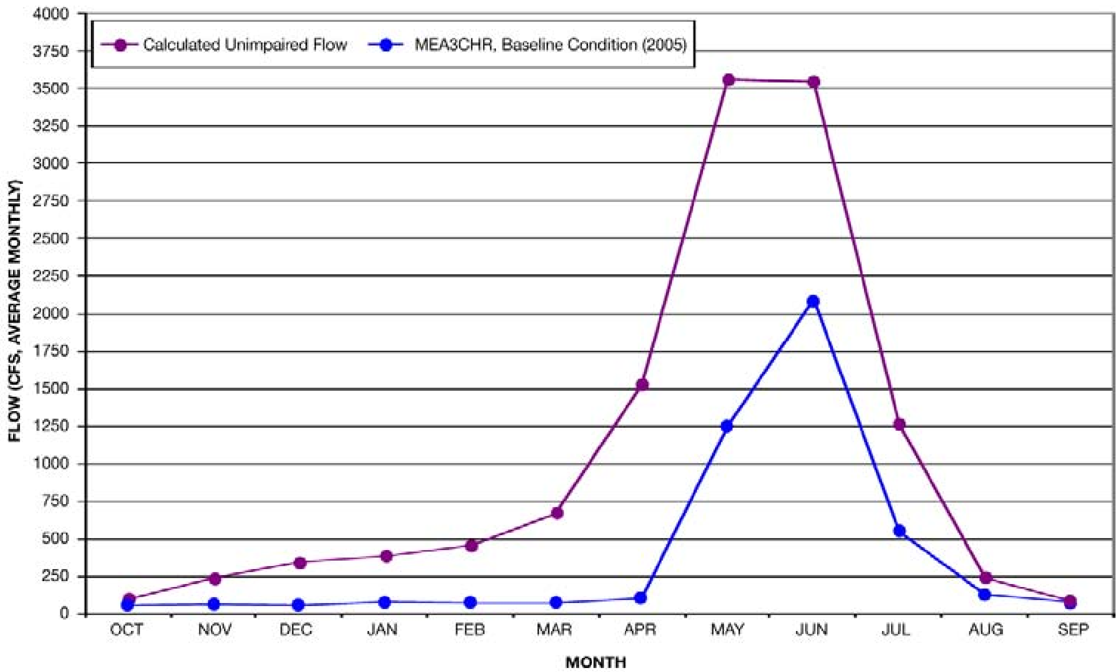
### Effect of Past and Present Projects

**Hydrology.** Construction and operation of the SFPUC regional water system has substantially altered the hydrology of the Tuolumne River below Hetch Hetchy Reservoir. Average annual "unimpaired flow" in the Tuolumne River at Hetch Hetchy Reservoir is estimated to be about 750,000 acre-feet (Beck, 1992). Unimpaired flow is the flow in the river that would have occurred if there were no upstream water diversions or storage reservoirs. For the Tuolumne River, unimpaired flow is roughly equivalent to "natural flow"; that is, the flow that would have occurred prior to Euro-American settlement.

Currently, the SFPUC diverts about 63 percent of the average annual unimpaired flow of the river at Hetch Hetchy Reservoir (472,500 afy) for water supply and hydropower generation. About half of the water diverted at Hetch Hetchy Reservoir is conveyed to the Bay Area and used for municipal water supply. Most of the other half is used to generate electrical power at the Kirkwood Powerhouse and then is discharged back to the river at Early Intake, about 10 miles downstream of Hetch Hetchy Reservoir. About 5 percent of the water diverted at Hetch Hetchy Reservoir is discharged to Moccasin Creek, which flows to Don Pedro Reservoir. Thus, operation of the regional water system currently reduces average annual flow in the Tuolumne River immediately below Hetch Hetchy Reservoir to 37 percent of its historical value. The percentage reduction in flow decreases in a downstream direction as tributaries add flow and diverted water is returned to the river at Early Intake and Don Pedro Reservoir. Downstream, at Don Pedro Reservoir, the current SFPUC diversion represents approximately 13 percent of unimpaired flows. The relationship between the water supply facilities and the river is shown diagrammatically in Figure 5.3.1-2.

Operation of the regional water system has not only altered the total volume of flow in the river, but has also altered the pattern of flow. **Figure 5.7-1** shows the average monthly unimpaired and current flow in the Tuolumne River below Hetch Hetchy Reservoir. Operation of the reservoir has resulted in the delay of springtime flow increases and a reduction in peak flows.

The construction of Lake Lloyd and Lake Eleanor altered the hydrology of Cherry and Eleanor Creeks, respectively. Lake Lloyd retains snowmelt, which would have otherwise flowed downstream in Cherry Creek to the Tuolumne River. Most of the retained water is conveyed to Holm Powerhouse via the Cherry Power Tunnel and released to the creek just above its confluence with the Tuolumne River. Snowmelt stored in Lake Eleanor is conveyed in a tunnel to Lake Lloyd. The operations of the two reservoirs have resulted in decreases in both peak flow and total flow in Cherry and Eleanor Creeks below the dams.




*SFPUC Water System Improvement Program ▪ 203287*

**Figure 5.7-1**
Current and Unimpaired Average Monthly Flows in the Tuolumne River Below Hetch Hetchy Reservoir

In summary, past construction and continued operation of the regional water system has had a substantial effect on the hydrology of Cherry Creek, Eleanor Creek, and the Tuolumne River between Hetch Hetchy and Don Pedro Reservoirs. A substantially smaller total annual volume of water flows down the rivers and creeks compared to unimpaired conditions. Peak flows have been much reduced, and seasonal flow patterns have been altered. The hydrologic changes have had an adverse effect on the river's aquatic and riparian wildlife habitat, as described below.

**Geomorphology.** River channels exist in a state of dynamic equilibrium with their watersheds. When conditions in the watershed change, the dynamic equilibrium is disturbed, and river channel geomorphology, or "form," adjusts to the new conditions. From the beginning of the 20th century to the present, the SFPUC has built new water system facilities and increased diversions to keep pace with municipal water and power demands; these facilities and operations have progressively altered conditions in the watershed, primarily by reducing river flow. The form of the river channel continues to adjust to the changing conditions.

Peak, or flood, flows are the predominant influence on river channel geomorphology. Hetch Hetchy Reservoir and the associated diversions have had a substantial effect on the magnitude, duration, and frequency of flood flows. **Table 5.7-3** shows the estimated magnitude of flood peaks in the Tuolumne River below Hetch Hetchy Reservoir before and after completion of the reservoir. The table shows that peak flows with a given frequency of occurrence were reduced by

**TABLE 5.7-3**
**ESTIMATED FLOOD PEAKS IN THE TUOLUMNE RIVER BELOW HETCH HETCHY RESERVOIR**
**(cubic feet per second)**

| Recurrence Interval (Years) | Pre–Hetch Hetchy Reservoir | Post–Hetch Hetchy Reservoir[c] | Percent Change |
|---|---|---|---|
| 1.5 | 8,294[a] | 3,455 | -58 |
| 2.33 | 8,500[a] | 5,734 | -33 |
| 5 | 10,147[a] | 8,281 | -18 |
| 10 | 15,660[b] | 10,056 | -36 |
| 25 | 31,795[b] | 13,044 | -59 |
| 50 | 33,504[b] | 14,918 | -55 |

[a] Calculated from measured flows at Hetch Hetchy (1911–1922).
[b] Estimated using data from the Merced River.
[c] Calculated from measured flows below O'Shaughnessy Dam (1939–2002).

SOURCE: RMC Water and Environment and McBain and Trush, 2006.

18 to 59 percent following construction of the reservoir. For example, the peak flow expected to occur once in every 50 years without Hetch Hetchy Reservoir would be about 33,500 cfs, and with the reservoir in place is about 15,000 cfs, a reduction of 55 percent.

River channel form also depends on the free downstream movement of bedload (i.e., the silt, sand, gravel, and boulders transported by the stream). Hetch Hetchy Reservoir and Lakes Lloyd and Eleanor prevent the downstream movement of bedload. River channels deprived of bedload are subject to more erosion than those with a normal supply.

In summary, past construction and continued operation of the regional water system has had a substantial adverse effect on the geomorphology of the Tuolumne River and its tributaries. Channel-forming peak flows in the river are substantially smaller than under unimpaired conditions, and the reservoirs prevent the downstream movement of bedload, which leads to erosion in the river reaches below dams.

**Surface Water Quality.** Although past and present projects have had a substantial effect on stream flow and geomorphological conditions in the Tuolumne River between Hetch Hetchy and Don Pedro Reservoirs, they have probably not had much effect on water quality. Water quality in the Tuolumne River prior to construction and operation of the regional water system was excellent, and it remains so under existing conditions.

The capture and storage of water in Hetch Hetchy Reservoir and Lakes Lloyd and Eleanor affect the temperature of water in the reservoirs and in the streams below the reservoirs. It also reduces the dissolved oxygen content of water in the reservoirs, although any oxygen depletion is rapidly corrected by the release of turbulent water to the streams below the reservoirs, which enables rapid re-aeration. The temperature of surface waters in the reservoirs rises in the spring and summer with exposure to solar radiation, but the deeper waters remain cool. Almost all of the time, water is released from the reservoirs from the cooler pool of deep water, so water temperature in the streams below the reservoirs is probably similar to historical temperatures and may even be lower at times.

The reduction in flow in the river as a result of past and present projects causes water temperature to rise more rapidly in the early summer months than under unimpaired conditions. Solar radiation heats streams with low flows more rapidly than streams with greater flows. However, any changes in temperature attributable to past and present projects has not lessened the Tuolumne River's ability to support its beneficial uses, as designated by the Central Valley Regional Water Quality Control Board.

**Groundwater.** From Hetch Hetchy Reservoir to Don Pedro Reservoir, the Tuolumne River flows through a deep canyon in mountainous terrain. Most of the bed of the river is exposed rock. There are no large groundwater bodies, but small groundwater bodies are probably associated with limited alluvial deposits and a few riverside meadows, such as the meadow in the Poopenaut Valley. Changes in the surface water hydrology of the river attributable to past and present projects have probably had no effect on groundwater quality. By delaying the advent of large spring flows in the river and reducing the magnitude of peak flows, past and present projects have reduced the frequency and extent of flooding of the few riverside meadows, which has probably reduced groundwater levels underlying the meadows.

**Fisheries.** Past and present projects have substantially reduced stream flow in the Tuolumne River between Hetch Hetchy and Don Pedro Reservoirs in most months. The reduction in stream flow has reduced the extent of spawning habitat for resident trout. The variability of daily flows as a result of hydropower operations, and flow shaping to facilitate river rafting, has also reduced the suitability of the river as habitat for trout by increasing the risk of stranding and causing possible unintended downstream movement of juvenile fish. The construction of dams and reservoirs has decreased the ability of river fish to move upstream and downstream, but has increased the availability of habitat for fish that are adapted to life in lakes. Overall, past construction and continued operation of the regional water system has had a substantial adverse effect on the fishery resources of the Tuolumne River between Hetch Hetchy and Don Pedro Reservoirs.

**Terrestrial Biology.** When Hetch Hetchy Reservoir and Lakes Lloyd and Eleanor were built, a large area of terrestrial wildlife habitat within river canyons was inundated. Changes in river hydrology attributable to past and present projects probably damaged some riparian areas and streamside meadows, but other riparian habitats may have expanded as the river channel adjusted to the new flow regime. Overall, past construction and continued operation of the regional water system has had a substantial adverse effect on the terrestrial biological resources of the Tuolumne River corridor between Hetch Hetchy and Don Pedro Reservoirs.

**Recreation and Visual Quality.** Changes in river hydrology attributable to past and present projects may have improved whitewater recreation by reducing the magnitude of the unrunnable spring flood flows and extending the season in which the river can be run by commercial rafters. The changes in river hydrology that have reduced fish habitat may have also reduced angling success.

When the regional water system was built, sections of scenic river canyons were inundated to form artificial lakes. A vegetation-free zone extends around the perimeter of the lakes in the area and is visible when the reservoir is drawn down. The lakes provide a different visual experience than the canyons they replaced. The reduction in flow in the river as a result of past and present projects has also altered the appearance of the river corridor in some months. Dams and associated water and power facilities have introduced prominent man-made features into an entirely undeveloped scenic area. Overall, past construction and continued operation of the regional water system has had a substantial adverse effect on the visual resources of the Tuolumne River corridor between Hetch Hetchy and Don Pedro Reservoirs.

#### Potential Effects of Future Projects

This section describes the potential effects of the following projects: Hetch Hetchy Communications System Upgrade Project, the Hetch Hetchy Repair and Rehabilitation Program, discretionary fishery releases from Hetch Hetchy Reservoir, the SFPUC's Watershed and Environmental Improvement Program, the Don Pedro Pumped Storage Project, and the Tuolumne Wild and Scenic River Comprehensive Management Plan.

The Hetch Hetchy Communications System Upgrade Project is currently undergoing environmental review, and it is expected that the potential adverse impacts resulting from construction of the project would be reduced to a less-than-significant level through implementation of conventional construction mitigation measures. The communications upgrade project would not be expected to have long-term significant adverse effects on the environment.

The Hetch Hetchy Repair and Rehabilitation Program consists of a number of small projects that would be implemented over a several-year period. The projects could have short-term adverse impacts on water quality, fisheries, terrestrial biological, and other environmental resources during the construction period. However, adverse impacts would likely be reduced to a less-than-significant level through implementation of conventional construction mitigation measures, including the SFPUC standard construction measures. The project would not likely cause any long-term adverse environmental impacts.

The discretionary fishery releases from Hetch Hetchy Reservoir could have an effect on hydrology, water quality, fisheries, and terrestrial biological resources. However, the releases would be expected to have little or no effect on geomorphology, groundwater, and recreational and visual resources.

Even though no specific actions have been identified, it is expected that the Tuolumne Wild and Scenic River Comprehensive Management Plan would have a beneficial impact on hydrology, geomorphology, groundwater, surface water quality, fisheries, terrestrial biological resources, and visual resources. Similarly, the SFPUC's Watershed and Environmental Improvement Program would result in beneficial impacts on the same resources.

The Don Pedro Pumped Storage Project is defined only in concept, so its potential environmental impacts can only be described in general terms. The project would involve large-scale construction in the vicinity of Don Pedro Reservoir. Most, and perhaps all, of the short-term construction impacts would be reduced to a less-than-significant level through implementation of conventional construction mitigation measures. The project would inundate several hundred acres of undeveloped land and would require the construction of a dam several hundred feet high and more than 1,000 feet long, a combined powerhouse and pump station, pipelines, and electrical power transmission lines. Once complete, the project would likely be a prominent landscape feature and have long-term adverse impacts on visual quality. The project would have no effect on flow in the Tuolumne River and little effect on water levels in Don Pedro Reservoir.

**Hydrology.** The current daily minimum required releases from Hetch Hetchy Reservoir to the Tuolumne River are shown in Section 5.3.1, Table 5.3.1-2. As described in Section 5.3, the analysis of the direct impacts of the WSIP assumed that the same minimum releases would be required in 2030. For the cumulative impact analysis, it was also assumed that the discretionary flow releases would increase the required minimum releases from Hetch Hetchy Reservoir in July, August, and September.

Although USFWS did not establish the specific months for release, July through September are analyzed here as reasonable assumptions because they represent the summer season when trout could likely benefit from additional flow (as snowmelt releases from the reservoir diminish) and they represent the months when additional releases would have the greatest potential effect on water supply. The effect on water supply would reduce the amount of water in reservoir storage and require capture of more snowmelt the following spring to refill the reservoir. Additional flow releases in these three summer months were analyzed to assess the potential effects of such a release on top of WSIP operation.

**Table 5.7-4** shows the estimated minimum required releases with the addition of the discretionary flow releases under three different hydrologic conditions. These hydrologic conditions are referred to as Type A, Type B, and Type C and are defined in Table 5.3.1-2 and the accompanying text. The assumption that the discretionary releases would be made in the summer was based on the fact that early discussions between the SFPUC and the USFWS envisaged a summer release. It is only an assumption, however, because the SFPUC and USFWS are currently engaged in studies designed to determine whether a release is needed to improve conditions for resident trout and, if needed, when the releases should be made.

A discretionary release from Hetch Hetchy Reservoir at any time of the year except in the spring would be made by drawing water from storage in the reservoir and thus would lower water levels in the reservoir compared to the existing condition (without the discretionary release). Water drawn as a result of the discretionary release would need to be replaced in the subsequent spring. If it is ultimately decided that the discretionary release should be made in the spring, then in some years, target flows below Hetch Hetchy Reservoir might be achievable without drawing the reservoir down, because enough snowmelt would be available in some years to both refill the reservoir and make the releases.

**TABLE 5.7-4**
**HETCH HETCHY RESERVOIR MODELED MINIMUM STREAM RELEASES WITH DISCRETIONARY FLOW FISHERY RELEASES[a,b]**
**(all values in acre-feet)**

| Month | Type A | | | Type B | | | Type C | | |
|---|---|---|---|---|---|---|---|---|---|
| | Release | Discretionary Release | Total Release | Release | Discretionary Release | Total Release | Release | Discretionary Release | Total Release |
| October | 3,689 | 0 | 3,689 | 3,074 | 0 | 3,074 | 2,152 | 0 | 2,152 |
| November | 3,570 | 0 | 3,570 | 2,975 | 0 | 2,975 | 2,083 | 0 | 2,083 |
| December | 3,074 | 0 | 3,074 | 2,460 | 0 | 2,460 | 2,152 | 0 | 2,152 |
| January | 3,074 | 0 | 3,074 | 2,460 | 0 | 2,460 | 2,152 | 0 | 2,152 |
| February | 3,362 | 0 | 3,362 | 2,802 | 0 | 2,802 | 1,961 | 0 | 1,961 |
| March | 3,689 | 0 | 3,689 | 3,074 | 0 | 3,074 | 2,152 | 0 | 2,152 |
| April | 4,463 | 0 | 4,463 | 3,868 | 0 | 3,868 | 2,083 | 0 | 2,083 |
| May | 6,149 | 0 | 6,149 | 4,919 | 0 | 4,919 | 3,074 | 0 | 3,074 |
| June | 7,438 | 0 | 7,438 | 6,545 | 0 | 6,545 | 4,463 | 0 | 4,463 |
| July | 7,686 | 6,000 | 13,686 | 6,764 | 2,600 | 9,364 | 4,612 | 1,800 | 6,412 |
| August | 7,686 | 6,000 | 13,686 | 6,764 | 2,500 | 9,264 | 4,612 | 1,800 | 6,412 |
| September | 5,316 | 3,000 | 8,316 | 4,284 | 1,400 | 5,684 | 3,669 | 800 | 4,469 |
| **Total** | **59,196** | **15,000** | **74,196** | **49,989** | **6,500** | **56,489** | **35,165** | **4,400** | **39,565** |

[a] If the July 1 first-of-month storage at Hetch Hetchy Reservoir is less than 210,000 acre-feet, the fishery release schedule would not require a discretionary release.
[b] If diversion into Canyon Power Tunnel exceeds 920 cfs, the flow release is increased by 64 cfs, or up to 3,928 acre-feet per month. This is not included in this table.

Compared to the existing condition, the assumed discretionary flow releases would increase flow in the Tuolumne River immediately below Hetch Hetchy Reservoir by 22 to 78 percent in July, August, and September, with the percentage increase depending on hydrologic conditions. Because the release would increase drawdown of Hetch Hetchy Reservoir during the summer months (except during very dry or very wet years), it would increase the amount of water needed to refill the reservoir in a subsequent spring, thus delaying and reducing the duration of high spring flows in the river below the reservoir compared to the existing condition.

The effects of the assumed summertime discretionary release on the timing of spring releases from Hetch Hetchy Reservoir would be similar in kind to those of the WSIP. The assumed summertime discretionary flow releases would reduce spring releases to the Tuolumne River below Hetch Hetchy Reservoir by an annual average of about 4,100 acre-feet because more snowmelt would need to be captured to refill the reservoir after the previous years' summertime releases. Because more snowmelt would need to be captured to refill the reservoir after the previous years' summertime releases, the reduction in annual releases would range from zero in some years up to about 18,400 acre-feet. The reduction in release would manifest itself as a delay in spring releases of up to about three days, after which the release pattern would be the same as under the existing condition. A delay in spring releases of only up to three days would not represent a substantial change in the timing of spring flows in the river. Under existing conditions, the beginning of the higher spring releases varies by a few days from year to year depending on year type. This small delay in spring releases would result in less-than-significant hydrology effects compared to the existing condition.

It is expected that the SFPUC and USFWS will consider the findings of this impact analysis as they evaluate how and if to implement these discretionary flow releases to benefit resident fish. While a release of additional flow in summer months could benefit fish in that summer, it results in potentially adverse effects in the following spring. Although this adverse effect is found to be less than significant, the USFWS may want to modify the timing of such releases, if warranted, to minimize any potential adverse effects.

**Surface Water Quality.** Water for the assumed summertime discretionary flow releases would be drawn from the pool of cool water deep within Hetch Hetchy Reservoir. Water temperature in the stream increases in a downstream direction below the release point under the influence of solar radiation. Greater flow in the stream in the summer months would retard the rate of temperature increase. Overall, the discretionary fishery releases would have a modestly beneficial effect on water quality.

**Fisheries.** The increase in summer flow and decrease in water temperature that would result from the discretionary flow releases would likely benefit resident fish in the reach of the river below Hetch Hetchy Reservoir during the summer. The delay of a few days in large spring releases from Hetch Hetchy Reservoir that would occur as a result of the summertime discretionary flow releases would have a minor adverse effect on the availability of spawning habitat for resident trout. Overall, the assumed summertime discretionary fishery releases would likely have a beneficial effect on fish and fish habitat, although, as noted earlier, studies are in progress to determine whether the releases would be beneficial and, if so, how they should be implemented.

**Terrestrial Biology.** The Tuolumne River between Hetch Hetchy and Don Pedro Reservoirs lies within a deep canyon and flows primarily over a rock bed; nonetheless, there are a number of locations where alluvial materials have accumulated and riparian vegetation has become established. The vegetation depends on groundwater that is recharged during large springtime flows. As a result of the assumed summertime discretionary flow releases, the commencement of the large spring releases from Hetch Hetchy Reservoir would be delayed for a few days and reduced in duration in some years, which could adversely affect groundwater recharge and riparian vegetation in riverside meadows and alluvial deposits. Because of the sensitivity of plant species in riverside meadows, the adverse impacts of reduced groundwater recharge could be significant if the discretionary releases were implemented as modeled here based on the initial assumptions. However, adverse impacts on plant species in riverside meadows are unlikely to be acceptable to USFWS. It is expected that the USFWS will consider the findings of this impact analysis on the proposed discretionary releases and incorporate them into current studies regarding how and if to implement these releases. As discussed above, the USFWS did not previously specify that these releases must be made in July through September. Because of the potential effect that a delay in spring releases might have on riverside meadows along the Tuolumne River below Hetch Hetchy, it is assumed that the USFWS would modify the release schedule to avoid this potential impact or otherwise incorporate measures to reduce such effects to a less-than-significant level (such as the action proposed in WSIP Measure 5.3.7-2, Controlled Releases to Recharge Groundwater in Streamside Meadows and Other Alluvial Deposits). It is assumed that the USFWS would require that any discretionary releases be made in a manner that would not be injurious to special status plants. Therefore, it is assumed that the impacts of discretionary releases on meadow plants would be less than significant.

**Recreation and Visual Quality.** The Hetch Hetchy Communications System Upgrade Project would include three new microwave towers and equipment shelters at undeveloped sites. One site would be located on land owned by the CCSF below Cherry Dam, one at Burnout Ridge in the Stanislaus National Forest, and one at Poopenaut Pass in Yosemite National Park. The preliminary analysis indicates that the visual impact of the new towers in the Tuolumne River corridor can be reduced to a less-than-significant level through implementation of appropriate mitigation measures (SFPUC, 2007).

The assumed summertime discretionary flow release would make it slightly easier to maintain adequate flows between the Cherry Creek confluence and Don Pedro Reservoir for rafting. This could result in a slight increase in the length of the rafting season, a modestly beneficial effect. If it is ultimately determined that the discretionary releases should be made at some time other than the summer, then they would have no effect on the rafting season.

#### Cumulative Effects and WSIP Contribution

**Table 5.7-5** summarizes the effects of past and present projects, the impacts of the WSIP, the effects of probable future projects, and the combined impacts of the WSIP plus probable future projects on the Tuolumne River between Hetch Hetchy Reservoir and La Grange Dam. Past and present projects have substantially altered the hydrology, geomorphology, fisheries, and terrestrial biology of this river reach compared to pre-Euro-American settlement conditions.

Water quality, groundwater, and visual and recreational resources have been moderately altered. The existing condition, which serves as the baseline for the analysis of the WSIP, reflects the substantial environmental changes that have occurred as a result of the past and present projects. Because past and present actions have altered this river reach, some of the reach's environmental resources are more sensitive to small adverse changes than they would be if the reach had remained relatively unaltered from pre-Euro-American settlement conditions.

As described in Section 5.3, the WSIP would have a less-than-significant adverse impact on hydrology, geomorphology, surface water quality, groundwater, fisheries, and recreational and visual resources. It would have a less-than-significant impact on terrestrial biological resources after mitigation (Measure 5.3.7-2). As described in the previous section, probable future projects would have less-than-significant impacts on hydrology, geomorphology, surface water quality, groundwater, terrestrial biological resources, and recreation and visual resources. These projects would have beneficial impacts on fisheries.

**TABLE 5.7-5**
**CUMULATIVE EFFECTS ON THE TUOLUMNE RIVER BETWEEN HETCH HETCHY AND DON PEDRO RESERVOIRS**

| Resource | Effects of Past and Present Projects | Impacts of WSIP (prior to mitigation/after mitigation) | Effects of Future Projects | Cumulative Impact (WSIP after mitigation + Future Projects) | WSIP Contribution Cumulatively Considerable? |
|---|---|---|---|---|---|
| Hydrology | SA | LS | LS | LS | No |
| Geomorphology | SA | LS | LS | LS | No |
| Surface Water Quality | MA | LS | LS | LS | No |
| Groundwater | MA | LS | LS | LS | No |
| Fisheries | SA | LS | B | LS | No |
| Terrestrial Biology | SA | PSM/LS | LS | LS | No |
| Recreation/Visual Quality | MA | LS | LS | LS | No |

B = Beneficial impact
LS = Less than Significant, no mitigation required
PSM/LS = Potentially Significant but reduced to Less than Significant with mitigation
SA = Substantially Altered
MA = Moderately Altered

When the WSIP and foreseeable future projects are considered together, none of their cumulative effects would rise to a level of significance. Even though past and present projects have moderately to substantially altered the environmental resources along this reach of the Tuolumne River, the cumulative impacts of the WSIP after mitigation combined with the effects of future projects would not result in a substantial or noticeable change from the existing condition. In particular, the WSIP's impacts on terrestrial biology would be expected to be substantially avoided with implementation of Measure 5.3.7-2. Further, as described under Terrestrial Biology on the previous page, it is expected that the USFWS would require that future discretionary releases be made in a manner that is protective of biological resources. Thus, the cumulative impact on terrestrial biology would be considered less than significant. Because there are no significant cumulative impacts, no mitigation measures beyond Measure 5.3.7-2 would be necessary.

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## *Tuolumne River – Don Pedro Reservoir to the San Joaquin River*

### Impact 5.7.2-2: Cumulative impacts on the Tuolumne River from Don Pedro Reservoir to the San Joaquin River.

#### Effect of Past and Present Projects

**Hydrology.** Construction and operation of the SFPUC regional water system and TID's and MID's water supply facilities, including Don Pedro Reservoir, La Grange Dam, and the Turlock and Modesto Canals, have substantially altered the hydrology of the Tuolumne River below La Grange Dam. Average annual unimpaired flow in the Tuolumne River at La Grange Dam is estimated to be about 1,850,000 acre-feet (Beck, 1992). Currently, the SFPUC, TID, and MID divert an average of about 63.8 percent of the unimpaired flow of the river at La Grange Dam for municipal and agricultural water supply. The SFPUC's upstream diversion reduces flow at La Grange Dam by about 298,500 afy, and TID and MID divert about 867,000 afy below the dam. Operation of the water supply facilities reduces average annual flow in the Tuolumne River below La Grange Dam to 36.2 percent of the unimpaired value. The percentage reduction in flow decreases in a downstream direction as groundwater infiltration, spills from irrigation canals, agricultural tailwater discharges, and tributaries add water to the river.

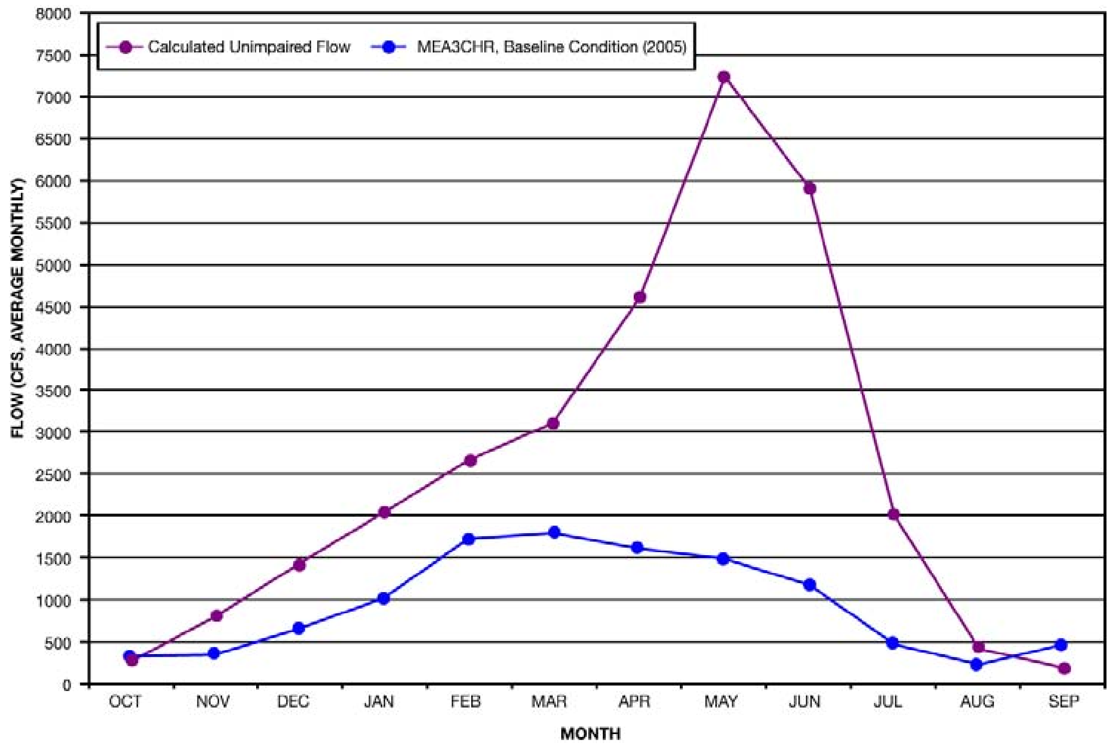
Operation of SFPUC, TID, and MID reservoirs and diversions has not only altered the total volume of flow in the river, but has also altered the pattern of flow. **Figure 5.7-2** shows the average monthly unimpaired and current flow in the Tuolumne River below La Grange Dam. The effect of upstream reservoirs and diversions is an overall reduction in flow, particularly in March through June, as well as a shifting in the seasonal occurrence of peak flows.

In summary, past construction and continued operation of the upstream reservoirs and diversions has had a substantial adverse effect on the hydrology of the Tuolumne River below La Grange Dam. The river is substantially smaller than under historical unimpaired conditions, and its flow regime is managed to provide water supply and hydropower.

**Geomorphology.** The river channel downstream of La Grange Dam has been modified by past gold and aggregate mining, agricultural and urban development within the river corridor, and past and present municipal and agricultural water supply operations. Gold mining involved dredging the sand and gravel from the riverbed and floodplain, extracting the gold, and piling the unwanted materials (referred to as tailings) along the river corridor. Mid- and late-19th century gold mining and the resulting tailings primarily affected a 10-mile reach of the river between La Grange Dam and Roberts Ferry. Some of the tailings were removed and used to construct Don Pedro Dam.

Instream and offstream gravel mining in a 16-mile reach of river corridor between Roberts Ferry and the community of Empire has created a number of water-filled pits. In addition, from Roberts Ferry to the confluence with the San Joaquin River, the Tuolumne River channel is confined by streamside agricultural and urban development and is often separated from the floodplain by privately owned levees. From the late 19th century to the present, the SFPUC, TID, and MID have built water system facilities and increased diversions to keep pace with water demand; these facilities and operations have progressively changed the magnitude and pattern of river flow. The channel of the Tuolumne River, greatly altered by mining and agricultural and urban development, is continually adjusting its form in response to these flow changes.

Peak, or flood, flows are the predominant influence on river channel geomorphology. The reservoirs and associated diversions on the Tuolumne River have had a substantial effect on the magnitude, duration, and frequency of flood flows. **Table 5.7-6** shows the estimated magnitude of flood peaks in the Tuolumne River below La Grange Dam before and after completion of Don Pedro Reservoir. The table shows that peak flows with a given frequency of occurrence were all reduced by 70 to 75 percent following construction of Don Pedro Reservoir. For example, the




*SFPUC Water System Improvement Program ▪ 203287*

**Figure 5.7-2**
Current and Unimpaired Average Monthly Flows in the Tuolumne River Below La Grange Dam

**TABLE 5.7-6**
**ESTIMATED FLOOD PEAKS IN THE TUOLUMNE RIVER BELOW LA GRANGE DAM**
**(cubic feet per second)**

| Recurrence Interval (Years) | Pre–Don Pedro Reservoir[a] | Post–Don Pedro Reservoir[b] | Percent Change |
|---|---|---|---|
| 1.5 | 8,360 | 2,400 | -71 |
| 2.0 | 12,100 | 3,350 | -72 |
| 5.0 | 25,000 | 6,700 | -73 |
| 10 | 36,000 | 9,900 | -73 |
| 25 | 54,000 | 15,200 | -72 |

[a] Estimated from measured flows below La Grange Dam (1897–1969).
[b] Estimated from measured flows below La Grange Dam (1970–2002), but excluding the January 1997 flood.

SOURCE: RMC Water and Environment and McBain and Trush, 2006.

peak flow expected to occur once in every 25 years without Hetch Hetchy and Don Pedro Reservoirs would be about 54,000 cfs; with the reservoirs in place, it is about 15,200 cfs, a reduction of 72 percent.

River channel form also depends on the free downstream movement of bedload; that is, the silt, sand, gravel and boulders transported by the stream. Don Pedro Reservoir and La Grange Dam prevent the downstream movement of bedload from the watershed above Don Pedro Reservoir.

In summary, past construction and continued operation of water storage and diversion facilities has had a substantial adverse effect on the geomorphology of the Tuolumne River and its tributaries. Channel-forming peak flows in the river are substantially smaller than under historical unimpaired conditions, and the reservoirs prevent the downstream movement of bedload.

**Surface Water Quality.** Although past and present projects have had a substantially adverse effect on stream flow and geomorphological conditions in the Tuolumne River between Don Pedro Reservoir and the San Joaquin River confluence, they have probably not had much effect on water quality. Water quality in the Tuolumne River prior to construction and operation of the reservoirs and diversions was excellent, and it remains good under the existing condition. Surface runoff from agricultural fields and urban areas and the discharge of groundwater contaminated with agricultural chemicals has caused some deterioration, particularly below the river's confluence with Dry Creek. The Central Valley Regional Water Quality Control Board has listed the lower Tuolumne River as impaired by diazanon and other pesticides. However, a recent study indicated that plant nutrient and pesticide concentrations are still very low (Stillwater Sciences, 2004).

As noted above, the capture and storage of water in reservoirs affects the temperature of water in both the reservoirs and the streams below the reservoirs. Because Don Pedro Reservoir is large, water is always released to the Tuolumne River from the cool pool of water deep within the reservoir. The water temperature in the river below La Grange Dam is probably similar to historical unimpaired conditions in the winter and spring, but may be cooler in the summer and early fall.

Because solar radiation heats small streams more rapidly than larger ones, the reduction in flow as a result of past and present projects and activities causes water temperatures under current conditions to rise more rapidly than under historical unimpaired conditions. In portions of the river, the past artificial widening of the river channel and the clearing of riparian vegetation has further accelerated the rate of temperature increase. The changes in water temperature attributable to past and present projects and activities have reduced but not eliminated the Tuolumne River's ability to support coldwater fish species, as reflected in the COLD beneficial use designation. The changes have probably limited the length of the river reach below La Grange Dam that is suitable for coldwater fish.

**Groundwater.** Much of the Tuolumne River between La Grange Dam and the confluence with the San Joaquin River flows over water-bearing alluvial deposits. The Modesto Groundwater Subbasin lies to the north of the river, and the Turlock Groundwater Subbasin lies to the south. Historically, the river recharged the groundwater basins in a short reach below La Grange Dam, and elsewhere groundwater discharged to the river. The same overall pattern of groundwater recharge and discharge to the river occurs under current conditions, but groundwater levels and quality have been affected by agricultural and urban development. About half of the Tuolumne River's unimpaired flow at Don Pedro Reservoir is diverted at La Grange Dam and applied to crops. A portion of the applied water percolates into the groundwater, raising levels in the upper aquifer and probably increasing discharge to the river. However, because some farmers and most municipalities obtain some or all of their water supplies from wells, groundwater levels have become depleted in some areas. As a result, in a five-mile-long reach of the river in Modesto, the river discharges to the groundwater basin rather than gaining from it.

Some of the fertilizers and pesticides applied to agricultural lands have percolated into the groundwater, and groundwater quality has deteriorated compared to historical conditions. Overall, past and present projects have both raised and lowered groundwater levels and caused groundwater quality to deteriorate substantially.

**Fisheries.** Past and present water projects prevent the downstream movement of bedload from the upper watershed to the Tuolumne River channel below La Grange Dam and have substantially reduced the volume and changed the pattern of stream flow in the river between the dam and the San Joaquin River confluence. Mining and agriculture have greatly altered the characteristics of the river channel. These changes have substantially reduced the extent and suitability of spawning and rearing habitat for migratory salmonids. The variability of daily flows as a result of hydropower operations has also reduced the suitability of habitat for fish by increasing the risk of stranding and causing unintended downstream movement of juvenile fish.

Prior to large-scale water development on the San Joaquin River and its tributaries, an estimated 300,000 to 500,000 salmon returned to the San Joaquin River watershed each year (Brown and Moyle, 1993). A substantial fraction of the salmon run probably returned to the Tuolumne River. In 1944, long after La Grange Dam had blocked access to the upper river, 130,000 spawners returned to the river (CDFG, 1946; Fry, 1961). Between 1971 and 2004, salmon runs averaged about 6,700 per year. The decline is probably due to many factors, including ocean conditions and increased levels of salmon fishing as well as cumulative habitat degradation as a result of water projects and other development in the Sacramento–San Joaquin Delta, the Tuolumne River drainage basin, and other parts of the San Joaquin River drainage basin. Overall, the past river channel modification and the construction and continued operation of the water supply facilities have had a substantial adverse effect on the fishery resources of the Tuolumne River between Don Pedro Reservoir and the San Joaquin River confluence.

**Terrestrial Biology.** When Don Pedro Reservoir was built (in 1923) and later expanded (in the late 1960s), large areas of terrestrial wildlife habitat within the canyons formed by the Tuolumne River and its tributaries upstream of the dam site were inundated. Gold mining more than a century ago and subsequent gravel mining and clearing of land for agriculture destroyed most of the riparian forest along the Tuolumne River corridor below La Grange Dam. Changes in river hydrology attributable to past and present water supply projects have also contributed to the destruction of the riparian forest. Overall, past mining, current agricultural activities, and the construction and continued operation of water supply facilities have had a substantial adverse effect on the terrestrial biological resources of the Tuolumne River corridor between La Grange Dam and the San Joaquin River.

**Recreation and Visual Quality.** When Don Pedro Reservoir was built and expanded, scenic river canyons were inundated to form an artificial lake. A vegetation-free zone extending around the perimeter of the reservoir is visible when the reservoir is drawn down. The reservoir has a different scenic value than the canyons it replaced.

Historically, a band of riparian forest up to five miles wide followed the Tuolumne River corridor from La Grange Dam to the confluence with the San Joaquin River. Almost all of the forest was destroyed by gold and gravel mining or cleared to make room for agriculture. The diminution of flow in the river as a result of past and present water supply projects has also contributed to the loss of riparian vegetation. Overall, past and present activities have altered the character and appearance of the river corridor from continuous riparian forest to a patchwork of open river channel, tailings, agricultural and urban lands, and forest remnants.

#### Potential Effects of Future Projects

This section describes the potential effects of the following projects: TID Infiltration Gallery Project, TID Regional Surface Water Supply Project, 1995 FERC Settlement Agreement, New Don Pedro Project FERC relicensing, and the expansion of the MID municipal water treatment plant.

The TID Infiltration Gallery Project and the TID Regional Surface Water Supply Project would result in an increase in flow in a 25-mile reach of the Tuolumne River below La Grange Dam that would likely have beneficial effects on biological resources. Flow requirements for the lower Tuolumne River below La Grange Dam will also be reexamined during the New Don Pedro Project FERC relicensing process in 2016; during this process, the current flow release schedules may be retained or modified. The 1995 FERC Settlement Agreement has led to the development of a habitat restoration plan which, if implemented, would benefit biological resources in the river corridor between La Grange Dam and the confluence with the San Joaquin River. None of these projects would be expected to have adverse environmental effects.

The existing 30-mgd capacity MID municipal water treatment plant is located adjacent to Modesto Reservoir, and it obtains its water supply from the reservoir. The Tuolumne River supplies water to Modesto Reservoir via the Modesto Canal. Water is diverted into the Modesto Canal at La Grange Dam. The supplemental EIR on the proposed expansion of the MID treatment plant indicates that the existing plant is operated in a way that does not increase the rate of diversion of water from the Tuolumne River at La Grange Dam. The supplemental EIR notes that this is possible because the increased use of water for municipal purposes in the MID service area is offset by a reduction in agricultural use as agricultural lands are converted to urban uses. The expanded treatment plant would be operated in the same way as the existing plant. Like the existing plant, the expanded plant would not alter the total volume of water diverted by MID at La Grange Dam, but it would slightly alter the seasonal pattern of diversions and releases to the Tuolumne River at La Grange. The supplemental EIR on the expansion project indicates that there would be no substantial changes in releases to the Tuolumne River from La Grange Dam as a result of the project (Jones and Stokes, 2004).

**Hydrology.** The Infiltration Gallery Project as originally envisaged would have changed the point of diversion for some of TID's agricultural water supply. Water that would otherwise have been diverted at La Grange Dam and conveyed to farmers in the Turlock Canal would be released at the dam and allowed to flow downstream in the Tuolumne River to the infiltration gallery near the Geer Road Bridge, at which point it would be pumped into the Ceres Main Canal. The Infiltration Gallery Project would have increased flow in the Tuolumne River between La Grange Dam and the Geer Road Bridge by about 100 cfs between mid-March and mid-October.

It is now likely that the original Infiltration Gallery Project will be modified to supply water to a TID-owned municipal water treatment plant that is a part of TID's Regional Surface Water Supply Project. With the modified project in place, water that would otherwise have been diverted at La Grange Dam and conveyed to farmers would be released at the dam and allowed to flow downstream in the Tuolumne River to the infiltration gallery. Up to 66 cfs would be diverted from the river and pumped to the new municipal water treatment plant year-round. Another 34 cfs might be diverted from mid-March to mid-October and pumped to the Ceres Main Canal for agricultural use. The Infiltration Gallery/Regional Surface Water Supply Project would increase flow in the reach of the Tuolumne River between La Grange Dam and the Geer Road Bridge by 66 cfs from mid-October to mid-March, and by 100 cfs from mid-March to mid-October.

Flow in the river under the existing condition and with the Infiltration Gallery/Regional Surface Water Supply Project in place, and the difference between the two, are shown in **Tables 5.7-7** and **5.7-8**. For Table 5.7-7, it was assumed that the additional flow would be 66 cfs year-round. For Table 5.7-8, it was assumed that there would be 66 cfs of additional flow from October through March, and 100 cfs of additional flow from April through September. The Infiltration Gallery/Regional Surface Water Supply Project would increase flow in this reach of the river every month compared to the existing condition. The greatest increases would occur during June, July, August, and September of average below-normal, dry, and critically dry years, when only the minimum required amount of water is currently released from La Grange Dam. In these months, assuming only municipal diversions, the Infiltration Gallery/Regional Surface Water Supply Project would about double the volume of flow in the river and thus would have a substantial beneficial impact on hydrology. If the Infiltration Gallery/Regional Surface Water Supply Project involves the diversion of water for both municipal and agricultural use, then it would more than double the volume of flow in the river in the summer of average below-normal, dry, and critically dry years.

The New Don Pedro Project is scheduled for relicensing by FERC in 2016. The current minimum fishery release requirements for the Tuolumne River below La Grange Dam will be reexamined during the relicensing process. The minimum required fishery releases could be retained or modified (it is unlikely they would be decreased). If summertime minimum releases are increased, then large spring releases could be delayed while TID and MID replenish storage in Don Pedro Reservoir. The impacts on overall hydrology would be minor and probably beneficial.

**TABLE 5.7-7**
**FLOW IN THE TUOLUMNE RIVER BELOW LA GRANGE DAM –**
**EXISITING CONDITION PLUS INFILTRATION GALLERY PROJECT (66 cfs year-round)**

| | Wet | | Above Normal | | Below Normal | | Dry | | Critical Dry | | All | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Existing Condition (2005) | | | | | | | | | | | | |
| **Oct** | 431 | | 298 | | 294 | | 351 | | 236 | | 333 | |
| **Nov** | 374 | | 507 | | 314 | | 324 | | 195 | | 350 | |
| **Dec** | 857 | | 1,230 | | 422 | | 292 | | 204 | | 654 | |
| **Jan** | 2,161 | | 1,257 | | 318 | | 285 | | 189 | | 1,022 | |
| **Feb** | 3,493 | | 2,381 | | 647 | | 478 | | 188 | | 1,723 | |
| **Mar** | 4,096 | | 1,969 | | 654 | | 421 | | 189 | | 1,806 | |
| **Apr** | 3,424 | | 1,568 | | 958 | | 497 | | 344 | | 1,613 | |
| **May** | 3,161 | | 1,348 | | 943 | | 497 | | 344 | | 1,489 | |
| **June** | 3,633 | | 408 | | 75 | | 73 | | 50 | | 1,180 | |
| **July** | 1,300 | | 240 | | 75 | | 73 | | 50 | | 463 | |
| **Aug** | 516 | | 240 | | 75 | | 73 | | 50 | | 233 | |
| **Sept** | 1,299 | | 249 | | 75 | | 73 | | 50 | | 464 | |
| Difference and Percent Change, Existing Condition vs Existing plus La Grange Release (66 cfs) | | | | | | | | | | | | |
| **Oct** | 64 | [ 15% ] | 64 | [ 22% ] | 64 | [ 22% ] | 64 | [ 18% ] | 64 | [ 27% ] | 64 | [ 19% ] |
| **Nov** | 67 | [ 18% ] | 67 | [ 13% ] | 67 | [ 21% ] | 67 | [ 21% ] | 67 | [ 34% ] | 67 | [ 19% ] |
| **Dec** | 64 | [ 8% ] | 64 | [ 5% ] | 64 | [ 15% ] | 64 | [ 22% ] | 64 | [ 32% ] | 64 | [ 10% ] |
| **Jan** | 64 | [ 3% ] | 64 | [ 5% ] | 64 | [ 20% ] | 64 | [ 23% ] | 64 | [ 34% ] | 64 | [ 6% ] |
| **Feb** | 71 | [ 2% ] | 71 | [ 3% ] | 71 | [ 11% ] | 71 | [ 15% ] | 71 | [ 38% ] | 71 | [ 4% ] |
| **Mar** | 64 | [ 2% ] | 64 | [ 3% ] | 64 | [ 10% ] | 64 | [ 15% ] | 64 | [ 34% ] | 64 | [ 4% ] |
| **Apr** | 67 | [ 2% ] | 67 | [ 4% ] | 67 | [ 7% ] | 67 | [ 13% ] | 67 | [ 19% ] | 67 | [ 4% ] |
| **May** | 64 | [ 2% ] | 64 | [ 5% ] | 64 | [ 7% ] | 64 | [ 13% ] | 64 | [ 19% ] | 64 | [ 4% ] |
| **June** | 67 | [ 2% ] | 67 | [ 16% ] | 67 | [ 89% ] | 67 | [ 91% ] | 67 | [ 133% ] | 67 | [ 6% ] |
| **July** | 64 | [ 5% ] | 64 | [ 27% ] | 64 | [ 86% ] | 64 | [ 88% ] | 64 | [ 129% ] | 64 | [ 14% ] |
| **Aug** | 64 | [ 12% ] | 64 | [ 27% ] | 64 | [ 86% ] | 64 | [ 88% ] | 64 | [ 129% ] | 64 | [ 28% ] |
| **Sept** | 67 | [ 5% ] | 67 | [ 27% ] | 67 | [ 89% ] | 67 | [ 91% ] | 67 | [ 133% ] | 67 | [ 14% ] |

**Key**
> 0%
< 0 to -5%
< -5%

NOTE: "Existing Condition (2005)" is based on model run MEA3CHR. An overview of the model runs is presented in Section 5.1. Detailed information on the models and underlying assumptions is provided in Appendix H.

**Geomorphology.** The habitat restoration plan for the lower Tuolumne River, a part of the 1995 FERC Settlement Agreement, includes a number of recommendations which, if implemented, would improve stream channel geomorphology between La Grange Dam and the confluence with the San Joaquin River. As described above, past and present projects and actions have radically altered the flow regime of the river and the physical characteristics of the river channel. The dynamic equilibrium between river flow and channel characteristics has been thoroughly and continually disturbed over the past 140 years. The habitat restoration plan recommends a series of actions to accelerate the development of a river channel that is in balance with its current flow regime. These recommendations include shaping releases from La Grange Dam to provide specified peak flows every few years, adding gravel, removing levees and reconstructing the river channel, and restoring riparian vegetation. Overall, the habitat restoration plan would have a substantial beneficial impact on stream channel geomorphology.

**TABLE 5.7-8**
**FLOW IN THE TUOLUMNE RIVER BELOW LA GRANGE DAM –**
**EXISTING CONDITION PLUS INFILTRATION GALLERY PROJECT (66 cfs winter, 100 cfs summer)**

| | Wet | | Above Normal | | Below Normal | | Dry | | Critical Dry | | All | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Existing Condition (2005) | | | | | | | | | | | | |
| Oct | 431 | | 298 | | 294 | | 351 | | 236 | | 333 | |
| Nov | 374 | | 507 | | 314 | | 324 | | 195 | | 350 | |
| Dec | 857 | | 1,230 | | 422 | | 292 | | 204 | | 654 | |
| Jan | 2,161 | | 1,257 | | 318 | | 285 | | 189 | | 1,022 | |
| Feb | 3,493 | | 2,381 | | 647 | | 478 | | 188 | | 1,723 | |
| Mar | 4,096 | | 1,969 | | 654 | | 421 | | 189 | | 1,806 | |
| Apr | 3,424 | | 1,568 | | 958 | | 497 | | 344 | | 1,613 | |
| May | 3,161 | | 1,348 | | 943 | | 497 | | 344 | | 1,489 | |
| June | 3,633 | | 408 | | 75 | | 73 | | 50 | | 1,180 | |
| July | 1,300 | | 240 | | 75 | | 73 | | 50 | | 463 | |
| Aug | 516 | | 240 | | 75 | | 73 | | 50 | | 233 | |
| Sept | 1,299 | | 249 | | 75 | | 73 | | 50 | | 464 | |
| Difference and Percent Change, Existing Condition vs Existing plus La Grange Release (66 and 100 cfs) | | | | | | | | | | | | |
| Oct | 64 | [ 15% ] | 64 | [ 22% ] | 64 | [ 22% ] | 64 | [ 18% ] | 64 | [ 27% ] | 64 | [ 19% ] |
| Nov | 67 | [ 18% ] | 67 | [ 13% ] | 67 | [ 21% ] | 67 | [ 21% ] | 67 | [ 34% ] | 67 | [ 19% ] |
| Dec | 64 | [ 8% ] | 64 | [ 5% ] | 64 | [ 15% ] | 64 | [ 22% ] | 64 | [ 32% ] | 64 | [ 10% ] |
| Jan | 98 | [ 5% ] | 98 | [ 8% ] | 98 | [ 31% ] | 98 | [ 34% ] | 98 | [ 52% ] | 98 | [ 10% ] |
| Feb | 107 | [ 3% ] | 107 | [ 4% ] | 107 | [ 17% ] | 107 | [ 22% ] | 107 | [ 57% ] | 107 | [ 6% ] |
| Mar | 98 | [ 2% ] | 98 | [ 5% ] | 98 | [ 15% ] | 98 | [ 23% ] | 98 | [ 52% ] | 98 | [ 5% ] |
| Apr | 101 | [ 3% ] | 101 | [ 6% ] | 101 | [ 11% ] | 101 | [ 20% ] | 101 | [ 29% ] | 101 | [ 6% ] |
| May | 98 | [ 3% ] | 98 | [ 7% ] | 98 | [ 10% ] | 98 | [ 20% ] | 98 | [ 28% ] | 98 | [ 7% ] |
| June | 101 | [ 3% ] | 101 | [ 25% ] | 101 | [ 134% ] | 101 | [ 138% ] | 101 | [ 202% ] | 101 | [ 9% ] |
| July | 98 | [ 8% ] | 98 | [ 41% ] | 98 | [ 130% ] | 98 | [ 134% ] | 98 | [ 195% ] | 98 | [ 21% ] |
| Aug | 64 | [ 12% ] | 64 | [ 27% ] | 64 | [ 86% ] | 64 | [ 88% ] | 64 | [ 129% ] | 64 | [ 28% ] |
| Sept | 67 | [ 5% ] | 67 | [ 27% ] | 67 | [ 89% ] | 67 | [ 91% ] | 67 | [ 133% ] | 67 | [ 14% ] |

**Key**
> 0%
< 0 to -5%
< -5%

NOTE: “Existing Condition (2005)” is based on model run MEA3CHR. An overview of the model runs is presented in Section 5.1. Detailed information on the models and underlying assumptions is provided in Appendix H.

**Surface Water Quality.** Water for the Infiltration Gallery/Regional Surface Water Supply Project would be drawn from the pool of cool water deep within Don Pedro Reservoir. Water temperature in the stream increases in a downstream direction below the release point from the reservoir under the influence of solar radiation. Greater flow in the stream in the summer months would retard the rate of temperature increase. Overall, the Infiltration Gallery/Regional Surface Water Supply Project would have a modestly beneficial effect on water quality.

**Fisheries.** The habitat restoration plan, a part of the 1995 FERC Settlement Agreement, and the Infiltration Gallery/Regional Surface Water Supply Project would both improve conditions for coldwater fish in the Tuolumne River between La Grange Dam and the San Joaquin River confluence. Construction of a more natural river channel that is in balance with its flow regime, the addition of gravel, and the restoration of the riparian forest as part of the habitat restoration plan would improve the quality of habitat for salmonids. Increases in river flow as a result of the Infiltration Gallery/Regional Surface Water Supply Project would increase the extent of spawning and rearing habitat for salmonids. Increased flow would also extend the length of the river reach in which water remains at a suitable temperature for salmonids. Increased flow in May would aid out-migration by juvenile Chinook salmon. Increased flow in June, July, August, and September would aid oversummering steelhead. Overall, future projects are likely to have a substantial beneficial effect on the fishery resources of the Tuolumne River between La Grange Dam and the San Joaquin River confluence.

**Terrestrial Biology.** The habitat restoration plan, a part of the 1995 FERC Settlement Agreement, would improve conditions for both terrestrial wildlife and vegetation in the Tuolumne River corridor between La Grange Dam and the San Joaquin River confluence. Construction of a more natural river channel that is in balance with its flow regime and the planting of native vegetation as part of the habitat management plan would help restore and maintain the riparian forest along the river corridor. The restored riparian forest would provide improved habitat for birds, mammals, and amphibians. Increased summertime flow in the river between La Grange Dam and Geer Road would have a modest beneficial effect on the survival of riparian vegetation. Overall, future projects are likely to have a substantial beneficial effect on the terrestrial biological resources of the Tuolumne River corridor between La Grange Dam and the San Joaquin River confluence.

### Cumulative Effects and WSIP Contribution

**Table 5.7-9** summarizes the effects of past and present projects, the impacts of the WSIP, the effects of probable future projects, and the combined impacts of the WSIP plus probable future projects on the Tuolumne River between La Grange Dam and the San Joaquin River confluence. Past and present projects have substantially altered the hydrology, geomorphology, groundwater, fisheries, terrestrial biology, and visual and recreational resources of this river reach compared to pre-Euro-American settlement conditions. Water quality has been moderately altered. The existing condition, which serves as the baseline for the analysis of the WSIP, reflects the substantial environmental changes that have occurred as a result of past and present projects. Because past and present actions have drastically altered this river reach, some of the reach’s environmental resources are more sensitive to small adverse changes than they would be if the reach had remained relatively unaltered from pre-Euro-American settlement conditions.

As described in Section 5.3, the WSIP would have a less-than-significant adverse impact on hydrology, geomorphology, surface water quality, groundwater, and recreational and visual resources. It would have less-than-significant impacts on fisheries and terrestrial biological resources after mitigation (Measure 5.3.6-4a, Avoidance of Flow Changes by Reducing Demand for Don Pedro Reservoir Water, or Measures 5.3.6-4b, Fishery Habitat Enhancement, and 5.3.7-6, Lower Tuolumne River Riparian Habitat Enhancement). As described in the previous section, probable future projects would have potentially adverse but less-than-significant impacts or beneficial effects on hydrology, geomorphology, surface water quality, groundwater, fisheries, terrestrial biology, and recreational and visual resources.

**TABLE 5.7-9**
**CUMULATIVE EFFECTS ON THE TUOLUMNE RIVER BETWEEN LA GRANGE DAM AND THE SAN JOAQUIN RIVER**

| Resource | Effects of Past and Present Projects | Impacts of WSIP (prior to mitigation/after mitigation) | Effects of Future Projects | Cumulative impact (WSIP after mitigation + Future Projects) | WSIP Contribution Cumulatively Considerable? |
|---|---|---|---|---|---|
| Hydrology | SA | LS | B | LS | No |
| Geomorphology | SA | LS | B | LS | No |
| Surface Water Quality | MA | LS | B | LS | No |
| Groundwater | SA | LS | LS | LS | No |
| Fisheries | SA | PSM/LS | B | LS | No |
| Terrestrial Biology | SA | PSM/LS | B | LS | No |
| Recreation/Visual Quality | SA | LS | B | LS | No |

B = Beneficial impact
LS = Less than Significant, no mitigation required
PSM/LS = Potentially Significant but reduced to Less than Significant with mitigation
SA = Substantially Altered
MA = Moderately Altered

As noted above, many of the foreseeable future projects would have beneficial environmental effects. Two of the foreseeable future projects, the Infiltration Gallery Project and the Regional Surface Water Supply Project, would produce environmental benefits by increasing flow in the reach of the river between La Grange Dam and Roberts Ferry. **Tables 5.7-10** and **5.7-11** show the cumulative effects of the Infiltration Gallery/Regional Surface Water Supply Project and the WSIP on flow in the Tuolumne River below La Grange Dam. For Table 5.7-10, it was assumed that the Infiltration Gallery Project would add 66 cfs year-round. For Table 5.7-11, it was assumed that the Infiltration Gallery/Regional Surface Water Supply Project would add 66 cfs of flow from October through March, and 100 cfs of flow from April through September.

The WSIP would have no effect on flow in the river below La Grange Dam in critically dry years, but would result in infrequent reductions in flow in below-normal and dry years. The Infiltration Gallery/Regional Surface Water Supply Project and the WSIP together would increase flow in the river in almost every month of below-normal, dry, and critically dry years compared to the existing condition. The Infiltration Gallery/Regional Surface Water Supply Project would more than offset the infrequent WSIP-induced reductions in flow in below-normal and dry years.

The WSIP alone would reduce flows in the river in most months of average above-normal years, and in all months of average wet years, compared to the existing condition. The Infiltration Gallery/Regional Surface Water Supply Project and the WSIP together would result in flow reductions of a lesser magnitude in average above-normal and wet years than would the WSIP alone.

Thus, as shown in Table 5.7-9, when the WSIP and future projects are considered together, none of their cumulative effects would rise to a level of significance. Even though past and present projects have moderately to substantially altered the environmental resources along this reach of

**TABLE 5.7-10**
**FLOW IN THE TUOLUMNE RIVER BELOW LA GRANGE DAM –**
**WSIP PLUS INFILTRATION GALLERY PROJECT (66 cfs year-round)**

| | Wet | | Above Normal | | Below Normal | | Dry | | Critical Dry | | All | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Existing Condition (2005) | | | | | | | | | | | | |
| **Oct** | 431 | | 298 | | 294 | | 351 | | 236 | | 333 | |
| **Nov** | 374 | | 507 | | 314 | | 324 | | 195 | | 350 | |
| **Dec** | 857 | | 1,230 | | 422 | | 292 | | 204 | | 654 | |
| **Jan** | 2,161 | | 1,257 | | 318 | | 285 | | 189 | | 1,022 | |
| **Feb** | 3,493 | | 2,381 | | 647 | | 478 | | 188 | | 1,723 | |
| **Mar** | 4,096 | | 1,969 | | 654 | | 421 | | 189 | | 1,806 | |
| **Apr** | 3,424 | | 1,568 | | 958 | | 497 | | 344 | | 1,613 | |
| **May** | 3,161 | | 1,348 | | 943 | | 497 | | 344 | | 1,489 | |
| **June** | 3,633 | | 408 | | 75 | | 73 | | 50 | | 1,180 | |
| **July** | 1,300 | | 240 | | 75 | | 73 | | 50 | | 463 | |
| **Aug** | 516 | | 240 | | 75 | | 73 | | 50 | | 233 | |
| **Sept** | 1,299 | | 249 | | 75 | | 73 | | 50 | | 464 | |
| Difference and Percent Change, Existing Condition vs Cumulative | | | | | | | | | | | | |
| **Oct** | 64 | [ 15% ] | 60 | [ 20% ] | 55 | [ 19% ] | 54 | [ 15% ] | 67 | [ 29% ] | 61 | [ 18% ] |
| **Nov** | 80 | [ 22% ] | 81 | [ 16% ] | 27 | [ 9% ] | 3 | [ 1% ] | 67 | [ 34% ] | 58 | [ 16% ] |
| **Dec** | 0 | [ 0% ] | -56 | -[ 5% ] | 16 | [ 4% ] | 45 | [ 15% ] | 64 | [ 32% ] | 10 | [ 2% ] |
| **Jan** | -87 | -[ 4% ] | 74 | [ 6% ] | 68 | [ 22% ] | 42 | [ 15% ] | 64 | [ 34% ] | 19 | [ 2% ] |
| **Feb** | -22 | -[ 1% ] | -162 | -[ 7% ] | 43 | [ 7% ] | 30 | [ 6% ] | 71 | [ 38% ] | -15 | -[ 1% ] |
| **Mar** | -60 | -[ 1% ] | -201 | -[ 10% ] | 62 | [ 9% ] | 69 | [ 16% ] | 64 | [ 34% ] | -27 | -[ 1% ] |
| **Apr** | -9 | [ 0% ] | 24 | [ 2% ] | 51 | [ 5% ] | 67 | [ 13% ] | 67 | [ 19% ] | 33 | [ 2% ] |
| **May** | -35 | -[ 1% ] | 62 | [ 5% ] | 64 | [ 7% ] | 64 | [ 13% ] | 64 | [ 19% ] | 35 | [ 2% ] |
| **June** | -221 | -[ 6% ] | -50 | -[ 12% ] | 67 | [ 89% ] | 67 | [ 91% ] | 67 | [ 133% ] | -42 | -[ 4% ] |
| **July** | 47 | [ 4% ] | 64 | [ 27% ] | 64 | [ 86% ] | 64 | [ 88% ] | 64 | [ 129% ] | 59 | [ 13% ] |
| **Aug** | 52 | [ 10% ] | 64 | [ 27% ] | 64 | [ 86% ] | 64 | [ 88% ] | 64 | [ 129% ] | 61 | [ 26% ] |
| **Sept** | 91 | [ 7% ] | 57 | [ 23% ] | 67 | [ 89% ] | 67 | [ 91% ] | 67 | [ 133% ] | 72 | [ 15% ] |

**Key**
> 0%
< 0 to -5%
< -5%

NOTE: "Existing Condition (2005)" is based on model run MEA3CHR. The Cumulative scenario is based on model run MEA5ix. An overview of the model runs is presented in Section 5.1. Detailed information on the models and underlying assumptions is provided in Appendix H.

the Tuolumne River, the cumulative impacts of the WSIP after mitigation combined with the effects of future projects would not result in a substantial or noticeable change from the existing condition. In particular, the WSIP's impacts on fisheries and terrestrial biology would be expected to be avoided with implementation of Measure 5.3.6-4a, or would be substantially reduced with implementation of Measures 5.3.6-4b and 5.3.7-6. Since the implementation of future projects would be expected to be beneficial to both fisheries and terrestrial biology, the combined cumulative impacts on fisheries and terrestrial biology would be considered less than significant. Because there are no significant cumulative impacts, no mitigation measures beyond Measure 5.3.6-4a or Measures 5.3.6-4b and 5.3.7-6 would be necessary.

**TABLE 5.7-11**
**FLOW IN THE TUOLUMNE RIVER BELOW LA GRANGE DAM –**
**WSIP PLUS INFILTRATION GALLERY PROJECT (66 cfs winter, 100 cfs summer)**

| | Wet | | Above Normal | | Below Normal | | Dry | | Critical Dry | | All | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Existing Condition (2005) | | | | | | | | | | | | |
| **Oct** | 431 | | 298 | | 294 | | 351 | | 236 | | 333 | |
| **Nov** | 374 | | 507 | | 314 | | 324 | | 195 | | 350 | |
| **Dec** | 857 | | 1,230 | | 422 | | 292 | | 204 | | 654 | |
| **Jan** | 2,161 | | 1,257 | | 318 | | 285 | | 189 | | 1,022 | |
| **Feb** | 3,493 | | 2,381 | | 647 | | 478 | | 188 | | 1,723 | |
| **Mar** | 4,096 | | 1,969 | | 654 | | 421 | | 189 | | 1,806 | |
| **Apr** | 3,424 | | 1,568 | | 958 | | 497 | | 344 | | 1,613 | |
| **May** | 3,161 | | 1,348 | | 943 | | 497 | | 344 | | 1,489 | |
| **June** | 3,633 | | 408 | | 75 | | 73 | | 50 | | 1,180 | |
| **July** | 1,300 | | 240 | | 75 | | 73 | | 50 | | 463 | |
| **Aug** | 516 | | 240 | | 75 | | 73 | | 50 | | 233 | |
| **Sept** | 1,299 | | 249 | | 75 | | 73 | | 50 | | 464 | |
| Difference and Percent Change, Existing Condition vs Cumulative (66 and 100 cfs) | | | | | | | | | | | | |
| **Oct** | 64 | [ 15% ] | 60 | [ 20% ] | 55 | [ 19% ] | 54 | [ 15% ] | 67 | [ 29% ] | 61 | [ 18% ] |
| **Nov** | 80 | [ 22% ] | 81 | [ 16% ] | 27 | [ 9% ] | 3 | [ 1% ] | 67 | [ 34% ] | 58 | [ 16% ] |
| **Dec** | 0 | [ 0% ] | -56 | -[ 5% ] | 16 | [ 4% ] | 45 | [ 15% ] | 64 | [ 32% ] | 10 | [ 2% ] |
| **Jan** | -54 | -[ 3% ] | 107 | [ 8% ] | 102 | [ 32% ] | 75 | [ 26% ] | 98 | [ 52% ] | 52 | [ 5% ] |
| **Feb** | 14 | [ 0% ] | -125 | -[ 5% ] | 79 | [ 12% ] | 66 | [ 14% ] | 107 | [ 57% ] | 21 | [ 1% ] |
| **Mar** | -27 | -[ 1% ] | -167 | -[ 9% ] | 95 | [ 15% ] | 102 | [ 24% ] | 98 | [ 52% ] | 7 | [ 0% ] |
| **Apr** | 25 | [ 1% ] | 58 | [ 4% ] | 86 | [ 9% ] | 101 | [ 20% ] | 101 | [ 29% ] | 67 | [ 4% ] |
| **May** | -2 | [ 0% ] | 95 | [ 7% ] | 98 | [ 10% ] | 98 | [ 20% ] | 98 | [ 28% ] | 68 | [ 5% ] |
| **June** | -187 | -[ 5% ] | -16 | -[ 4% ] | 101 | [ 134% ] | 101 | [ 138% ] | 101 | [ 202% ] | -8 | -[ 1% ] |
| **July** | 80 | [ 6% ] | 98 | [ 41% ] | 98 | [ 130% ] | 98 | [ 134% ] | 98 | [ 195% ] | 92 | [ 20% ] |
| **Aug** | 52 | [ 10% ] | 64 | [ 27% ] | 64 | [ 86% ] | 64 | [ 88% ] | 64 | [ 129% ] | 61 | [ 26% ] |
| **Sept** | 91 | [ 7% ] | 57 | [ 23% ] | 67 | [ 89% ] | 67 | [ 91% ] | 67 | [ 133% ] | 72 | [ 15% ] |

**Key**
> 0%
< 0 to -5%
< -5%

NOTE: "Existing Condition (2005)" is based on model run MEA3CHR. The Cumulative scenario is based on model run MEA5ix. An overview of the model runs is presented in Section 5.1. Detailed information on the models and underlying assumptions is provided in Appendix H.

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## *Downstream Water Bodies: the San Joaquin River, Stanislaus River, and Delta*

### Impact 5.7.2-3: Cumulative impacts on the San Joaquin River, Stanislaus River, and Delta.

As discussed in Section 5.3, the WSIP would result in less-than-significant impacts on the San Joaquin River, Stanislaus River, and/or Delta in the areas of hydrology, water quality, water supply, and fisheries; therefore, these issue areas are discussed below. The WSIP would have no effect on these downstream water bodies in the areas of geomorphology, groundwater, terrestrial biology, recreation, or visual resources; therefore, these issue areas are not discussed further.

### Effect of Past and Present Projects

**Hydrology.** Past water and flood control project development on the San Joaquin River has substantially altered the river hydrology. The river between Gravelly Ford and Mendota is essentially dry, except when flood releases are being made. Past water and flood control project developments on the major tributaries to the San Joaquin River, including the Merced, Tuolumne, and Stanislaus Rivers, have also affected the hydrology of the San Joaquin River. The past activities of hydraulic mining in the Sierra foothills, levee construction, major water supply project development and operation in the Delta and upstream of the Delta, and ship channel development and maintenance have in combination substantially altered Delta hydrology.

The diversion of water by the Central Valley Project, State Water Project, and others in the south Delta as well as upstream depletion of San Joaquin River flows affect the pattern of flow in the Delta channels. Historically, net flow in the Delta channels was toward the San Francisco Bay Estuary. Now, because freshwater inflow to the south Delta from the San Joaquin River is small relative to the diversions at the Banks and Tracy Pumping Plants, net flow in many south Delta channels reverses during summer and fall. Flow in the lower San Joaquin River and the south Delta channels is directed upstream toward the pumping plants rather than downstream toward the estuary (Miller, 1993).

The diminution of flow and flow reversals in the lower San Joaquin River as a result of water diversions by the State Water Project and Central Valley Project are harmful to migrating salmon. In 1990, the California Department of Water Resources (DWR) began installing temporary barriers in several waterways in the south Delta to improve conditions for migrating salmon. Temporary barriers have been placed across the Grant Line Canal, Middle River, and Old River. The purpose of the barriers is to control water levels for irrigators, improve water quality, and direct more water down the lower San Joaquin River for downstream migrating juvenile salmon in the spring and for upstream migrating adults in the fall. It is expected that permanent operable barriers will replace the temporary barriers in the next few years.

**Water Quality.** As described in Section 5.3.3, San Joaquin River water quality has been degraded by a combination of agricultural drainage, past mining activity, wastewater and urban stormwater runoff, wildlife refuge discharge, and flow depletion in some months of some years. Inadequate drainage and accumulating naturally-occurring salts have been persistent problems in parts of the San Joaquin Valley for more than a century. The San Joaquin River has levels of total dissolved solids and total organic carbon that are high for natural waters and are considerably higher than for Tuolumne River water. The river is listed as an impaired water body for mercury, boron, various pesticides, salinity, and unknown toxicity. Both the Tuolumne River and the Stanislaus River contribute higher quality water to the San Joaquin River as it flows into the Delta.

Water quality in the Delta is governed by the Delta's complex hydrodynamics, which mix the freshwater entering the system from upstream tributary rivers with the saline water that enters from Suisun Bay. When freshwater flow is small, tidal flow enables saline water to penetrate into the Delta. Under these circumstances, water quality in some parts of the Delta becomes brackish. The reversal of flow in the lower San Joaquin River and many south Delta channels as a result of water diversion by the State Water Project and Central Valley Project increases the tendency for saline water to penetrate into the Delta. Water quality in the Delta generally declines in a southerly and westerly direction. Delta water quality is also affected by agricultural drainage, urban runoff, wastewater discharges, and high organic carbon input from drainage off the peat soils on the Delta islands.

**Fisheries.** As described in Section 5.3.6, the lower San Joaquin River and Delta provide habitat to a diverse assemblage of resident and migratory estuarine organisms. The biological environment is a complex community of plants and animals inhabiting the saltwater, estuarine (brackish water), and freshwater habitats within the Bay-Delta estuary.

Fishery sampling within the Bay-Delta estuary has shown that 55 fish species inhabit the estuary (Baxter et al., 1999), of which approximately one-half are non-native, introduced species. Many of the fish species inhabiting the estuary, such as striped bass and American shad, were purposefully introduced to provide recreational and commercial fishing opportunities. A number of the fish species have been introduced accidentally into the estuary through movement among connecting waterways (e.g., threadfin shad and inland silversides). In recent years, a number of fish and macroinvertebrate species have been accidentally introduced into the estuary, primarily from the Orient, through ballast water discharges from commercial cargo ships (e.g., yellowfin and chameleon gobies). In addition, an estimated 100 macroinvertebrates have also been introduced, primarily through ballast water discharge, into the estuary (Carlton, 1979). These introductions of non-native fish and macroinvertebrates have contributed to a substantial change in the species composition, predator/prey interactions, and competitive interactions affecting the population dynamics of native species. Many of the introduced fish and macroinvertebrates have colonized and inhabit the lower San Joaquin River and Delta.

In recent years, the bottom-dwelling fish community, including delta and longfin smelt and other species, has experienced a significant decline in abundance. State and federal resource agencies are currently evaluating various factors that could be contributing to the decline. Hypotheses include the effects of losses at water diversions, changes in Delta hydrology, the effects of pollutants on survival, and the effects of introduced species on the Delta food web. The importance of these factors in the decline in fish abundance has not been determined.

A variety of special-status fish species, several of which have been listed for protection under the Federal and/or California Endangered Species Acts, are present in the Delta and the San Joaquin and Tuolumne Rivers. Special-status fish species that occur in the lower San Joaquin River and Delta include steelhead, green sturgeon, delta smelt, Chinook salmon, Sacramento splittail, and longfin smelt. Several special-status species use the Delta as a migratory corridor. The winter-run Chinook salmon is federally and state-listed as endangered. The spring-run Chinook salmon is federally and state-listed as threatened. The fall/late-fall-run Central Valley Chinook salmon is a federal candidate species and California species of special concern. The Distinct Population Segment of Central Valley steelhead is federally listed as threatened. Fall/late-fall-run Central Valley Chinook salmon use the lower San Joaquin River as a migratory corridor and spawn in the Tuolumne River below La Grange Dam. The Evolutionarily Significant Unit of Central Valley steelhead may also spawn in the Tuolumne River in small numbers. In addition, delta smelt, a federally and state-listed threatened species, and Sacramento splittail, a California species of special concern and formerly a federal threatened species, have been documented within the lower San Joaquin River and Delta (USFWS, 2003). The NMFS recently listed green sturgeon as a threatened species. Although the distribution of green sturgeon in the lower San Joaquin River is poorly understood, the species is known to reside within the Delta.

The Pacific Fisheries Management Council has designated Central San Francisco Bay, Suisun Bay, and the Delta as Essential Fish Habitat (EFH) to protect and enhance habitat for coastal marine fish and macroinvertebrate species that support commercial fisheries. The major rivers tributary to the Delta, including the San Joaquin and Tuolumne Rivers, have also been identified as EFH for Pacific salmon. The amended Magnuson-Stevens Fishery Conservation and Management Act, also known as the Sustainable Fisheries Act (Public Law 104-297), requires all federal agencies to consult with the Secretary of Commerce on activities or proposed activities authorized, funded, or undertaken by that agency that may adversely affect EFH of commercially managed marine and anadromous fish species.

#### Potential Effects of Future Projects

**San Joaquin River.** As shown in Table 5.7-1, above, of the 11 potential future projects affecting the San Joaquin River directly, five are proposed primarily to improve environmental conditions in the river, including water quality and habitat quality. These projects that will benefit the river environment include the TMDL (total daily maximum load) programs being implemented by the Regional Water Quality Control Board, the San Luis Drainage Feature Re-evaluation Program (which will reduce agricultural drainage to the river), the San Joaquin River Restoration Settlement, and the Delta-Mendota Canal Recirculation Feasibility Study. Other projects propose to improve water supply benefits and reliability, but also generally incorporate measures to protect or enhance the river's environmental resources. The projects could contribute to both adverse and beneficial cumulative effects on the San Joaquin River. Overall, future projects affecting the San Joaquin River could result in both beneficial and potentially significant adverse effects on the river's water resources, supply, quality, and aquatic fishery resources.

**Stanislaus River.** Existing water supply diversions for agricultural, municipal and industrial use will continue. Continuation of the USBR's water releases in compliance with the Central Valley Project Improvement Act Section (b)(2) water requirements as well as continued implementation of the Vernalis Adaptive Management Program (VAMP) (through 2012 with possible renewal/extension), both of which are intended to improve habitat conditions for anadromous fish, would provide overall environmental benefit in the areas of hydrology, water quality, fisheries and, potentially visual resources as well. The USBR's proposal to revise its operation plan for the New Melones Reservoir could modify current reservoir release patterns and quantities with potential adverse effects. It is expected that mitigation would be required for any potentially significant effects.

**Sacramento-San Joaquin Delta**. Implementation of the regulatory water quality and flow objectives for the Delta limits the potential for future cumulative flow impacts and water quality effects in the Delta and related impacts on biological resources that could be associated with these physical effects. The USBR and DWR, through the Central Valley Project and State Water Project, respectively, remain largely responsible for meeting these Delta environmental standards through adjustments in their diversions and/or reservoir operations. In addition, as shown on Table 5.7-1, several proposed future projects target improvement of Delta environmental conditions, such as the Environmental Water Account, the South Delta Improvements Program – Phase I, the OCAP ESA Reconsultation, the CVPIA Water Acquisition Program, and the Bay-Delta Habitat Conservation Plan, among others. Several other projects have multiple-purpose objectives to increase water supply and/or improve supply reliability while also improving environmental conditions in the Delta, such as the Delta Cross Channel Reoperation and Through-Delta Facility, the Los Vaqueros Reservoir Expansion Project, or the Upstream of Delta Offstream Storage (Sites Reservoir). These two types of projects are intended to result in beneficial effects to the Delta environment. Other projects are primarily water supply and water reliability projects, including the Freeport Regional Water Project, Stockton Delta Water Project, and Sacramento River Water Reliability Study Project; these could result in some additional adverse impacts on the Delta, although mitigation has been or is expected to be imposed to address these impacts.

The potential cumulative effects on the Delta are strictly limited by existing regulations that have established both water quality and flow objectives for the Delta that must be met. These regulatory requirements are described in the setting discussions in Sections 5.3.1 and 5.3.3, above. In summary, the State Water Resources Control Board (SWRCB) established water quality objectives for the Delta in the 1995 Water Quality Control Plan; it also established flow objectives and adopted Water Rights Decision 1641 and subsequent orders to update and clarify responsibilities among water-rights holders for implementing the flow objectives. In D-1641 and Order WR 2001-05, the SWRCB assigned responsibilities to water-rights holders for specified periods, including the USBR and DWR, in certain watersheds tributary to the Delta. The SWRCB accepted with modifications the proposals made by some water agencies and groups of water agencies with respect to their responsibilities for meeting flow objectives in the Delta. The responsibilities of various parties, including water users in the Sacramento, San Joaquin, Mokelumne, Calaveras, and Cosumnes River watersheds, were defined in D-1641. These responsibilities require that the water users in these watersheds contribute specified amounts of water to protect water quality, and that the USBR and/or DWR ensure the objectives are met in the Delta.

As a result of existing regulations coupled with future projects intended to benefit the Delta environment, future cumulative effects on the Delta would be both beneficial and adverse.

### Cumulative Effects and WSIP Contribution

**Table 5.7-12** summarizes the effects of past and present projects, the impacts of the WSIP, the effects of probable future projects, and the combined impacts of the WSIP plus probable future projects on the San Joaquin River, Stanislaus River, and Delta. Past and present projects have substantially altered the hydrology, geomorphology, water quality, groundwater, fisheries, terrestrial biology, and visual and recreational resources of these water bodies compared to pre-Euro-American settlement conditions. The existing condition, which serves as the baseline for the analysis of the WSIP, reflects the substantial environmental changes that have occurred as a result of the past and present projects.

**TABLE 5.7-12**
**CUMULATIVE EFFECTS ON THE SAN JOAQUIN RIVER, STANISLAUS RIVER, AND DELTA**

| Resource | Effects of Past and Present Projects | Impacts of WSIP (prior to mitigation/after mitigation) | Effects of Future Projects | Cumulative Impact(WSIP after mitigation + Future Projects) | WSIP Contribution Cumulatively Considerable? |
|---|---|---|---|---|---|
| Hydrology | SA | LS | B/PSM | B/PSM | No |
| Surface Water Quality | SA | LS | B/PSM | B/PSM | No |
| Water supply | MA | LS | B/PSM | B/PSM | No |
| Fisheries | SA | LS | B/PSM | B/PSM | No |

B = Beneficial impact
LS = Less than Significant, no mitigation required
PSM/LS = Potentially Significant but reduced to Less than Significant with mitigation
SA = Substantially Altered
MA = Moderately Altered

As discussed in Section 5.3, the WSIP would result in less-than-significant impacts on the San Joaquin River, Stanislaus River, and/or Delta in the areas of hydrology, water quality, water supply, and fisheries. The WSIP would have no effect on these downstream water bodies in the areas of geomorphology, groundwater, terrestrial biology, recreation or visual resources.

As described in the previous section, probable future projects would have both beneficial effects and potentially significant effects on hydrology, surface water quality, water supply, and fisheries. Some future projects could contribute further to significant adverse effects on the San Joaquin River and downstream to the Delta. The WSIP would have a less-than-significant effects on the San Joaquin and Stanislaus Rivers and the Delta. As summarized below, the WSIP's contribution to adverse cumulative effects would be less than cumulatively considerable.

As discussed in Impact 5.3.1-5, the WSIP would reduce flows in the lower Tuolumne River and, in turn, downstream in the San Joaquin River and to the Delta primarily between February and June in wet or above-normal years, when flow in the San Joaquin is at its seasonal maximum. Very infrequently (observed once over the modeled 82-year period of hydrologic record), following a protracted drought, flow reductions in the San Joaquin River attributable to the WSIP would be sufficient to cause flow in the river at Vernalis to fall below the flow objective established for that location. This would, in turn, cause salinity levels to increase above the objective established for that location. However, as required by regulation, under these circumstances, the USBR would increase flow releases from New Melones Reservoir on the Stanislaus River (or, in the future, implement an alternate means of providing additional flows) to meet the Vernalis flow and salinity objectives. Thus, flow and water quality objectives would continue to be met under the WSIP.

Similarly, with respect to the Delta, in most years, the flow reduction attributable to the WSIP would not be sufficient to cause Delta outflow to fall below the regulatory objective. Only very infrequently (observed once over the modeled 82-year period of hydrologic record), following a protracted drought, would the reduction in flow due to the WSIP have the potential to result in Delta outflow below the objective. However, in accordance with SWRCB regulation, the USBR and DWR would be required to decrease diversions or otherwise adjust their operations to maintain the Delta outflow standards. Thus, with WSIP implementation, both the San Joaquin River flow and salinity objectives and the Delta outflow objectives would be met. Therefore, the WSIP's contribution to potential cumulative flow effects on the San Joaquin or in the Delta would be less than cumulatively considerable.

As discussed in Impact 5.3.4-1, the WSIP would have a less-than-significant effect on water availability and water quality affecting water use by other diverters on the Stanislaus River or San Joaquin River. Very infrequently, following a protracted drought, the USBR might be required to release additional flows from New Melones Reservoir (or implement an alternate means of augmenting flow) to maintain flow and water quality objectives at Vernalis and in the Delta, but this would not have a significant effect on water supply. No other new significant diversions from the Tuolumne or Stanislaus Rivers have been proposed that would result in additional cumulative effects on water supply availability for existing users. On the San Joaquin River, additional water supply diversions are being implemented such as the Stockton Delta Water Supply Project, and studies such as the Upper San Joaquin Storage Investigation are underway to evaluate the potential for expanding supply storage. As indicated in Table 5.7-1, other projects are proposed to improve supply availability for San Joaquin River users through revised water management and other actions.

As discussed in Impact 5.3.4-2, under most conditions the WSIP would have no effect on water supply availability from the Delta, and only on rare occasions would the WSIP reduce Delta inflow during excess conditions[3] but when the export limits do affect State Water Project and Central Valley Project pumping. Rather than reducing pumping for supply deliveries in that same year to compensate for the WSIP effects, the USBR and/or DWR could release additional water from storage to maintain flow objectives and pumping for deliveries; however, this would contribute to an increased risk to water delivery reliability in a subsequent year, if reservoir storage did not refill and thus compensate for the additional release. The WSIP's contribution to this increased risk to supply availability is small and less than cumulatively considerable; the potential Delta inflow difference caused by the WSIP would be typically 20,000 afy, a fraction (less than 0.001 percent) of the total average inflow of about 21 million acre-feet.

The cumulative effect of other past and present projects and regulatory actions has reduced supply availability for Delta water users, primarily for the State Water Project contractors and Central Valley Project contractors, as they represent the more junior water rights holders to Delta water. Some future projects would contribute to this cumulative effect as more senior water rights holders exercise their rights, and as area-of-origin water rights claims to the Delta and tributaries

[3] Excess conditions refers to conditions when Delta outflow exceeds the maximum flow required to comply with SWRCB flow and water quality objectives for the San Francisco Bay / Sacramento-San Joaquin Delta Estuary.

are pursued. At the same time, other future projects, such as the South Delta Improvement Project, the Environmental Water Account, the Los Vaqueros Reservoir Expansion Project, the Delta Cross Channel Reoperation, and the Delta-Mendota Canal / California Aqueduct Intertie, seek to improve water supply reliability for Delta water users. As shown in Table 5.7-12, the cumulative effects of potential future projects on Delta water supply availability reflect a mix of both potentially beneficial and significant, adverse impacts.

As discussed in Impact 5.3.6-5, with mitigation, the WSIP would have a less-than-significant effect on fishery resources along the San Joaquin River and a negligible effect downstream in the Delta. For the San Joaquin River and its tributaries, a relationship has been established between spring flow and the subsequent survival and contribution of adults to the salmon population (USFWS, 1994). A reduction in river flow during the spring rearing and juvenile emigration period would result in an incremental contribution to reduced juvenile survival and a small incremental contribution to the cumulative reduction in juvenile survival and subsequent adult population abundance. Increased water temperatures, particularly during the late spring juvenile salmonid migration period (April–May), would also be expected to adversely affect juvenile salmon survival. The WSIP could contribute to flow reductions that would result in corresponding temperature increases in some summer flows following a protracted drought; however, these infrequent temperature increases would not be expected to result in significant adverse effects on salmon or steelhead migrating downstream within the San Joaquin River, since the migration would occur earlier in the year and ambient water temperatures within the river might already be elevated (as a result of low flow drought conditions).

In the future, implementation of TID’s Infiltration Gallery Project would contribute additional flows to a segment of the lower Tuolumne River, but these flows would be recaptured upstream of the confluence with the San Joaquin River. Under the FERC relicensing process for the Don Pedro Project, scheduled to occur in 2016, fishery release requirements for the lower Tuolumne River will be reviewed. It is speculative, at this time, to assess how these flow requirements might change.

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## 5.7.3 Cumulative Effects on Alameda Creek Watershed Streams and Reservoirs

### 5.7.3.1 Relevant Projects

#### Past and Present Projects

A number of existing facilities under the jurisdiction of the SFPUC, the Alameda County Water District (ACWD), Zone 7 Water Agency, the Alameda County Flood Control and Water Conservation District (ACFCWCD), and the California Department of Water Resources (DWR), among others, affect environmental conditions in the Alameda Creek watershed upstream, adjacent to, and downstream of the proposed WSIP projects. Although built in the past, these existing facilities continue to operate and thus affect current conditions. The major facilities, shown in **Figure 5.7-3**, include:

- Calaveras Dam and Reservoir
- Turner Dam and San Antonio Reservoir
- Del Valle Reservoir/South Bay Aqueduct
- Alameda Creek Diversion Dam and Tunnel
- BART weir
- Sunol infiltration galleries (refer to description in Section 5.4.4)
- ACWD's upper, middle, and lower inflatable dams
- ACWD and Sunol groundwater wells
- Gravel mining operations and quarries
- ACFCWCD channelization projects

Calaveras Dam was constructed between 1913 and 1925, while Turner and Del Valle Dams were constructed in the late 1960s. Calaveras Reservoir was operated at its full 96,800-acre-foot capacity for over 75 years before being restricted to a capacity of 37,800 acre-feet in late 2001. The Sunol infiltration galleries and Sunol Dam were constructed in 1901. The other listed facilities were constructed between 1910 and the present. Use of the water supply facilities, with the exception of the infiltration galleries, has increased over the same time period to keep pace with water demand in the Bay Area. Through mid-2006, the SFPUC owned two smaller dams on Alameda Creek, Niles and Sunol Dams, which were removed in 2006. Groundwater pumping and extraction via near-surface wells and infiltration facilities has been ongoing for many decades in both the Sunol area and the Niles Cone area downstream of the SFPUC facilities. Lands within the CCSF-owned Alameda watershed are managed in accordance with the SFPUC's *Alameda Watershed Management Plan* (Alameda WMP), as described in Sections 4.2 and 5.2 of this PEIR.

As described in Section 5.4, the roughly 175-square-mile Alameda Creek watershed upstream of Calaveras, San Antonio, and Del Valle Reservoirs has remained mostly undeveloped. However, urbanization, quarrying, and other land use activities have altered major portions of the Alameda Creek watershed. About 400 square miles of the overall 625-square-mile Alameda Creek watershed drains into Arroyo de la Laguna to the north and east of the SFPUC lands. This area has been heavily urbanized, resulting in significantly increased peak flows and major inputs of urban pollutants. Similarly, the Bay Plain downstream of Niles Canyon has also experienced extensive urbanization.

### *Future Projects*

Reasonably foreseeable future projects affecting stream flow or related resources in the Alameda Creek watershed are listed in **Table 5.7-13** and shown in Figure 5.7-3. Table 5.7-13 presents other SFPUC projects in the watershed; even though the SFPUC's Alameda WMP is currently being implemented, it is included in this list because it encompasses numerous future sub-projects and activities. The replacement of Calaveras Dam just downstream from the current dam (Calaveras Dam, SV-2) and the recapture facility (Alameda Creek Fishery, SV-1) are considered part of the WSIP and therefore are not included on the cumulative projects table. In addition to the listed projects, the SFPUC would conduct routine maintenance on its facilities in the Alameda watershed. Table 5.7-13 also presents non-SFPUC projects planned or proposed by other agencies or organizations.

Most of the projects on both tables are habitat or watershed enhancement projects or plans intended to reverse some of the degradation of watershed resources resulting from a century of urban development. The list includes over a dozen projects that are in various stages of planning and implementation by public agencies, citizens' groups, and quarry operators. These projects range from removing dams, weirs, culverts, pipelines, and screens that block fish passage to restoring and protecting habitat and fish flows. The SFPUC's projects identified in the table include the Alameda WMP and related activities and two WSIP-related activities, the Watershed and Environmental Improvement Program and the Habitat Reserve Program (both described in Chapter 3, Section 3.12).

Many of the non-SFPUC projects are part of Zone 7's Stream Management Master Plan for Alameda Creek and ACWD's Alameda Creek steelhead restoration program. The list also includes a major flood detention project (the Chain of Lakes project, part of Zone 7's Master Plan) in the Arroyo de la Laguna watershed, levee improvements, and two quarries. Table 5.7-13 includes summary descriptions of each project, the affected watershed or water body, and the potential cumulative impact areas that could be compounded due to identified impacts of the WSIP.

## 5.7.3.2 Cumulative Impacts

### *Significance Criteria*

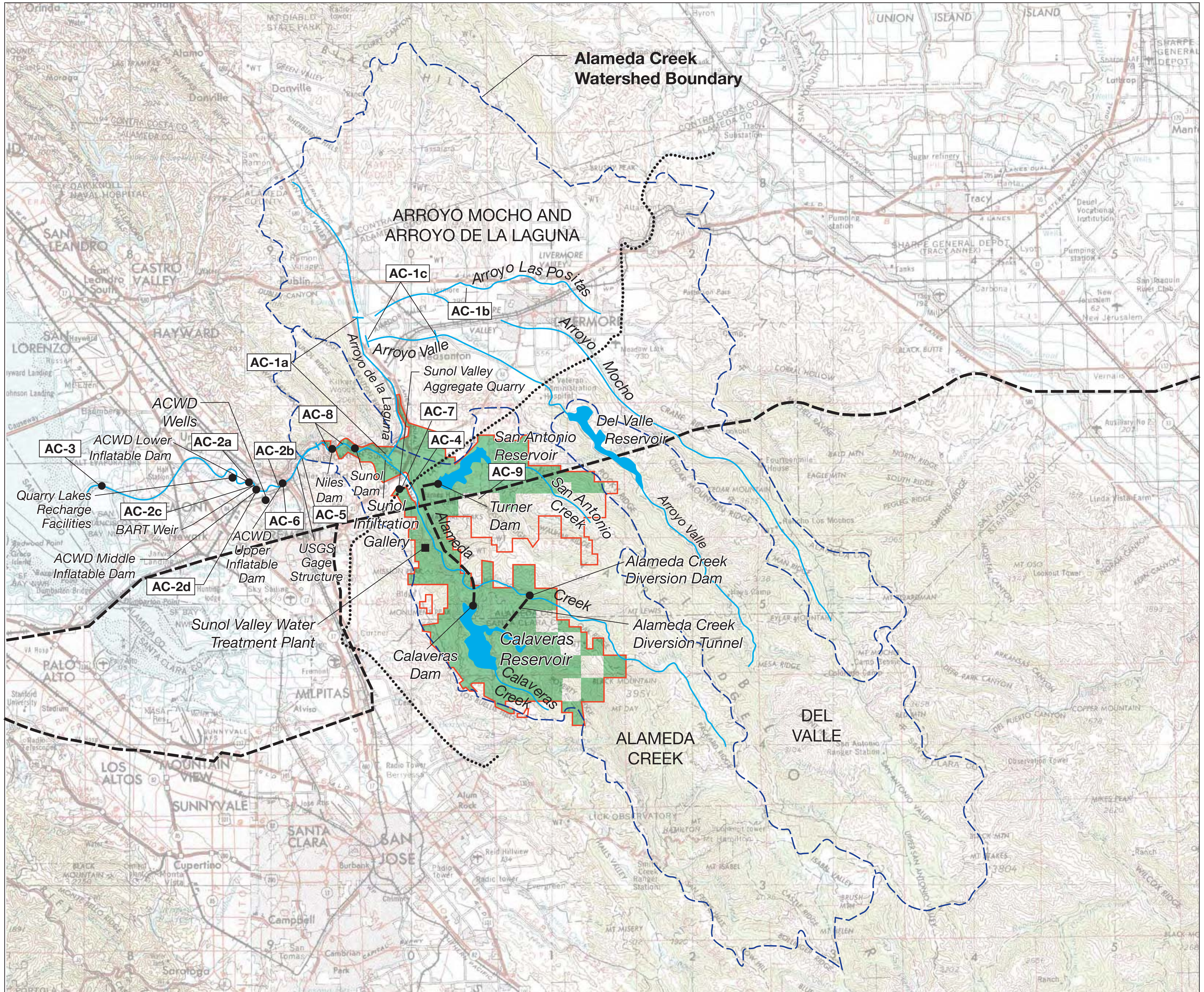
The CCSF has not formally adopted significance standards for impacts related to cumulative effects, but generally considers that implementation of the proposed program would have significant cumulative impacts if it were to:

- Have impacts that would be individually limited, but cumulatively considerable ("cumulatively considerable" means that the incremental effects of a project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)

Impacts associated with the proposed program that would be "individually limited" are based on the impact analyses presented in Section 5.4 and the significance criteria presented in that section for the various environmental resource areas.

### *Approach to Analysis and Impact Summary*

Cumulative impacts are analyzed based on the CEQA guidance and approach described above in Section 5.7.1. Cumulative impacts are discussed below, and impact significance determinations are summarized in **Table 5.7-14**.




Watershed Boundary

Existing SFPUC System Corridor

AP-1 Other SFPUC Project

AC-1 Non-SFPUC Project

CCSF Ownership (also project boundary for AP-1, AP-2, AP-3)

HCP Study Area (also project boundary for AP-1a)

DWR South Bay Aqueduct

*See Table 5.7-13 for names and descriptions of projects*

| Cumulative Project No. | Plan/Project Name |
|---|---|
| **OTHER SFPUC PROJECTS (not shown on figure as watershed wide)** | |
| AP-1 | Alameda Watershed Management Plan (WMP) |
| AP-1a | Alameda Watershed Habitat Conservation Plan (sub-project of Alameda WMP) |
| AP-2 | Watershed and Environmental Improvement Program (WSIP-related activity) |
| AP-3 | Habitat Reserve Program (WSIP-related activity) |
| **NON-SFPUC PROJECTS** | |
| AC-1 | Zone 7 Stream Management Master Plan (SMMP) |
| AC-1a | Arroyo de la Laguna Reach 10 Improvements (sub-project of Zone 7 SMMP) |
| AC-1b | Chain of Lakes (sub-project of Zone 7 SMMP) |
| AC-1c | Lower Arroyo del Valle Restoration and Enhancement (sub-project of Zone 7 SMMP) |
| AC-2 | Alameda Creek Steelhead Restoration |
| AC-2a | Rubber Dam 2 Decommissioning and Foundation Modification Project (sub-project of Alameda Creek Steelhead Restoration) |
| AC-2b | Alameda Creek Pipeline No. 1 Fish Screen (sub-project of Alameda Creek Steelhead Restoration) |
| AC-2c | BART Weir (sub-project of Alameda Creek Steelhead Restoration Efforts) |
| AC-2d | Middle Inflatable Dam Modification |
| AC-3 | Alameda Creek – Levee Reconfiguration |
| AC-4 | PG&E Gas Line Crossing |
| AC-5 | Stonybrook Creek Culvert Removal |
| AC-6 | Upper Inflatable Dam Fish Passage Project |
| AC-7 | Sunol Valley Aggregate Quarry – SMP 30 |
| AC-8 | Section 1135 Alameda Creek Flood Control Project Fish Passage Modifications |
| AC-9 | Apperson Ridge Quarry |

0 20
Miles

SOURCE: ESA + Orion

SFPUC Water System Improvement Program . 203287

**Figure 5.7-3 (Revised)**
Future Projects in the Alameda Creek Watershed Considered in the Cumulative Analysis

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**TABLE 5.7-13**
**FUTURE PROJECTS IN THE ALAMEDA CREEK WATERSHED CONSIDERED IN THE CUMULATIVE ANALYSIS**

| Cumulative Project No. | Plan/Project Name | Jurisdiction | Project Description | Affected Watershed/ Water Body | Potential Cumulative Impact Areas | Status/Schedule |
|---|---|---|---|---|---|---|
| OTHER SFPUC PROJECTS | | | | | | |
| AP-1 | Alameda Watershed Management Plan (WMP)[a] | SFPUC | Provides a policy framework for the SFPUC to make consistent decisions about the activities, practices, and procedures that are appropriate on SFPUC watershed lands. Included in the plan are several management actions designed to implement the established goals and policies for water quality, water supply, and ecological enhancement. | CCSF-owned lands in Alameda Creek watershed | Beneficial impacts on terrestrial biological resources, fisheries, and surface water quality | Plan adopted in 2000, implementation ongoing |
| AP-1a | Alameda Watershed Habitat Conservation Plan (sub-project of Alameda WMP)[a] | SFPUC | Develop a comprehensive, multi-species habitat conservation plan for species of concern in the watershed, including steelhead. | Alameda Creek watershed – Alameda Creek, San Antonio Creek, Calaveras Creek, Arroyo Hondo, and Arroyo de la Laguna and tributary streams and reservoirs | Beneficial impacts on terrestrial biological resources and fisheries | Phase 2 – indicates implementation within 10 years of adoption of Alameda WMP |
| AP-2 | Watershed and Environmental Improvement Program (WSIP-related activity) | SFPUC | Protect and restore lands and natural resources critical to operation of the SFPUC's regional water system. The program could include water quality, ecosystem and habitat protection, improvements, and restoration and would address such issues as fish passage, riparian habitat degradation, and sensitive species recovery. | CCSF-owned lands in Alameda Creek watershed | Beneficial impacts on terrestrial biological resources, fisheries, and surface water quality | Program funded but still under development; includes implementation of actions in the WMP |
| AP-3 | Habitat Reserve Program (WSIP-related activity) | SFPUC | Develop and enhance wetlands and other habitats to be applied toward mitigation of impacts on biological resources resulting from implementation of the WSIP. | CCSF-owned lands in the Alameda and Peninsula watersheds; also includes locations in the San Joaquin Valley | Beneficial long-term impacts on terrestrial biological resources, and surface water quality, but short-term construction impacts; possible impacts on agricultural resources depending on the site | Program in development, with environmental review scheduled from 2007 to 2008 and implementation between 2008 and 2010 |

[a] SFPUC, *Alameda Watershed Management Plan,* Final Draft. April 2001.
[b] Bay Area Watershed Management, Habitat Protection & Restoration Plan, Watershed Project Inventory Master Table. April 6, 2006.

**TABLE 5.7-13 (Continued)**
**FUTURE PROJECTS IN THE ALAMEDA CREEK WATERSHED CONSIDERED IN THE CUMULATIVE ANALYSIS**

| Cumulative Project No. | Plan/Project Name | Jurisdiction and/or Project Sponsor | Project Description | Affected Watershed/ Water Body | Potential Cumulative Impact Areas | Status/Schedule |
|---|---|---|---|---|---|---|
| NON-SFPUC PROJECTS | | | | | | |
| AC-1 | Zone 7 Stream Management Master Plan (SMMP)[a] | Zone 7 Water Agency | Involves 45 individual projects with the primary purpose of providing flood protection within arroyos, creeks, and streams in the greater Alameda Creek watershed in partnership with local agencies, including the SFPUC. In addition to flood control, the projects strive to meet regional resource area goals and objectives to the extent possible. Only SMMP projects with the potential to contribute to cumulative impacts are addressed in this analysis. | Alameda Creek watershed – Alameda Creek, Arroyo de la Laguna, Arroyo Mocho, Arroyo del Valle, Arroyo Las Positas, Alamo Canal | Beneficial impacts on surface water quality, hydrology (regional flooding), terrestrial biological resources, and fisheries | Varies by project |
| AC-1a | Arroyo de la Laguna Reach 10 Improvements (sub-project of Zone 7 SMMP)[a] | Zone 7 Water Agency | Improvements along Reach 10 of Arroyo de la Laguna include bank stabilization and protection features, enhancement of stream corridor and riparian habitat, and removal of barriers to steelhead fish migration along creeks. | Arroyo de la Laguna | Beneficial impacts on hydrology (flood protection and drainage), erosion, surface water quality, and habitat | Estimated construction schedule is 2008–2010 |
| AC-1b | Chain of Lakes (sub-project of Zone 7 SMMP)[a] | Zone 7 Water Agency | Provides 5,000 acre-feet of flood retention and storage in the Sunol-Niles area and the Livermore Valley. | Arroyo Las Positas, Arroyo Mocho | Beneficial impacts on hydrology (flood protection and drainage), water supply, and surface water quality | Began operation in 2005, with total project completed in 2030 |
| AC-1c | Lower Arroyo del Valle Restoration and Enhancement (sub-project of Zone 7 SMMP)[a] | Zone 7 Water Agency | Remove three fish barriers, modify flap gates, and improve riparian vegetation. | Lower Arroyo del Valle | Beneficial impacts on hydrology (flood protection and drainage), fisheries, and habitat | Unknown |
| AC-2 | Alameda Creek Steelhead Restoration[b] | Alameda County Water District (ACWD) | In 2005, ACWD received $1 million from the National Fish and Wildlife Foundation to initiate two projects that will improve steelhead migration in Alameda Creek. ACWD's two projects are part of a much larger effort by multiple agencies, including the SFPUC, to improve fish passage in the Alameda Creek watershed. In June 2007, ACWD began installing a fish screen as part of this effort. | Alameda Creek watershed – Alameda Creek Flood Control Channel | Beneficial impacts on fisheries | Unknown |
| AC-2a | Rubber Dam 2 Decommissioning and Foundation Modification Project (sub-project of Alameda Creek Steelhead Restoration)[b] | ACWD | Remove the fabric portion of the Rubber Dam 2 and a section of the dam's foundation to improve steelhead migration in Alameda Creek. Located in Fremont within the Alameda Creek Flood Control Channel adjacent to the Quarry Lakes Regional Recreational Area. | Alameda Creek | Beneficial impacts on fisheries | Mitigated Negative Declaration (MND) adopted June 2006<br><br>Estimated construction schedule: 2007–2009 |

**TABLE 5.7-13 (Continued)**
**FUTURE PROJECTS IN THE ALAMEDA CREEK WATERSHED CONSIDERED IN THE CUMULATIVE ANALYSIS**

| Cumulative Project No. | Plan/Project Name | Jurisdiction and/or Project Sponsor | Project Description | Affected Watershed/ Water Body | Potential Cumulative Impact Areas | Status/Schedule |
|---|---|---|---|---|---|---|
| NON-SFPUC PROJECTS (cont.) | | | | | | |
| AC-2b | Alameda Creek Pipeline No. 1 Fish Screen (sub-project of Alameda Creek Steelhead Restoration)[b] | ACWD | Install a diversion screen to eliminate the potential for out-migrating juvenile steelhead at the intake location of Alameda Creek Pipeline No. 1. | Alameda Creek | Beneficial impacts on fisheries | MND adopted June 2006<br><br>Estimated construction schedule 2007–2009 |
| AC-2c | BART Weir (sub-project of Alameda Creek Steelhead Restoration Efforts) | Alameda County Flood Control and Water Conservation District (ACFCWCD) | Modify flood control drop structure (the BART weir) to allow for fish passage. | Alameda Creek | Beneficial impacts on fisheries | Feasibility study completed in 2006; project currently in preliminary design phase. |
| AC-2d | Middle Inflatable Dam Modification (sub-project of Alameda Creek Steelhead Restoration)[c] | ACWD | Modify middle inflatable dam (adjacent to BART weir) to allow for fish passage. Could result in taking inflatable dam out of commission (used for redundancy). | Alameda Creek | Beneficial impacts on fisheries | Unknown |
| AC-3 | Alameda Creek – Levee Reconfiguration[j] | ACFCWCD | Reconfigure levee at mouth of Alameda Creek. | Arroyo Las Positas – Alameda Creek watershed | Beneficial impacts on habitat and flood control | Unknown |
| AC-4 | PG&E Gas Line Crossing[e] | PG&E | Modify the cement-armored PG&E gas pipeline crossing of Alameda Creek in the Sunol Valley above the confluence with San Antonio Creek, which likely poses a barrier to fish migration at most water flows. This project involves modification of the concrete mat or construction of a fish ladder to allow fish passage. | Alameda Creek | Beneficial impacts on fisheries | Scheduled for completion by 2009 |
| AC-5 | Stonybrook Creek Culvert Removal[f] | Caltrans | Remove culvert and design/install new creek crossing (two county-owned culverts and one Caltrans culvert). | Alameda Creek | Beneficial impacts on fisheries | Unknown |
| AC-6 | Upper Inflatable Dam Fish Passage Project[g] | Alameda Creek Alliance | Install pool and weir ladder in the right north channel. | Alameda Creek | Beneficial impacts on fisheries | Unknown |

**TABLE 5.7-13 (Continued)**
**FUTURE PROJECTS IN THE ALAMEDA CREEK WATERSHED CONSIDERED IN THE CUMULATIVE ANALYSIS**

| Cumulative Project No. | Plan/Project Name | Jurisdiction and/or Project Sponsor | Project Description | Affected Watershed/ Water Body | Potential Cumulative Impact Areas | Status/Schedule |
|---|---|---|---|---|---|---|
| NON-SFPUC PROJECTS (cont.) | | | | | | |
| AC-7 | Sunol Valley Aggregate Quarry – SMP 30[h] | Sunol Valley Aggregate Quarry | Continued mining under current permit in the near term, with planned expansion to increase mining depth. Project would restore portions of the Alameda Creek and San Antonio Creek banks and install a slurry cutoff wall. | Alameda and San Antonio Creeks | Would affect groundwater flow pattern. Installation of the slurry cutoff wall is expected to benefit creek flow hydrology by reducing seepage to the quarry pits; no adverse impacts on creek flows expected. Planned creek bank restoration would also benefit riparian habitat. | Near-term continuation of quarry operations; expansion of quarry and other activities in 2009–2011 |
| AC-8 | Section 1135 Alameda Creek Flood Control Project Fish Passage Modifications[j] | U.S. Army Corps of Engineers, ACFCWCD | Study concepts include potential fishways at BART weir and middle and upper ACWD inflatable dams, and four fish screens at Shinn Pond Diversion 1 and 2, Kaiser Pond Diversion, and Alameda Creek Pipeline Intake. | Alameda Creek, approximately 1.25 miles downstream of Niles Dam site and 4.75 miles downstream of Sunol Dam site | Beneficial impacts on fisheries | Project schedule unknown |
| AC-9 | Apperson Ridge Quarry[i] | Oliver de Silva, Inc. | Surface mining permit for the operation of 680-acre hard rock quarry and associated manufacturing facilities located on the Apperson Ranch (a.k.a. Diamond A. Ranch) on Apperson Ridge in the Sunol area. | East of Sunol Valley, midway between Sunol Regional Wilderness and San Antonio Reservoir | EIR identified potential impacts on water quality due to increased erosion and sedimentation, detrimental impacts on wildlife habitat (i.e., San Antonio tule elk herd); and potential impacts on well yields in the Welch Creek area | EIR prepared in 1984; project approved by Alameda County in 1984; implementation schedule unknown |

a ESA, *Zone 7 Stream Management Master Plan*. Final MEIR. August 2006.
b ACWD, "Alameda Creek Watershed Steelhead Restoration Efforts." Online. Accessed December 12, 2006. Available: http://www.acwd.org/engineering/projects.php5?goback=news/index.php5
c (1) Bay Area Watershed Plan, Watershed Project Inventory Master Table. April 6, 2006. (2) ACFCWCD, Lower Alameda Creek/BART Weir Fish Passage Assessment, Draft Alternatives Evaluation Report. August 2006.
d Bay Area Watershed Plan, Watershed Project Inventory Master Table. April 6, 2006.
e Alameda Creek Alliance, "Fish Passage Projects, Sunol Valley." Online. Accessed December 14, 2006. Available: http://www.alamedacreek.org/Fish_Passage/Sunol%20Valley/Sunol%20Valley.htm
f (1) Bay Area Watershed Plan, Watershed Project Inventory Master Table. April 6, 2006. (2) Alameda Creek Alliance, "Fish Passage Projects, Stonybrook Creek." Online. Accessed December 14, 2006. Available: http://www.alamedacreek.org/Fish_Passage/Stonybrook/Stonybrook%20Creek.htm
g Bay Area Watershed Plan, Watershed Project Inventory Master Table. April 6, 2006.
h ESA, *Sunol/Niles Dam Removal Project Final Environmental Impact Report*. State Clearinghouse No. 2004072049. Certified April 6, 2006.
i Alameda County Planning Department, *SMP-17 Apperson Ridge Quarry, Draft Environmental Impact Report, Volume 1: Text,* 1984.

**TABLE 5.7-14**
**SUMMARY OF CUMULATIVE IMPACTS IN THE ALAMEDA CREEK WATERSHED RELATED TO WSIP WATER SUPPLY AND SYSTEM OPERATIONS**

| | Significance Determination | | | | | | |
|---|---|---|---|---|---|---|---|
| **Impact** | Hydrology | Geomorphology | Surface Water Quality | Groundwater | Fisheries | Terrestrial Biology | Recreational / Visual Quality |
| 5.7.3-1: Cumulative effects on the Alameda Creek watershed | N/A | LS | LS | LS | LS | LS | LS |

NOTE: Significance determinations presented in this table assume implementation of all mitigation measures presented in Chapter 5, Section 5.4, and described in Chapter 6.

LS = Less than Significant, no mitigation required
N/A = Not Applicable

Because impacts on stream flow and reservoir levels are related to effects on other environmental resources (see Section 5.1), the cumulative impacts in this section are organized by geographic area rather than by environmental topic in order to characterize the overall effects on the affected water body. In determining the significance of cumulative impacts, it is assumed that mitigation measures identified in Section 5.4 and described in Chapter 6 would be implemented, and any residual effects after mitigation are considered in combination with the effects of past, other current, and probable future projects. The incremental contribution of the program's residual effects to the overall cumulative impact is then examined to determine whether it would be "cumulatively considerable."

The WSIP would increase summer flow releases from Calaveras Reservoir, reduce rainy season flows in upper Alameda Creek below the diversion dam, and substantially raise the water level in Calaveras Reservoir compared to existing conditions. However, as described below, the proposed program, in combination with the cumulative projects identified in the tables above, would not have significant adverse environmental effects beyond the program effects already described for the WSIP in Section 5.4.

### *Alameda Creek Watershed*

**Impact 5.7.3-1: Cumulative effects on the Alameda Creek watershed.**

#### Effect of Past and Present Projects

**Hydrology.** Construction and operation of the SFPUC regional water system and the State of California's Del Valle Reservoir have substantially altered the hydrology of the Alameda Creek watershed. Peak flows in the various upstream tributaries to Alameda Creek have been substantially reduced by reservoir operations.

Development has also greatly altered the Alameda Creek watershed. Major alterations include channelization of the lower 12 miles of the creek for flood control; construction of Turner, Calaveras, and Del Valle Dams for water supply; and construction of a concrete drop structure to stabilize the channel around the Fremont BART weir. As described above, the Arroyo de la Laguna watershed, which constitutes nearly two-thirds of the entire Alameda Creek watershed, has been extensively altered by urbanization and quarrying.

Since 1931, following construction of the Alameda Creek Diversion Dam and Tunnel, the SFPUC has diverted flows and drainage from the southern Alameda Creek watershed into Calaveras Reservoir for municipal water supply. For about 70 years, from 1931 to 2001, the SFPUC diverted substantial flows from Alameda Creek above the diversion dam to Calaveras Reservoir. However, as described in Section 5.4.1, the SFPUC reduced the diversions from Alameda Creek into Calaveras Reservoir in December 2001 due to interim California Division of Safety of Dams (DSOD) operational restrictions on Calaveras Reservoir. The SFPUC currently diverts a small percentage of the unimpaired flow of Alameda Creek above the diversion dam, as well as nearly all of the flow of Arroyo Hondo, to Calaveras Reservoir. The DWR also diverts a substantial portion of the flow from Arroyo del Valle. The water diverted from the Alameda Creek watershed is conveyed to the Bay Area and used for municipal water supply.

Flows to Alameda Creek from portions of the watershed upstream of Arroyo del Valle and from the Arroyo de la Laguna watershed have been affected by urban development and groundwater withdrawal, but are not diverted to any large dams/reservoirs. The lower reach of the creek is characterized by extensive urban development and has been channelized (rip-rapped) for floodwater conveyance.

In summary, past construction and continued operation of the regional water system have had a substantial adverse effect on the hydrology of portions of Alameda Creek, Arroyo Hondo, Calaveras Creek, and San Antonio Creek. These streams are managed for water supply and flood control and carry flows that are substantially reduced compared to historical conditions.

**Geomorphology.** Stream channels exist in a state of dynamic equilibrium with their watersheds. When conditions in the watershed change, the dynamic equilibrium is disturbed, and the river channel form will adjust to the new watershed condition. Water resources development, flood control structures, gravel mining, and urbanization have progressively changed conditions in the Alameda Creek watershed; only the headwater watersheds (above the dams) and Niles Canyon stream reaches retain any semblance of pre-Euro-American settlement conditions.

The SFPUC reservoirs served as catchments for sediments from the San Antonio and Arroyo Hondo/Calaveras Creek upper watersheds; however, these watersheds contribute a small percentage of the sediment supply to Alameda Creek. Extensive quarrying and urban development have also interrupted sediment flow to the creek. The recent removal of Niles and Sunol Dams in 2006 will allow for the release of small amounts of additional sediments to the lower portion of Alameda Creek over time. The ACFCWCD periodically removes accumulated sediments from the lower, channelized reach of Alameda Creek.

**Surface Water Quality.** Water quality in the headwater areas of Alameda Creek and its tributaries, above the water development facilities, has likely been minimally affected relative to natural conditions. However, urban development has introduced large quantities of urban runoff pollutants such as oil and grease, herbicides, and pesticides into Alameda Creek and its tributaries both north and east of the Sunol Valley (i.e., in the San Ramon and Livermore Valleys) and in the main stem of Alameda Creek downstream of SFPUC facilities. Increased runoff in the Arroyo de la Laguna watershed resulting from urbanization has also resulted in increased sediment generation. In addition, the diminution of flow in the creeks immediately downstream of the dams as a result of past and present projects causes water temperature and dissolved oxygen to rise more rapidly than under historical conditions. On occasion, the SFPUC also stores and mixes Tuolumne River water with local water in San Antonio Reservoir, and the State of California mixes South Bay Aqueduct water with local sources in Del Valle Reservoir, altering the water quality characteristics of the local watershed but not necessarily degrading water quality.

In summary, past construction and continued operation of the regional water system combined with urban development in the watershed have had a substantial adverse effect on water quality in Alameda Creek downstream of the SFPUC facilities.

**Groundwater.** As described in Section 5.4.4, primary groundwater resources in the Alameda Creek watershed are in the Livermore and Sunol Valleys, downstream of the major SFPUC facilities. Major groundwater withdrawal projects managed by the ACWD (in the Niles Cone) and Zone 7 Water Agency (in the Sunol and Arroyo de la Laguna groundwater basins) have been developed in the Pleasanton area, the Sunol Valley, and the Niles Cone. Groundwater withdrawal in these areas has lowered water tables and resulted in groundwater quality degradation. The ACWD and Zone 7 have implemented groundwater recharge projects in these areas to assist in restoring groundwater conditions.

**Fisheries.** Section 5.4.5 provides a detailed description of the existing condition of fishery resources in the Alameda Creek watershed, depicting the effects of past and present projects. Alameda Creek historically hosted a steelhead run, with spawning occurring in the upper reaches of the watershed. This steelhead run was eliminated over the past century by the placement of several obstructions to migration within the Alameda Creek channel. Major alterations to Alameda creek and its tributaries (including the channelization of the lower 12 miles of the creek for flood control; the construction of San Antonio, Calaveras, and Del Valle Reservoirs for water supply; and the construction of a concrete drop structure to stabilize the channel around the Fremont BART weir) have made spawning habitat within the watershed inaccessible for some returning anadromous fishes such as steelhead and Chinook salmon (Gunther et al., 2000). Construction and operation of dams, diversions, and other structures that function as fish migration barriers (e.g., the Sunol and Niles Dams and the grade control structure at the BART weir) have prevented anadromous fishes migrating into Alameda Creek and through Niles Canyon from reaching coldwater habitat farther upstream within the watershed (Gunther et al., 2000). The Sunol and Niles Dams were partially removed in September 2006, eliminating them as obstacles to fish passage. Despite the recent removal of these structures, steelhead can currently migrate upstream only as far as the BART weir.

The upper reach of Alameda Creek supports a reproductive population of resident rainbow trout. Arroyo Hondo, a tributary to Calaveras Creek upstream from Calaveras Reservoir, is known to contain self-sustaining populations of resident rainbow trout. Populations of resident rainbow trout have been reported above Calaveras Reservoir on several occasions since 1905, in Arroyo Hondo, Isabel Creek, and Smith Creek (Leidy, 1984; cited in ESA, 2005). Young-of-year trout have been observed in Stonybrook Creek and Sinbad Creek, tributaries to Alameda Creek (Gunther et al., 2000). There is some evidence that a native, locally adapted trout stock survives in the Alameda Creek watershed (Gunther et al., 2000).

**Terrestrial Biology.** Construction of the regional water system combined with urban development in the lower watershed has had a substantial adverse effect on terrestrial biological resources in the Alameda Creek watershed. The creation of reservoirs in the upper watershed of Alameda Creek and its major tributaries as part of the regional water system and other water systems resulted in the inundation of substantial areas of land. These areas were probably occupied by native grassland, chaparral and scrub, mixed evergreen forest, and riparian forest. However, development of the reservoirs has resulted in replacement of upland habitats with creation of riparian, wetlands and freshwater marsh habitat around the periphery of the reservoirs. The characteristics and extent of the wetlands and related habitats have varied historically due to changes in the operating levels of the reservoirs.

The lower watershed was historically occupied by grassland, oak woodland forest, and riparian forest. However, urban development, gravel mining, grazing, and flood control projects have affected much of the terrestrial biological resources of the lower watershed, except in Niles Canyon; at present, non-native grassland is the most common natural community on the SFPUC Alameda watershed. The current status of wildlife and natural communities is described in more detail in Section 5.4.6.

**Recreational and Visual Quality.** Changes in stream hydrology attributable to past and present projects have affected visual quality due to reduced flows in scenic areas of the watershed (i.e., Little Yosemite); in addition, water supply facilities, mining, flood control projects, and urbanization have changed the entire visual character of the lower reaches of Alameda Creek. Upstream of the dams on Alameda, Calaveras, and Del Valle Creeks, the watersheds retain much of their predevelopment visual character. The East Bay Regional Park District has enhanced recreational resources in the watershed by constructing trails and visitor facilities (including major park facilities at Del Valle Reservoir).

### Potential Effects of Future Projects

The planned and reasonably foreseeable future projects in the watershed would have primarily beneficial effects on the environmental resources of the watershed. As described above, many of the proposed projects (shown as Projects AC-1, 1a, 1c, 2, 2a, 2b, 2c, 2d, 3, 4, 5, 6, and 8, and AP-1, 1a, 2, and 3 on Figure 5.7-3) would remove fish migration barriers from Alameda Creek and its major tributaries, enhance fish and riparian habitat, reduce sedimentation, and increase infiltration and retention of unnaturally high peak runoff resulting from urbanization. The proposed Chain of Lakes project (AC-1b) would provide recharge for Zone 7's Arroyo de la

Laguna groundwater basin and would both reduce peak flows and capture substantial quantities of sediments, thereby preventing their transport downstream. The Sunol Valley Aggregate Quarry project (AC-7) would continue current mining but would include a slurry cutoff wall that is expected to reduce seepage from Alameda and San Antonio Creeks to the quarry pits, thereby benefiting riparian habitats and fisheries. Project AC-9, the Apperson Ridge Quarry, would permit a hard-rock mine in the ridges in the upper end of the San Antonio Creek watershed. Depending on how this project is implemented, it could adversely affect water quality downstream, although implementation of conventional mitigation measures would likely mitigate water quality impacts to a less-than-significant level. Overall, the future cumulative projects would not substantially affect hydrology, geomorphology, water quality, groundwater, fisheries, riparian habitat, or visual quality/recreational resources.

### Cumulative Effects and WSIP Contribution

**Table 5.7-15** summarizes the effects of past and present projects, the impacts of the WSIP, the effects of probable future projects, and the combined impacts of the WSIP plus probable future projects on the Alameda Creek watershed. Past and present projects have substantially altered the hydrology, geomorphology, surface water quality, groundwater, fisheries, and terrestrial biology of this portion of the Alameda Creek watershed compared to pre-Euro-American settlement conditions. Visual and recreational resources have been moderately altered. The existing condition, which serves as the baseline for the analysis of the WSIP, reflects the substantial environmental changes that have occurred as a result of the past projects. Because past and present actions have drastically altered the Alameda Creek watershed, some of the environmental resources are more sensitive to small adverse changes than they would be if the watershed had remained relatively unaltered from pre-Euro-American settlement conditions.

**TABLE 5.7-15**
**CUMULATIVE EFFECTS ON THE ALAMEDA CREEK WATERSHED**

| Resource | Effects of Past and Present Projects | Impacts of WSIP (prior to mitigation/ after mitigation) | Effects of Other Future Projects | Cumulative Impact (WSIP after mitigation + Future Projects) | WSIP Contribution Cumulatively Considerable? |
|---|---|---|---|---|---|
| Hydrology | SA | SU/SU[a] | N/A | N/A | No |
| Geomorphology | SA | LS | LS | LS | No |
| Surface Water Quality | SA | LS | LSM | LS | No |
| Groundwater | SA | LS | LS | LS | No |
| Fisheries | SA | PSM/LS[a] | B | LS | No |
| Terrestrial Biology | SA | PSM/LS[a] | B | LS | No |
| Recreational/Visual Quality | MA | LS | LS | LS | No |

[a] Pertains to impacts on Alameda Creek downstream of the diversion dam. No other future project would add to this impact.

B = Beneficial impact
LS = Less than Significant, no mitigation required
LSM = Less than Significant with standard mitigation
PSM/LS = Potentially Significant impact, but reduced to Less than Significant with mitigation
SU = Significant, Unavoidable impact, even with implementation of mitigation measures
N/A = Not Applicable
SA = Substantially Altered
MA = Moderately Altered

As described in Section 5.4, the WSIP would have a less-than-significant adverse effect on geomorphology, surface water quality, and groundwater levels. However, because the proposed program would substantially reduce and alter flow patterns in Alameda Creek below the diversion dam, the WSIP itself could have significant adverse effects on hydrology, fisheries, and terrestrial biological resources in this stretch of the creek. With the exception of the hydrological impact in Alameda Creek below the diversion dam (and below the Calaveras Creek confluence), which would remain significant even with mitigation, the program impacts would be reduced to a less-than-significant level with implementation of mitigation measures described in Chapter 6 (Measures 5.4.5-3a, Minimum Flows for Resident Trout on Alameda Creek; 5.4.5-3b, Alameda Diversion Dam Restrictions or Fish Screens; 5.4.6-1, Compensation for Impacts on Terrestrial Biological Resources; and 5.4.6-3, Operational Procedures for Calaveras Dam Releases). As described above, most other foreseeable future projects are likely to have beneficial or less-than-significant impacts on geomorphology, surface water quality, groundwater levels and quality, fisheries, terrestrial biological resources, and recreational and visual resources in the Alameda Creek watershed.

The Apperson and Sunol quarry projects could create adverse water quality effects downstream in San Antonio Creek and Reservoir, but compliance with applicable water quality regulations coupled with implementation of conventional mitigation measures is expected to reduce these efforts to less than significant. Similarly, implementation of the physical components of many of the watershed and fish passage improvement projects could result in temporary increases in sedimentation and short-term water quality effects. Such short-term impacts are typically mitigated to a less-than-significant level by project-specific mitigation measures and best management practices. In the long term, these improvement projects, in combination with the WSIP fishery releases from Calaveras Reservoir, would result in beneficial cumulative effects on geomorphology, surface water quality, groundwater, fisheries, terrestrial biological resources, and recreational/visual resources and would likely offset any adverse effects from the proposed quarry projects.

Implementation of the WSIP would substantially reduce flows in the reach of Alameda Creek from the diversion dam to below its confluence with Calaveras Creek compared to existing conditions (Impact 5.4.1-2). This impact was determined to be significant and unavoidable, even with implementation of Measure 5.4.1-2 (Diversion Tunnel Operation) and bypass flows included as part of the protective measures in the Calaveras Dam Replacement project (SV-2). However, no other past, present, or future projects were identified that would further reduce the stream flow in this reach of Alameda Creek, and some of the projects listed in Table 5.7-13 could enhance the flow. Thus, there would be no adverse cumulative impact on hydrology associated with past, present, and future projects, and the WSIP's contribution to the cumulative impact on hydrology is not applicable.

Due to agreements and ongoing actions regarding the implementation of fish passage improvement projects in lower Alameda Creek (as described in Section 5.4.5 of the PEIR), it is possible that steelhead will be restored to the Alameda Creek watershed reaches upstream of the BART weir by 2030. More specifically, steelhead may be restored during construction or operation of the Calaveras Dam Replacement project (SV-2) under the WSIP. In response to this scenario, the SFPUC has modified the WSIP program description—mainly that of the Alameda Creek Fishery Enhancement (SV-1) and Calaveras Dam Replacement (SV-2) projects—to incorporate protective measures for steelhead in the event that man-made barriers in Alameda Creek have been successfully removed and that steelhead migration, spawning, and rearing have been restored in Alameda Creek above the BART weir. The protective measures incorporated into the operations of the Calaveras Dam Replacement project would address future-occurring steelhead and would provide for a range of minimum bypass flows and releases at the Alameda Creek Diversion Dam and Calaveras Dam to support steelhead migration, spawning, and rearing. The program as revised, and with implementation of mitigation measures identified in the PEIR, which together include minimum bypass flows to support the various life stages and habitat requirements for steelhead, would have a less-than-significant contribution to cumulative impacts on fishery resources in the Alameda Creek watershed. Please refer to Chapter 14, Section 14.9, of the PEIR for further discussion.

In summary, when the WSIP and future projects are considered together, none of their cumulative effects would rise to a level of significance. Even though past and present projects have moderately to substantially altered the environmental resources along this reach of Alameda Creek, the cumulative impacts of the WSIP after mitigation combined with the effects of future projects would not result in a substantial or noticeable change from the existing condition.

As stated previously, the WSIP's impacts on fisheries, terrestrial biology, and recreational/visual resources would be substantially reduced with implementation of Measures 5.4.5-3a, 5.4.5-3b, 5.4.6-1, and 5.4.6-3. Since the implementation of future projects would be expected to be beneficial to fisheries, terrestrial biology, and recreational/visual resources, the combined cumulative impacts on these resources with the WSIP after mitigation would be considered less than significant. Because there are no significant cumulative impacts, no mitigation measures beyond Measures 5.4.1-2, 5.4.5-3a, 5.4.5-3b, 5.4.6-1, and 5.4.6-3 would be necessary.

## 5.7.4 Cumulative Effects on San Francisco Peninsula Streams and Reservoirs

### 5.7.4.1 Relevant Projects

Past and present projects have affected streams, stream flow, and related environmental resources on the San Francisco Peninsula. The WSIP and other foreseeable future projects could also affect streams, stream flow, and related environmental resources. Foreseeable future projects, other than facility improvement projects included in the WSIP, are listed in **Table 5.7-16** and shown in **Figure 5.7-4**. They include both SFPUC and non-SFPUC projects.

#### *San Mateo Creek Watershed*

##### Past and Present Projects

Components of the SFPUC regional water system have substantially affected environmental quality in the San Mateo Creek watershed (shown in Section 5.5, Figure 5.5.1-1). Although built in the past, these components continue to operate and thus affect current conditions. These and other past projects and activities that affect the San Mateo Creek watershed include:

- San Andreas Reservoir
- Crystal Springs Reservoir
- Creek modifications in the lower watershed
- Urban development in the lower watershed
- Jefferson Martin Transmission Line

San Andreas Dam impounds San Andreas Reservoir and was built in 1870. Upper and Lower Crystal Springs Dams were built in 1877 and 1890 and together impound Crystal Springs Reservoir. The dams were built by the Spring Valley Water Company and later purchased by the CCSF. Various improvements to the reservoirs and associated conveyance and water treatment facilities have been made to accommodate increased demand for water and more stringent drinking water standards.

Land use in the San Mateo Creek watershed (which drains to San Andreas and Crystal Springs Reservoirs) has not changed much from conditions that existed prior to Euro-American settlement. The CCSF owns most of the land that drains to the two reservoirs; this land is almost

**TABLE 5.7-16**
**FUTURE PROJECTS IN THE PENINSULA WATERSHED CONSIDERED IN THE CUMULATIVE ANALYSIS**

| Cumulative Project No. | Jurisdiction and/or Project Sponsor | Project Name | Project Description | Affected Water Body/ Watershed | Potential Cumulative Impact Areas | Status |
|---|---|---|---|---|---|---|
| OTHER SFPUC PROJECTS | | | | | | |
| PP-1 | SFPUC | Peninsula Watershed Management Plan (WMP)[a] | Provides a policy framework for the SFPUC to make consistent decisions about the activities, practices, and procedures that are appropriate on SFPUC watershed lands. Included in the plan are several management actions designed to implement the established goals and policies for water quality, water supply, and ecological enhancement. | CCSF-owned lands in the Peninsula watershed, including portions of San Mateo Creek watershed and Pilarcitos Creek watershed | Beneficial impacts on terrestrial biological resources, fisheries, and surface water quality | Plan adopted in 2001, implementation ongoing |
| PP-1a | SFPUC | Peninsula Watershed Habitat Conservation Plan (sub-project of Peninsula WMP)[a] | Develop a comprehensive, multi-species habitat conservation plan for species of concern in the watershed. | CCSF-owned lands in the Peninsula watershed | Beneficial impacts on biological resources | Phase 2 – indicates implementation within 10 years of adoption of the Peninsula WMP |
| PP-2 | SFPUC | Watershed and Environmental Improvement Program(WSIP-related activity) | Protect and restore lands and natural resources critical to the operation of the SFPUC regional water system. The program could include ecosystem and habitat protection, improvements, and restoration and would address such issues as fish passage, riparian habitat degradation, and sensitive species recovery. | CCSF-owned lands in the Peninsula watershed | Beneficial impacts on terrestrial biological resources, fisheries, and surface water quality | Program funded but still under development; includes implementation of actions in the WMP |
| PP-3 | SFPUC | Habitat Reserve Program (WSIP-related activity) | Develop and enhance wetlands and other habitats, to be applied toward mitigation of impacts on biological resources due to implementation of the WSIP. | CCSF-owned lands in the Alameda and Peninsula watersheds; also includes locations in the Tuolumne River watershed | Beneficial long-term impacts on terrestrial biological resources, fisheries, and surface water quality, but short-term construction impacts | Program in development, with environmental review scheduled from 2007 to 2008 and implementation between 2008 and 2010 |

**TABLE 5.7-16 (Continued)**
**FUTURE PROJECTS IN THE PENINSULA WATERSHED CONSIDERED IN THE CUMULATIVE ANALYSIS**

| Cumulative Project No. | Jurisdiction and/or Project Sponsor | Project Name | Project Description | Affected Water Body/ Watershed | Potential Cumulative Impact Areas | Status |
|---|---|---|---|---|---|---|
| NON-SFPUC PROJECTS | | | | | | |
| PC-1 | San Mateo County | Lower Crystal Springs Dam Road Reconstruction | Reconstruct road over Crystal Springs Dam | Crystal Springs Reservoir/San Mateo Creek | Minor adverse impacts on water quality during construction period | Unknown. |
| PC-2 | San Mateo County Resource Conservation District (on behalf of the Pilarcitos Creek Restoration Workgroup) | Pilarcitos Creek Integrated Watershed Management Plan[b] | Intended purpose is to determine how to more effectively manage the competing beneficial uses of water from Pilarcitos Creek and promote balanced solutions that satisfy environmental, public health, recreational, and economic interests. | Pilarcitos Creek Watershed | Beneficial effects on fisheries, water quality, terrestrial biology | Currently under development; San Mateo Resource Conservation District sent out a Request for Proposals in November 2006 |
| PC-3 | City of San Mateo | San Mateo Creek Mouth Improvements | Consists of raising the north and south banks at the mouth of San Mateo Creek to meet requirements of the Federal Emergency Management Agency. | San Mateo Creek | Potential impact on hydrology (flood control) and biological resources | Needs funding |

[a] SFPUC, *Peninsula Watershed Management Plan*, 2001.
[b] San Mateo Resource Conservation District, Personal telephone communication between Kelly Nelson, of San Mateo Resource Conservation District, and Kelly White, of ESA. November 22, 2006.

entirely undeveloped and public access is very limited. The CCSF's watershed lands in the San Mateo Creek watershed are managed in accordance with the *Peninsula Watershed Management Plan* (Peninsula WMP), as described in Sections 4.2 and 5.2 of this PEIR. In 2006, Pacific Gas and Electric Company constructed an electrical power transmission line, the Jefferson Martin Transmission Line, along the eastern side of Crystal Springs Reservoir.

In the last 150 years, land use in the portion of the creek's watershed below Lower Crystal Springs Dam has been almost completely converted to urban uses. With the exception of a two-mile-long reach immediately below the dam, the San Mateo Creek channel has been progressively modified over many years to accommodate urban runoff and prevent flooding of lands adjacent to the creek. In the last five years, the City of San Mateo and Caltrans have completed several projects that enable the creek to convey the 100-year flood flows[4] without damage. These projects include the construction of two sections of floodwall near the Highway 101 crossing and replacement of the culverts at Norfolk Street and Highway 101 (Chan, 2006).

#### Future Projects

Reasonably foreseeable future projects by the SFPUC or others that could affect stream flow or related resources in the San Mateo Creek watershed are shown in Table 5.7-16. They include the Peninsula Watershed Habitat Conservation Plan, the Watershed and Environmental Improvement Program, and the Habitat Reserve Program. The SFPUC is preparing the habitat conservation plan for the watershed lands on the Peninsula, pursuant to the Federal Endangered Species Act. It will specify the actions necessary to protect listed species that are present within Peninsula watershed lands. Even though the Peninsula WMP is currently being implemented, it is included in the list of future SFPUC projects because it encompasses future sub-projects and activities. In addition, the SFPUC would conduct routine maintenance on its facilities in the Peninsula watershed.

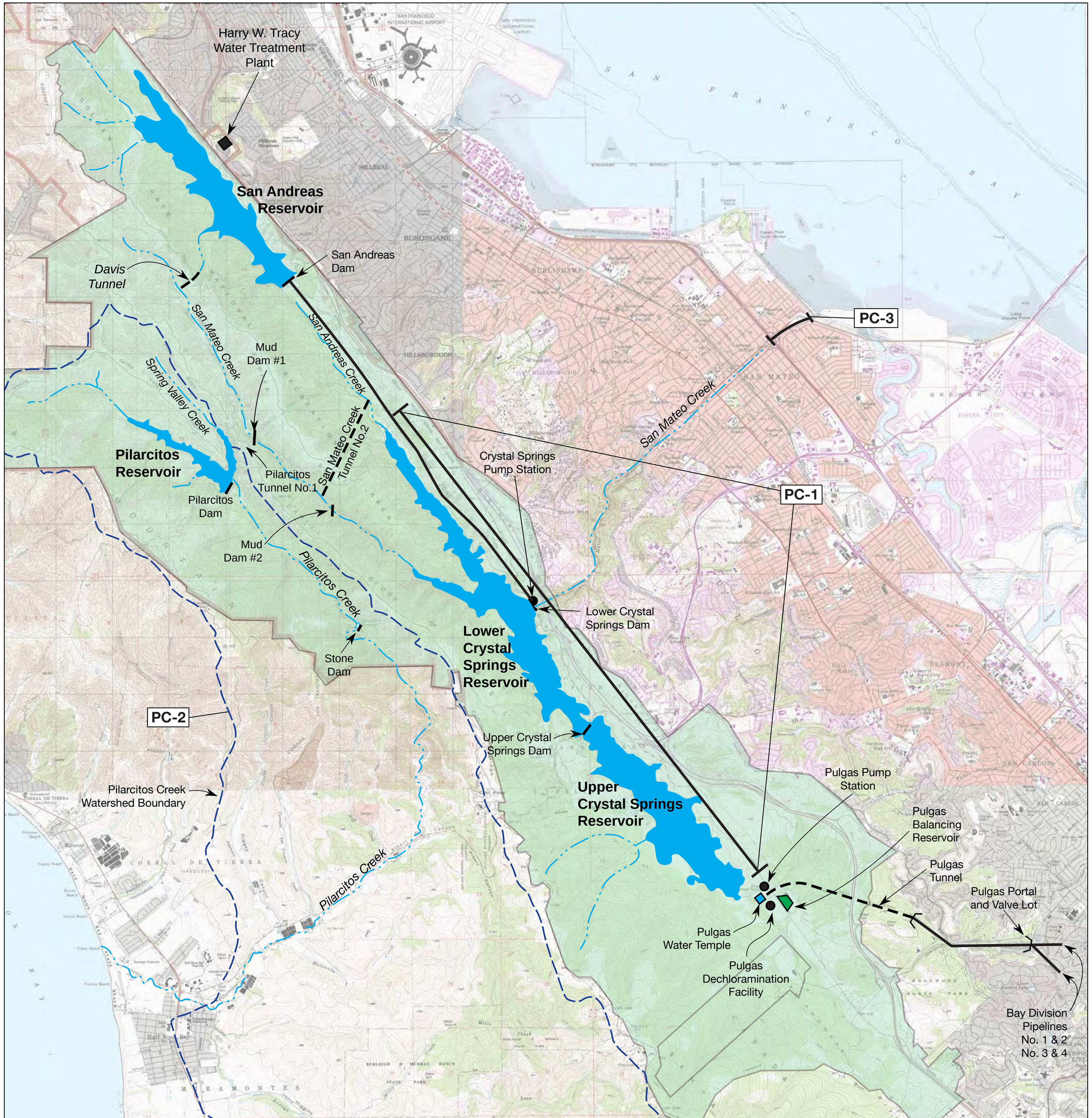
One future project by another agency has been identified that would affect the upper San Mateo Creek watershed. San Mateo County plans to reconstruct the roadway that crosses Crystal Springs Dam. In the lower San Mateo Creek watershed, one project has been identified—the City of San Mateo's proposed project to raise the levees near the mouth of the creek (Chan, 2006). This flood control project would be designed to meet the requirements of the Federal Emergency Management Agency, but funding for the project has yet to be obtained, and the construction schedule for the project is unknown. Implementation of the CS/SA Transmission (PN-2), Lower Crystal Springs Dam (PN-4), and Pulgas Balancing Reservoir (PN-5) projects are considered part of the WSIP and are therefore not included in the list of cumulative projects.

### *Pilarcitos Creek Watershed*

#### Past and Present Projects

Components of the SFPUC regional water system have substantially affected environmental quality in the Pilarcitos Creek corridor. Although built in the past, these components continue to

[4] The 100-year flood is the flood estimated to occur once every 100 years.




PP-1 Other SFPUC Project

PC-1 Non-SFPUC Project

CCSF Ownership (also project boundary for PP-1, PP-2, PP-3)

Pilarcitos Creek Watershed Boundary (also project boundary for PC-2)

*See Table 5.7-16 for names and descriptions of projects*

| Cumulative Project No. | Plan/Project Name |
|---|---|
| **OTHER SFPUC PROJECTS** | |
| PP-1 | Peninsula Watershed Management Plan (WMP) |
| PP-1a | Peninsula Watershed Habitat Conservation Plan (sub-project of Peninsula WMP) |
| PP-2 | Watershed and Environmental Improvement Program (WSIP-related activity) |
| PP-3 | Habitat Reserve Program (WSIP-related activity) |
| **NON-SFPUC PROJECTS** | |
| PC-3 | Lower Crystal Springs Dam Road Reconstruction |
| PC-2 | Pilarcitos Creek Integrated Watershed Management Plan |
| PC-3 | San Mateo Creek Mouth Improvements |

0 2 Miles

SOURCE: ESA + Orion



**Figure 5.7-4 (Revised)**
Future Projects in the Peninsula Watershed Considered in the Cumulative Analysis

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operate and thus affect current conditions. These and other projects and activities that affect Pilarcitos Creek include:

- Pilarcitos Reservoir
- Stone Dam
- Pilarcitos wells
- Highway 92
- Urban and agricultural development in the lower watershed

The Spring Valley Water Company built Pilarcitos Reservoir and Stone Dam in 1864 and 1871, respectively. They were subsequently purchased by the CCSF. The SFPUC uses Pilarcitos Reservoir to store and divert water from the Pilarcitos Creek watershed to the San Mateo Creek watershed. Stone Dam is used to divert water to the San Mateo Creek watershed and to the Coastside County Water District (Coastside CWD).

Land use in the Pilarcitos Creek watershed draining to Pilarcitos Reservoir and above Stone Dam has not changed much from conditions that existed prior to Euro-American settlement. The CCSF owns most of the Pilarcitos Creek watershed lands; these lands are undeveloped, and public access is very limited. The CCSF's lands in the Pilarcitos Creek watershed are managed in accordance with the Peninsula WMP, as described in Sections 4.2 and 5.2 of this PEIR.

Most land in the Pilarcitos Creek watershed downstream of Pilarcitos Reservoir remains undeveloped, but some floodplain lands near Half Moon Bay are used for agriculture, and portions of the watershed near the creek's mouth are used for urban purposes. Pilarcitos Creek itself has been adversely affected by the construction and improvement of Highway 92, which parallels about five miles of the creek, and by adjacent urban and agricultural development. A recent Caltrans project restored fish passage at two locations along the Highway 92 alignment. The Coastside CWD obtains some of its water supply from wells in the Pilarcitos Creek corridor.

### Future Projects

Reasonably foreseeable future projects by the SFPUC or others that could affect stream flow or related resources in the Pilarcitos Creek watershed are shown in Table 5.7-16. They include the Peninsula Watershed Habitat Conservation Plan, the Watershed and Environmental Improvement Program, the Habitat Reserve Program, and the Peninsula WMP.

As shown in Table 5.7-16, several agencies in addition to the SFPUC have expressed interest in improving Pilarcitos Creek and its migratory fishery. The San Francisco Bay Regional Water Quality Control Board and CDFG commissioned a creek restoration plan in 1996 (Phillip Williams and Associates, 1996). The San Mateo Resource Conservation District is also preparing an integrated watershed plan for the Pilarcitos Creek watershed (Nelson, 2006).

Coastside CWD has evaluated the possibility of installing more wells in the Pilarcitos Creek corridor. Although the installation of additional wells was shown to be technically and economically feasible, Coastside CWD is not currently planning to move forward with the project (Schmidt, 2006).

## 5.7.4.2 Cumulative Impacts

### *Significance Criteria*

The CCSF has not formally adopted significance standards for impacts related to cumulative effects, but generally considers that implementation of the proposed program would have significant cumulative impacts if it were to:

- Have impacts that would be individually limited, but cumulatively considerable ("cumulatively considerable" means that the incremental effects of a project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)

Impacts associated with the proposed program that would be "individually limited" are based on the impact analyses presented in Section 5.5 and the significance criteria presented in that section for the various environmental resource areas.

### *Approach to Analysis and Impact Summary*

Cumulative impacts are analyzed based on the CEQA guidance and approach described above in Section 5.7.1. Cumulative impacts are discussed below, and impact significance determinations are summarized in **Table 5.7-17**.

**TABLE 5.7-17**
**SUMMARY OF CUMULATIVE IMPACTS IN THE PENINSULA WATERSHED RELATED TO WSIP WATER SUPPLY AND SYSTEM OPERATIONS**

| | Significance Determination | | | | | | |
|---|---|---|---|---|---|---|---|
| **Impact** | Hydrology | Geomorphology | Surface Water Quality | Groundwater | Fisheries | Terrestrial Biology | Recreation / Visual Quality |
| 5.7.4-1: Cumulative effects on the San Mateo Creek watershed | LS | LS | LS | LS | LS | LS | LS |
| 5.7.4-2: Cumulative effects on the Pilarcitos Creek watershed | LS | LS | LS | LS | LS | LS | LS |

NOTE: Significance determinations presented in this table assume implementation of all mitigation measures as they are presented in Chapter 5, Section 5.5, and described in Chapter 6.

LS = Less than Significant, no mitigation required

Because impacts on stream flow and reservoir levels are related to effects on other environmental resources (see Section 5.1), the cumulative impacts in this section are organized by geographic area (i.e., San Mateo Creek watershed and Pilarcitos Creek watershed) rather than by environmental topic in order to characterize the overall effects on the affected water body. In determining the significance of cumulative impacts, it is assumed that mitigation measures identified in Section 5.5 and described in Chapter 6 would be implemented, and any residual effects after mitigation are considered in combination with the effects of past, other current, and probable future projects. The incremental contribution of the program's residual effects to the overall cumulative impact is then examined to determine whether it would be "cumulatively considerable."

### *San Mateo Creek Watershed*

**Impact 5.7.4-1: Cumulative effects on the San Mateo Creek watershed.**

#### Effect of Past and Present Projects

**Hydrology.** Components of the SFPUC regional water system in the San Mateo Creek watershed, including construction and operation of dams and reservoirs, have substantially altered the hydrology of San Mateo Creek. Construction of Lower Crystal Springs Dam separated the lower reaches of San Mateo Creek from about 80 percent of its tributary watershed in all but the wettest months of wet years. Under pre-Euro-American settlement conditions, some flow from the upper watershed probably reached the lower reaches in all but the driest months of the driest years. Under current conditions, releases from Lower Crystal Springs Dam occur only in the wettest months of wet years. The average annual release of water from the upper watershed to the lower reaches of San Mateo Creek is about one-tenth of the discharge that would occur if Crystal Springs and San Andreas Reservoirs did not exist.

Most of the time, flow into the reach of San Mateo Creek below Lower Crystal Springs Dam consists of seepage around the dam, infiltration from groundwater and, during and after storms, surface water runoff. Urban development in the watershed of the lower creek has probably increased the volume and speed of runoff into the creek compared to historical conditions. The replacement of vegetation and permeable soils with impermeable roofs, roads, and parking lots increases the volume of runoff in a given storm, and the replacement of natural tributary drainage channels with underground storm sewers reduces the time stormwater runoff takes to get to the mainstream channel.

In summary, past construction and continued operation of the regional water system combined with urban development in the lower watershed has had a substantial adverse effect on the hydrology of San Mateo Creek. Creek flow has been substantially reduced from historical conditions, and the creek's flow regime is managed for water supply in the upper watershed and for flood control and storm drainage purposes in the lower watershed.

**Geomorphology.** Crystal Springs and San Andreas Reservoirs and their associated diversions have substantially altered the magnitude, duration, and frequency of flood flows, which are the predominant influence on channel form. Currently, the 100-year return-period flow in San Mateo Creek immediately below Lower Crystal Springs Dam is estimated to be 1,320 cfs and would consist of a release from the dam and uncontrolled flow over the spillway. Under undeveloped conditions, it is estimated that the 100-year return-period flow in the creek was between 4,000 and 5,000 cfs. For more than 100 years, lower San Mateo Creek has been adjusting its channel form in response to the flow regime created by the regional water system and the lack of bedload transport from the upper watershed.

Channel adjustment in response to the altered flow regime is primarily occurring in the first two miles of San Mateo Creek below Lower Crystal Springs Dam. The channel in this reach of creek retains it natural form, much of it lying within a canyon. Below this reach, the creek channel has been modified to accommodate and accelerate the downstream movement of flood flows to San Francisco Bay. The creek consists of an earthen channel, with concrete floodwalls in places, and two long culverts under El Camino Real and Highway 101.

In summary, past construction and continued operation of the regional water system and channel modification to reduce flood hazards has had a substantial adverse effect on the geomorphology of San Mateo Creek. Channel-forming peak flows in the creek are substantially smaller than under historical conditions, the reservoirs prevent the downstream movement of bedload, and the lower reaches of the creek are confined within a flood control channel.

**Surface Water Quality.** The creation of reservoirs in the upper watershed as part of the regional water system and the blending of local and Tuolumne River water in the reservoirs have altered the chemical characteristics of water in the upper San Mateo Creek watershed. Although the water has been altered from its historical character, water quality in the upper watershed remains very good and is sufficient to support all designated beneficial uses.

Water quality in the lower reaches of San Mateo Creek has been adversely affected by the hydrologic changes attributable to the regional water system. Most of the time under the existing condition, flow in the creek below Lower Crystal Springs Dam is limited to seepage around the dam. Water quality in the creek below the dam site was undoubtedly better under historical conditions, since at least some flow reached the lower creek from the upper watershed in all but the driest months of the driest years. When no water reaches the creek from its upper watershed, detention time in the creek becomes extended and water is confined in pools, which causes water temperature to rise and dissolved oxygen levels to decline.

Water quality in the lower reaches of the creek has also been adversely affected by the discharge of urban runoff into the creek. Rainfall on roofs, streets, and parking lots washes accumulated debris and chemicals into the city storm sewers, which drain to San Mateo Creek. Water in urban creeks, such as the lower reaches of San Mateo Creek, typically contains higher levels of metals, plant nutrients, and pesticides than creeks in undeveloped areas.

In summary, past construction and continued operation of the regional water system combined with urban development in the lower watershed has had a substantial adverse effect on water quality in lower San Mateo Creek. Creek flow has been substantially reduced from historical conditions; this reduced flow coupled with the discharge of polluted urban runoff into the creek has caused water quality to deteriorate.

**Groundwater.** The creation of reservoirs in the upper watershed as part of the regional water system has raised groundwater levels in the vicinity of the reservoirs. Urban development overlies much of the lower San Mateo Creek watershed. Groundwater quality has probably declined relative to historical conditions because chemicals associated with residential, commercial, and industrial activities have percolated into the shallow groundwater basin.

**Fisheries.** San Mateo Creek historically supported resident rainbow trout populations. Small numbers of anadromous steelhead may have used the creek downstream of Lower Crystal Springs Dam for spawning and juvenile rearing habitat. The construction of reservoirs between 1860 and 1890 inundated instream fish habitat, created a complete barrier to fish migration, and excluded steelhead from the upper watershed. The reduction in flow in lower San Mateo Creek as a result of the regional water system has reduced the extent and quality of habitat for resident trout and steelhead in the canyon below Lower Crystal Springs Dam.

Downstream of the canyon, channel modifications designed to reduce flood hazards have introduced barriers to fish migration. Channel modifications and the discharge of contaminants in urban runoff have greatly reduced the quality of instream habitat.

In summary, past construction and continued operation of the regional water system combined with urban development in the lower watershed has had a substantial adverse effect on fish habitat in San Mateo Creek. The current extent and quality of fish habitat is reduced relative to historical conditions.

**Terrestrial Biology.** Construction of the regional water system combined with urban development in the lower watershed has had a substantial adverse effect on terrestrial biological resources in the San Mateo Creek watershed. The creation of reservoirs in the upper watershed of San Mateo Creek as part of the regional water system inundated about 2.5 square miles of land, which was probably occupied by native grassland, chaparral and scrub, mixed evergreen forest, and riparian forest. The lower watershed was occupied grassland, mixed evergreen forest, and riparian forest and, close to San Francisco Bay, tidal salt marsh. Urban development has destroyed most of the terrestrial biological resources of the lower watershed, except in the canyon immediately downstream of Lower Crystal Springs Dam. However, development of the reservoirs has resulted in the replacement of upland habitats with riparian, wetland, and freshwater marsh habitat around the periphery of the reservoir. The characteristics and extent of the wetlands and related habitats have varied historically due to the changes in operating levels of Crystal Springs Reservoir.

**Recreation and Visual Quality.** Construction of regional water system components combined with urban development in the lower watershed has had a substantial effect on visual quality in the San Mateo Creek watershed. When the components of the regional water supply system were built, parts of the natural landscape in the upper San Mateo Creek watershed were inundated to form artificial lakes. A muddy, vegetation-free zone extending around the perimeter of the lakes is inundated at times and becomes visible when the reservoir is drawn down. These artificial lakes have a different scenic value than the natural grassland and forest they replaced. Similarly, the grassland, riparian forest, and wetlands of the lower San Mateo Creek watershed have been largely converted to an urban landscape, which has less scenic value than the natural landscape it replaced.

### Potential Effects of Future Projects

The SFPUC's Peninsula Watershed Habitat Conservation Plan, Watershed and Environmental Improvement Program, Habitat Reserve Program, and Peninsula WMP would have beneficial impacts on the biological resources in the upper San Mateo Creek watershed. The only other identified future project that could adversely affect the upper San Mateo Creek watershed is San Mateo County's planned reconstruction of the roadway on Lower Crystal Springs Dam. It is expected that mitigation measures implemented during construction of the project would avoid significant impacts to environmental resources. Ongoing repair and maintenance activities for the SFPUC's water supply facilities will be necessary in the future, but these activities would be conducted consistent with management guidelines in the Peninsula WMP as well as in compliance with environmental regulations and the recently adopted Water Enterprise Environmental Stewardship Policy (SFPUC, 2006). Consequently, future projects would not be expected to have a significant adverse effect on hydrology, geomorphology, surface water quality, groundwater levels and quality, fisheries, terrestrial biological resources, or recreation and visual resources in the upper San Mateo Creek watershed.

Urban development and redevelopment is likely to continue in the lower San Mateo Creek watershed in accordance with city and county general plans. The creek channel may be further modified to reduce flooding in the future. One future flood control project has been identified. Although current regulations limit the environmental impacts of flood reduction projects and urban development/redevelopment compared to levels permitted in the past, some minor incremental impacts are likely to result from the increasingly dense urban environment and a more confined creek.

### Cumulative Effects and WSIP Contribution

**Table 5.7-18** summarizes the effects of past and present projects, the impacts of the WSIP, the effects of probable future projects, and the combined impacts of the WSIP plus probable future projects on the San Mateo Creek watershed. Past and present projects have substantially altered the hydrology, geomorphology, surface water quality, groundwater, fisheries, and terrestrial biology of the watershed compared to pre-Euro-American settlement conditions. Visual and recreational resources have been moderately altered. The existing condition, which serves as the baseline for the analysis of the WSIP, reflects the substantial environmental changes that have occurred as a result of the past projects. Because past and present actions have altered the watershed, some of the watershed's environmental resources are more sensitive to small adverse changes than they would be if the reach had remained relatively unaltered from pre-Euro-American settlement conditions.

As described in Section 5.5, the WSIP would have a less-than-significant adverse impact on hydrology, geomorphology, surface water quality, groundwater, and recreational and visual resources. It would have a less-than-significant impact on terrestrial biological resources after mitigation (Measures 5.5.6-1a, Adaptive Management of Freshwater March and Wetlands at Upper and Lower Crystal Springs Reservoirs; 5.5.6-1b, Compensation for Impacts on Terrestrial Biological Resources; and 5.5.6-1c, Compensation for Serpentine Seep-Related Special-Status Plants). Most aspects of the WSIP would have less than significant effects on fisheries in

**TABLE 5.7-18**
**CUMULATIVE EFFECTS ON THE SAN MATEO CREEK WATERSHED**

| Resource | Effects of Past and Present Projects | Impacts of WSIP (prior to mitigation/after mitigation) | Effects of Future Projects | Cumulative Impacts of WSIP (after mitigation) + Future Projects | WSIP Contribution Cumulatively Considerable? |
|---|---|---|---|---|---|
| Hydrology | SA | LS | LS | LS | No |
| Geomorphology | SA | LS | LS | LS | No |
| Surface Water Quality | SA | LS | LS | LS | No |
| Groundwater | SA | LS | LS | LS | No |
| Fisheries | SA | PSU[a]/unknown | LS | B/LS | No |
| Terrestrial Biology | SA | PSM/LS | B | LS | No |
| Recreation/Visual Quality | MA | LS | LS | LS | No |

[a] Pertains to potential inundation of trout spawning habitat in tributaries to Crystal Springs Reservoir. No other future project would add to this impact.

B = Beneficial impact
LS = Less than Significant, no mitigation required
PSM/LS = Potentially Significant but reduced to Less-than-Significant with mitigation
PSU = Potentially Significant and Unavoidable
SA = Substantially Altered
MA = Moderately Altered

the San Mateo Creek watershed except one. Increasing the water level in Crystal Springs Reservoir would inundate trout spawning habitat in segments of two creeks tributary to the reservoir. It is expected that mitigation to provide compensatory replacement habitat will be feasible, but until site-specific evaluation of this measure is completed (as part of the project-level CEQA review now in progress for the Lower Crystal Springs Replacement Project, PN-4), this impact is considered potentially significant and unavoidable. No other future project would add to this impact, thus, there is no cumulative impact. As described in the previous section, probable future projects would have overall beneficial effects and possibly some less-than-significant impacts associated with specific projects on hydrology, geomorphology, surface water quality, groundwater, fisheries, terrestrial biological resources, and recreational and visual resources.

When the WSIP and foreseeable future projects are considered together, none of their cumulative effects would rise to a level of significance. Even though past and present projects have moderately to substantially altered the environmental resources along San Mateo Creek, the cumulative impacts of the WSIP after mitigation combined with the effects of future projects would not result in a substantial or noticeable change from the existing/historical condition. Because there are no significant cumulative impacts, no mitigation measures beyond Measures 5.5.6-1a, 5.5.6-1b, and 5.5.6-1c would be necessary.

## *Pilarcitos Creek Watershed*

**Impact 5.7.4-2: Cumulative effects on the Pilarcitos Creek watershed.**

### Effect of Past and Present Projects

**Hydrology.** Construction and operation of SFPUC regional water system components have substantially altered the hydrology of Pilarcitos Creek. The construction of Pilarcitos Reservoir and Stone Dam effectively reduced the size of the Pilarcitos Creek watershed by about 25 percent. Runoff from the 25 percent of the watershed above Stone Dam is diverted to the San Mateo Creek watershed and to Coastside CWD rather than flowing down Pilarcitos Creek to the Pacific Ocean.

Prior to construction of Pilarcitos Reservoir and its associated diversion, flow in the reach of Pilarcitos Creek between the reservoir and the future Stone Dam site was likely considerable in the rainy months. Flow probably declined through the summer and may have dried up completely at times. Currently, the reservoir and diversion reduce flow in the rainy months relative to historical conditions. Releases from the reservoir through the summer to supply water to Coastside CWD probably increase flow relative to unimpaired conditions.

Prior to construction of Stone Dam, flow in the reach of Pilarcitos Creek below the dam site was likely considerable in the rainy season and minimal in the dry summer months. Most of the time and under the existing condition, flow in the creek immediately below Stone Dam consists only of leakage and seepage around the dam. The creek gains flow from tributaries beginning a few hundred yards below the dam. In wet months of wet years, water occasionally spills over Stone Dam to Pilarcitos Creek and flows to the Pacifica Ocean.

Flow in Pilarcitos Creek has also been affected by the installation of wells in the downstream end of the creek corridor. Creeks in rocky terrain often flow over beds of sand and gravel that have been deposited by the creek over time. The deposits of sand and gravel are saturated with water and are hydraulically connected to the overlying stream. The groundwater flowing in these deposits is referred to as underflow. Coastside CWD operates several wells close to the lower reaches of Pilarcitos Creek that pump water from the underflow. Because surface flow in the creek and underflow are hydraulically connected, operation of the wells has the potential to reduce stream flow.

Coastside CWD obtains an average of 53 million gallons per year, 3 percent of its water supply, from its wells adjacent to Pilarcitos Creek. Operation of the wells is only permitted between November and March, when creek flow is at its seasonal maximum, and the total extraction volume is limited to 117 million gallons per year (Coastside CWD, 2006). Average annual flow in Pilarcitos Creek is 3.7 billion gallons per year (USGS, 2006). Because of the small quantities involved and the prohibition on pumping in the low-flow months, the wells have a minimal effect on the hydrology of Pilarcitos Creek.

**Geomorphology.** As noted above, peak or flood flows are the predominant influence on channel geomorphology. Pilarcitos Reservoir and Stone Dam and their associated diversions have substantially altered the magnitude, duration, and frequency of flood flows in the reaches of the creek downstream of these structures. Peak flows in Pilarcitos Creek between Pilarcitos Reservoir and Stone Dam have been substantially reduced. Peak flows in Pilarcitos Creek immediately below Stone Dam have also been substantially reduced, but the effects diminish in a downstream direction as tributaries add flow to the main stem of the creek.

In addition to reducing peak flows, Pilarcitos and Stone Dams also prevent the downstream movement of sediment. For more than 100 years, Pilarcitos Creek has been adjusting its channel form in response to the flow regime created by the regional water system and the lack of bedload transport from the upper watershed.

**Surface Water Quality.** Pilarcitos Reservoir and Stone Dam and their associated diversions have affected the flow regime in Pilarcitos Creek, which has in turn affected water quality. Reductions in stream flow typically result in increased water temperature. Storage in reservoirs increases water temperature in the upper portion of the water column and preserves a pool of cool water in the summer. Storage may also reduce dissolved oxygen concentrations, particularly near the bottom of reservoirs. Although it has been altered from its historical character, water quality in the Pilarcitos Creek watershed remains good and is sufficient to support all designated beneficial uses. Some deterioration in water quality has probably occurred in the farthest downstream reaches of the creek due to runoff from agricultural fields and urban areas.

**Groundwater.** The creation of reservoirs in the upper watershed as part of the regional water system has raised groundwater levels in the vicinity of the reservoirs. Urban development and agricultural fields overlie the farthest downstream reaches of the Pilarcitos Creek watershed. Groundwater quality has probably declined in this area relative to historical conditions because chemicals associated with residential and agricultural activities have percolated into the shallow groundwater basin.

**Fisheries.** Construction of Pilarcitos Reservoir in 1864 inundated instream fish habitat in the upper reaches of Pilarcitos Creek, and construction of Stone Dam in 1871 created a complete barrier to fish migration into the upper watershed. With Stone Dam in place, anadromous salmonids were excluded from the upper reaches of the creek, which led to the development of two separate fish populations: resident trout in the creek above Stone Dam and anadromous salmonids below the dam. The current summertime releases from Pilarcitos Reservoir to Pilarcitos Creek to supply water to Coastside CWD probably increase flow relative to unimpaired conditions and thus may benefit resident trout in the reach of the creek between Pilarcitos Reservoir and Stone Dam.

The reduction in flow in Pilarcitos Creek below Stone Dam as a result of the regional water system has reduced the extent and quality of habitat for resident trout and steelhead. In addition to these adverse effects on fish habitat, fish passage may be limited at times by road culverts. The discharge of sediment into the creek due to highway maintenance and agricultural activities has degraded the quality of spawning habitat.

**Terrestrial Biology.** Construction of the regional water system combined with urban development and agricultural activities in the lower watershed has had an adverse effect on terrestrial biological resources in the upper Pilarcitos Creek watershed. The creation of Pilarcitos Reservoir inundated upland, riparian, and other wetland habitats along the historical creek channel, but resulted in the creation of riparian, freshwater marsh, and other wetlands around the periphery of the reservoir. Operation of the regional water system has increased summertime flows in Pilarcitos Creek between Pilarcitos Reservoir and Stone Dam, which may have contributed to the development of the white alder riparian forest along this reach of the creek. Operation of the regional water system has also reduced and altered the seasonal pattern of flow below Stone Dam, which in turn has probably reduced the extent and quality of riparian vegetation, although these effects diminish downstream as tributaries add water to the creek. Road construction, agriculture, and urban development in the lower watershed of the creek have reduced the extent and quality of riparian vegetation, and associated wildlife habitat, from their historical condition.

**Recreation and Visual Quality.** Construction of the regional water system combined with urban development has had some adverse effect on visual quality in parts of the Pilarcitos Creek watershed. When the regional water system was built, a small area of natural landscape in the upper Pilarcitos Creek watershed was inundated to form an artificial lake. A muddy, vegetation-free zone extending around the perimeter of the lake is inundated at times and becomes visible when the reservoir is drawn down. Pilarcitos Reservoir has a different scenic value than the landscape of coastal scrub it replaced. Road construction, agriculture, and urban development have reduced the visual quality of the lower Pilarcitos Creek watershed.

#### Potential Effects of Future Projects

The SFPUC's Peninsula Watershed Habitat Conservation Plan, Watershed and Environmental Improvement Program, Habitat Reserve Program, and Peninsula WMP would have beneficial impacts on the biological resources in the upper Pilarcitos Creek watershed. No other future projects have been identified that would affect the upper Pilarcitos Creek watershed above Stone Dam (within CCSF-owned watershed lands). Ongoing repair and maintenance activities for the SFPUC's facilities will be necessary in the future, but these activities would be conducted consistent with management guidelines in the Peninsula WMP as well as in compliance with environmental regulations and the recently adopted Water Enterprise Environmental Stewardship Policy (SFPUC, 2006). Consequently, future projects would not be expected to have a significant adverse effect on hydrology, geomorphology, surface water quality, groundwater levels and quality, fisheries, terrestrial biological resources, or recreational and visual resources in the upper San Mateo Creek watershed.

Urban development and redevelopment is likely to continue in the lower Pilarcitos Creek watershed below Stone Dam (outside of CCSF-owned watershed lands) in accordance with city and county general plans. Although current regulations limit the environmental impacts of development and redevelopment projects compared to levels permitted in the past, some minor incremental impacts are likely to result from the increasingly dense urban coastal zone.

As shown in Table 5.7-16, several future projects address habitat improvement and restoration in the lower Pilarcitos Creek watershed, including improving Pilarcitos Creek and its migratory fishery. These projects or activities resulting from associated planning activities are likely to be beneficial to the environment.

### Cumulative Effects and WSIP Contribution

**Table 5.7-19** summarizes the effects of past and present projects, the impacts of the WSIP, the effects of probable future projects, and the combined impacts of the WSIP plus probable future projects on the Pilarcitos Creek watershed. Past and present projects have substantially altered the hydrology, geomorphology, fisheries, and terrestrial biology of the watershed compared to pre-Euro-American settlement conditions. Surface water quality, groundwater, and visual and recreational resources have been moderately altered. The existing condition, which serves as the baseline for the analysis of the WSIP, reflects the substantial environmental changes that have occurred as a result of the past projects. Because past and present actions have altered the watershed, some of the watershed's environmental resources are more sensitive to small adverse changes than they would be if the reach had remained relatively unaltered from pre-Euro-American settlement conditions.

**TABLE 5.7-19**
**CUMULATIVE EFFECTS ON THE PILARCITOS CREEK WATERSHED**

| Resource | Effects of Past and Present Projects | Impacts of WSIP (prior to mitigation/after mitigation) | Effects of Future Projects | Cumulative Impacts of WSIP (after mitigation) + Future Projects | WSIP Contribution Cumulatively Considerable? |
|---|---|---|---|---|---|
| Hydrology | SA | LS | LS | LS | No |
| Geomorphology | SA | LS | LS | LS | No |
| Surface Water Quality | MA | PSM/LS | B/LS | LS | No |
| Groundwater | MA | LS | B/LS | LS | No |
| Fisheries | SA | PSM/LS | B | LS | No |
| Terrestrial Biology | SA | PSM/LS | B | LS | No |
| Recreation/Visual Quality | MA | LS | LS | LS | No |

B = Beneficial impact
LS = Less than Significant, no mitigation required
PSM/LS = Potentially Significant but reduced to Less-than-Significant with mitigation
SA = Substantially Altered
MA = Moderately Altered

As described in Section 5.5, the WSIP would have a less-than-significant adverse impact on hydrology, geomorphology, groundwater, and recreational and visual resources. It would have a less-than-significant impact on surface water quality, fisheries, and terrestrial biological resources after mitigation (Measure 5.5.3-2, Revised Operations Plan for Pilarcitos Watershed Facilities). As described in the previous section, probable future projects would have primarily beneficial effects on hydrology, geomorphology, surface water quality, groundwater, fisheries, terrestrial biology, and recreational and visual resources.

When the WSIP and foreseeable future projects are considered together, none of their cumulative effects would rise to a level of significance. Even though past and present projects have moderately to substantially altered environmental resources along Pilarcitos Creek, the cumulative impacts of the WSIP after mitigation, combined with the effects of future projects, would not result in a substantial or noticeable change from the existing condition. Because there are no significant cumulative impacts, no mitigation measures beyond Measure 5.5.3-2 would be necessary.

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## 5.7.5 Cumulative Effects on Westside Groundwater Basin Resources

This section describes the cumulative effects on groundwater resources in the Westside Groundwater Basin due to implementation of past, present, and reasonably foreseeable future projects or activities in combination with the WSIP water supply and system operations, including operations associated with the Local and Regional Groundwater Projects (SF-2) and Recycled Water Projects (SF-3) evaluated in Section 5.6. These are the only components of the proposed program expected to affect this groundwater basin.

### 5.7.5.1 Relevant Projects

#### *North Westside Groundwater Basin*

**Past and Present Projects**

As discussed in Section 5.6, San Francisco has intermittently used groundwater from the North Westside Groundwater Basin as a drinking water and irrigation supply since the early 1900s (Luhdorff & Scalmanini, 2006). By the early 1900s, wells had been constructed to the north, east, and south of Lake Merced for farming and drinking water supply. During that time, the Spring Valley Water Company had two wells located near the Lake Merced outlet that pumped about 0.1 mgd, or 100 afy, and the total of Lake Merced, Sunset District, and Golden Gate Park pumping averaged 0.4 mgd (400 to 500 afy). In the early 1930s, the San Francisco Board of Public Works installed production wells in the Sunset District as an emergency water supply. These wells pumped an average of about 5 mgd between 1930 and 1935, but were discontinued after Hetch Hetchy water became available in the mid-1930s.

In 2005, groundwater was used for irrigation and other nonpotable uses, primarily 1.0 mgd (1,100 afy) at Golden Gate Park[5] and 0.4 mgd (400 afy) at the San Francisco Zoo. In addition, less than 0.02 mgd (13 afy) is used for other purposes, including 8 afy at Edgewood School and 5 afy in Stern Grove (Luhdorff & Scalmanini, 2006). As of 2005, there are no other substantial users of North Westside Groundwater Basin water.

5 Historical pumping rates for the Golden Gate Park wells were estimated for this analysis. The recent installation of flow meters on two of the wells will allow for more accurate measurement of pumping rates in the future.

#### Future Projects

In addition to two of the WSIP facility improvement projects, the only identified probable future project in the North Westside Groundwater Basin is the San Francisco Public Works Department's restoration of Pine Lake using groundwater from the primary production aquifer (Pine Lake is described in Section 5.6.1.6). The Pine Lake project calls for pumping of up to 0.08 mgd (90 afy) of groundwater from an existing well for restoration of Pine Lake beginning in May 2007 (Mosqueda, 2007).

The two WSIP facility improvement projects that would affect the North Westside Groundwater Basin are the Recycled Water Projects (SF-3) and Local Groundwater Projects (part of SF-2). Under the Recycled Water Projects, described in Chapter 3, Section 3.8, approximately 1.4 mgd (1,500 afy) of groundwater pumping would be replaced by recycled water for irrigation at the San Francisco Zoo and Golden Gate Park. Once this project is implemented, up to 0.5 mgd (560 afy) of pumping for nonpotable uses would continue in the North Westside Groundwater Basin for such purposes as irrigation of sensitive plants in Golden Gate Park and water for some animal exhibits at the San Francisco Zoo.[6] Under the Local Groundwater Projects, also described in Chapter 3, Section 3.8, up to 4 mgd (4,500 afy) would be pumped for municipal supply, including development of 2 mgd of groundwater from new wells, and use or replacement of existing irrigation and nonpotable wells for an additional 2 mgd. The Local Groundwater Projects also includes the addition of treated stormwater, recycled water, groundwater, and/or dechlorinated SFPUC system water to Lake Merced.

### *South Westside Groundwater Basin*

#### Past and Present Projects

As discussed in Section 5.6, historical groundwater pumping in the South Westside Groundwater Basin resulted in a decline in groundwater levels to more than 100 feet below sea level from Daly City (immediately south of Lake Merced) to San Bruno. This decline contributed to a change in the direction of groundwater flow in the vicinity of Lake Merced from a northwesterly to a southwesterly direction. Although saltwater intrusion and land subsidence have not been observed, there has been public concern that this decline in water levels contributed to decreased water levels in Lake Merced. Efforts to restore groundwater levels in the South Westside Groundwater Basin and reduce potential effects on Lake Merced water levels have included the In-Lieu Recharge Demonstration Study implemented by the SFPUC, Daly City, California Water Service Company (Cal Water) in South San Francisco, and San Bruno, and the replacement of irrigation pumping in the vicinity of Lake Merced with recycled water from northern San Mateo County (Daly City), as discussed below.

Groundwater in the South Westside Groundwater Basin is primarily used for municipal and irrigation purposes. As indicated in Section 5.6, Figure 5.6-3, the total estimated and metered pumping for these uses reached a combined maximum of approximately 12.8 mgd (14,300 afy)[7]

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6 Pumping rates for nonpotable purposes may actually be less than estimated if recycled water is found to be of suitable quality for these uses.

7 This pumping level has been adjusted to exclude pumping in Golden Gate Park, which is located in the North Westside Groundwater Basin.

in the 1960s (Luhdorff & Scalmanini, 2006). In addition, there are some private wells within the basin. As discussed below, total pumping from the South Westside Groundwater Basin (including municipal and irrigation uses) was about 4.1 mgd (4,600 afy) by 2005 because nearly all irrigation pumping around Lake Merced was replaced with recycled water and because of a temporary reduction in municipal pumping as part of the In-Lieu Recharge Demonstration Study.

**Municipal Pumping.** Historical municipal groundwater pumping by Daly City, Cal Water, and San Bruno, as shown in Figure 5.6-3, reached a high of approximately 8 mgd (9,000 afy) in the mid-1960s and ranged between approximately 5.4 mgd (6,000 afy) and 7.1 mgd (8,000 afy) from the mid-1970s until 2001 (Luhdorff & Scalmanini, 2006). During implementation of the In-Lieu Recharge Demonstration Study from 2002 to 2005, as described in Section 5.6, total municipal pumping was decreased to an average of approximately 1.8 mgd (2,000 afy), as shown in Figure 5.6-3 (Luhdorff & Scalmanini, 2006). As a result of this demonstration study, the total increase in groundwater storage in the South Westside Groundwater Basin was approximately 13,000 acre-feet, including 6,300 acre-feet in the Daly City area, 3,600 acre-feet in the South San Francisco area, and 3,000 acre-feet in the San Bruno area (Luhdorff & Scalmanini, 2005).

Although the In-Lieu Recharge Demonstration Study ended in 2005, Daly City did not resume full-scale pumping and continued to receive system water from the SFPUC in lieu of groundwater pumping. In 2005, Daly City pumped approximately 0.6 mgd (700 afy) of groundwater. As of 2006, Cal Water had not resumed pumping since cessation of the In-Lieu Recharge Demonstration Study, and San Bruno had resumed pumping at rates of approximately 1.5 mgd (1,700 afy).

**Irrigation Pumping.** Historical golf course and cemetery irrigation in the 1960s was previously estimated at about 4.7 mgd (5,300 afy) of groundwater,[8] and irrigation for three golf courses in the vicinity of Lake Merced (the Olympic Club, San Francisco Golf Club, and Lake Merced Golf Club) accounted for approximately 2.1 mgd (2,235 afy) of this amount. In 2005, irrigation pumping at these three golf courses was reduced to approximately 0.04 mgd (45 afy) when recycled water was made available from north San Mateo County (Daly City) as a substitute irrigation supply.

Other irrigation pumping rates in the South Westside Groundwater Basin in 2005 are consistent with historical pumping rates and are estimated at up to 2.1 mgd (2,400 afy) for cemeteries in Colma, 0.1 mgd (120 to 150 afy) for the California Golf Club[9] in San Bruno, and an undetermined amount for the Golden Gate National Cemetery in San Bruno (Luhdorff & Scalmanini, 2006).

In all, irrigation pumping in the South Westside Groundwater Basin has recently been estimated at 2.3 mgd (2,600 afy) in 2005—a reduction of 2.4 mgd (2,700 afy) from a high of approximately

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8 Historical irrigation pumping amounts were estimated for this analysis. Recent metered use of recycled water at the Lake Merced area golf courses indicates that actual usage may have been less than previously estimated. Therefore, estimates of historical unmetered irrigation pumping may be high.

9 2005 estimated pumping rates for the California Golf Club were reduced, from the historical estimate of 665 afy to 120–150 afy, based on information on actual water use rates at the Lake Merced area golf courses obtained when metered recycled water was provided to these golf courses.

4.7 mgd (5,300 afy) in the 1960s—primarily due to the replacement of recycled water for irrigation purposes at the Lake Merced area golf courses.

**Pumping from Private Wells.** There are over 90 backyard wells in Hillsborough residential areas; most were installed during the 1987–1992 drought and serve multiple adjoining lots. In 2003, total pumping from these wells was estimated at 0.27 mgd (300 afy) (Yates, 2003). There are not likely a large number of private wells in the San Bruno to Daly City portion of the South Westside Groundwater Basin, which typically has small lot sizes with limited irrigation areas. Also, San Mateo County requires well setbacks from sewer lines, which make small lots more difficult to permit for water wells.

### Future Projects

In the future, the South Westside Groundwater Basin would continue to be used for municipal and irrigation uses, as well as by private well owners, as described below. With the exception of these uses, the proposed WSIP conjunctive-use program associated with the Regional Groundwater Projects (part of SF-2), and negligible irrigation pumping by the City of Burlingame, no other reasonably foreseeable future projects were identified in the South Westside Groundwater Basin.

**Municipal Pumping.** Planned groundwater uses for municipal purposes through 2030 are described in the urban water management plans (UWMPs) prepared for each municipality in the South Westside Groundwater Basin, as summarized below:

- In its 2005 UWMP, the City of Daly City estimates that future municipal groundwater pumping under the WSIP conjunctive-use program (Regional Groundwater Projects, SF-2) would range from 1.34 mgd (1,501 afy) during a nondrought year when surface water is supplied by the SFPUC to 3.76 mgd (4,212 afy) during a drought year when the city is also allowed to pump its banked groundwater (City of Daly City, 2005). These projected pumping volumes are presented in Table 4-4 of the 2005 UWMP.

- The 2006 UWMP for the South San Francisco Water District does not yet reflect long-term participation in the SFPUC's proposed conjunctive-use program, but participation in this program is expected to be included in the next revision of its UWMP. In its 2006 UWMP, Cal Water estimates that groundwater usage will be 1.37 mgd per year (1,534 afy) between 2010 and 2030 (California Water Service Company, 2006).

- The 2007 UWMP for the San Bruno does not yet reflect long-term participation in the SFPUC's proposed conjunctive-use program, but, if approved, participation in this program is expected to be included in the next revision of its UWMP. In its 2007 UWMP, the City of San Bruno estimates that overall, groundwater usage will decrease from 2.5 mgd (2,800 afy) in 2010 to zero in 2030 through implementation of conservation measures and increased purchases from the SFPUC. In a drought year, groundwater use between 2010 and 2030 is projected to range from 0.80 mgd (896 afy) to a maximum of 2.5 mgd (2,800 afy) (City of San Bruno, 2007).

- In its 2006 UWMP, the City of Burlingame estimates that it may use less than 0.01 mgd (11 afy) of groundwater for irrigation purposes between 2010 and 2030 (City of Burlingame, 2005). This amount would have negligible effects on the groundwater basin during nondrought or drought years compared to pumping by Daly City, South San Francisco, and San Bruno.

- Hillsborough and Millbrae do not currently utilize or plan to utilize groundwater as a water source (BAWSCA, 2006; City of Millbrae, 2005).

**Irrigation Pumping.** It is expected that the existing irrigation uses of South Westside Groundwater Basin groundwater described above would continue in the future at approximately 2.3 mgd (2,600 afy). As described further in Chapter 7 (see Table 7.2), there are no planned recycled water projects in South San Francisco, San Bruno, Burlingame, Millbrae, or Daly City that would replace groundwater for irrigation (other than Daly City's replacement of irrigation pumping at the Lake Merced area golf courses with recycled water, as described above).

**Pumping from Private Wells.** At a minimum, water usage by private well owners would continue at the current rate of approximately 0.27 mgd (300 afy), and it is possible that new private wells could be permitted in the future.

## 5.7.5.2 Cumulative Impacts

### *Significance Criteria*

The CCSF has not formally adopted significance standards for impacts related to cumulative effects, but generally considers that implementation of the proposed program would have significant cumulative impacts if it were to:

- Have impacts that would be individually limited, but cumulatively considerable ("cumulatively considerable" means that the incremental effects of a project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)

Impacts associated with the proposed program that would be "individually limited" are based on the impact analyses presented in Section 5.6 and the significance criteria presented in that section for the various environmental resource areas.

### *Approach to Analysis and Impact Summary*

Cumulative impacts are analyzed based on the CEQA guidance described above in Section 5.7.1. For this groundwater analysis, as described in Section 5.6, a potentially significant effect would occur if withdrawal of groundwater would result in overdraft conditions and related adverse effects, including saltwater intrusion, land subsidence, and/or effects on interrelated surface water features, or if it would adversely affect groundwater quality. The analysis describes the effects of past and present projects on the groundwater basin, and since many projects are still in operation today, the existing environmental conditions reflect the cumulative effects of these past projects and their present operations. These existing conditions form the basis for analysis of the WSIP impacts described in Section 5.6 as well as the basis for assessing the effects of probable future projects and cumulative impacts. The analysis then describes the cumulative impacts on groundwater resources of past, present, and probable future projects together with impacts of the

WSIP. The WSIP's contribution to cumulative impacts is considered prior to mitigation, but the effects of mitigation measures identified in Section 5.6 and described in Chapter 6 are assessed in determining the significance of overall cumulative impacts. Based on this analysis, the WSIP's contribution to the cumulative effect is then evaluated to determine if it is "cumulatively considerable." Impacts are discussed separately for the North and South Westside Groundwater Basins.

Cumulative impacts are discussed below, and impact significance determinations are summarized in **Table 5.7-20**.

**TABLE 5.7-20**
**SUMMARY OF CUMULATIVE IMPACTS IN THE WESTSIDE GROUNDWATER BASIN RELATED TO WSIP WATER SUPPLY AND SYSTEM OPERATIONS**

| Impact | Significance Determination |
|---|---|
| 5.7.5-1: Cumulative impacts on the North Westside Groundwater Basin | LS |
| 5.7.5-2: Cumulative impacts on the South Westside Groundwater Basin | LS |

NOTE: Significance determinations presented in this table assume implementation of all mitigation measures as they are presented in Chapter 5, Section 5.6 and described in Chapter 6.

LS = Less than Significant, no mitigation required

### *North Westside Groundwater Basin*

**Impact 5.7.5-1: Cumulative impacts on the North Westside Groundwater Basin.**

As discussed above, future groundwater pumping in the North Westside Groundwater Basin would include up to 0.5 mgd (560 afy) of pumping for nonpotable uses once the Recycled Water Projects (SF-3) are implemented, up to 4 mgd (4,500 afy) of pumping for municipal supply under the Local Groundwater Projects (SF-2), and up to 0.08 mgd (90 afy) of groundwater from an existing well to restore water levels in Pine Lake. The Local Groundwater Projects also include the addition of treated stormwater, recycled water, groundwater, and/or dechlorinated SFPUC system water to Lake Merced to achieve the desired lake level, or range of levels.

With implementation of the WSIP projects and pumping for restoration of Pine Lake in combination with ongoing pumping in the basin, total future, cumulative groundwater withdrawals from the North Westside Groundwater Basin would be up to approximately 4.6 mgd (5,150 afy). This cumulative, maximum level of pumping would be within the range of recharge to the basin (4,850 afy to 6,950 afy), but would exceed the lower end of the range. However, cumulative impacts related to the potential for basin overdraft and associated adverse effects on surface water resources, saltwater intrusion, and land subsidence in the North Westside Groundwater Basin would be considered less than significant, assuming implementation of Measure 5.6-1 (Groundwater Monitoring to Determine Basin Safe Yield) and Measure 5.6-2 (Implementation of a Lake Level Management Plan). Measure 5.6-1 requires the SFPUC to continue ongoing studies (including groundwater and lake level monitoring programs to determine the safe yield of the North Westside Groundwater Basin) and to use this monitoring data to inform decisions regarding appropriate pumping patterns to avoid overdraft and the related undesirable effects. Measure 5.6-2 requires the SFPUC to prepare and implement a lake level management plan identifying strategies to alter pumping patterns or lake level augmentation to maintain Lake Merced within the desired long-term range, should monitoring conducted under Measure 5.6-1 indicate the potential for adverse effects on lake levels due to groundwater pumping. With implementation of these measures, to be coordinated by the SFPUC and subject to separate project-level CEQA review prior to implementation of the Local Groundwater Projects (SF-2) and Recycled Water Projects (SF-3), groundwater pumping attributable to the proposed program and the Pine Lake project would not result in overdraft of the North Westside Groundwater Basin or related adverse effects. Therefore, the WSIP in combination with the Pine Lake project would have less-than-significant cumulative impacts on the groundwater basin. No additional mitigation beyond Measures 5.6-1 and 5.6-2 would be necessary.

In addition, the San Francisco Department of Public Health, the agency responsible for permitting water wells in San Francisco, would not grant a permit for a new well unless measures were in place to avoid adverse effects on the groundwater basin. In accordance with Article 12B of the San Francisco Health Code, as discussed in Section 5.6, the Department of Public Health would ensure that any permit application for a water well would undergo CEQA environmental review and receive SFPUC approval prior to issuance of the permit. The operator of the well would be required to comply with any conditions or restrictions on use of the water well imposed by the SFPUC and/or as mitigation measures under CEQA. With implementation of these well permitting requirements, including review by the SFPUC, potential cumulative impacts on groundwater resources and interrelated surface water features of the North Westside Groundwater Basin would be less than significant.

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### *South Westside Groundwater Basin*

**Impact 5.7.5-2: Cumulative impacts on the South Westside Groundwater Basin.**

Future and continuing projects identified in the northern portion of the South Westside Groundwater Basin include the WSIP conjunctive-use program (the regional component of SF-2), municipal pumping by the participating pumpers, and continued irrigation pumping at 2,600 afy. To the south of this area, future pumping includes up to approximately 0.27 mgd (300 afy) of pumping from private wells and negligible irrigation pumping by the City of Burlingame. As discussed in Section 5.6, impacts related to the potential for basin overdraft, saltwater intrusion, and land subsidence would be less than significant for the conjunctive-use program under the Regional Groundwater Projects (SF-2) because, under the WSIP, the SFPUC, Daly City, Cal Water, and San Bruno would enter into an operating agreement(s) that would restrict pumping under the conjunctive-use program to water banked as a result of reductions in pumping in nondrought years. With implementation of the proposed operating agreement(s):

- Groundwater levels would increase and there would be a larger quantity of water in the South Westside Groundwater Basin during nondrought years due to the in-lieu recharge resulting from deliveries of SFPUC system water and correspondingly reduced groundwater pumping.

- Under the proposed conjunctive-use program, the participating pumpers collectively would not be allowed to pump more than the quantity of banked groundwater resulting from the in-lieu delivery of SFPUC system water.

Although in a drought year, pumping under the Regional Groundwater Projects, in combination with municipal pumping by the participating pumpers could temporarily exceed historic high groundwater withdrawal rates, the proposed operating agreement(s), executed between the SFPUC and the participating pumpers, would outline allowable operating parameters for pumping during drought years to avoid adverse long-term conditions; an operating committee would be formed to develop annual operating maintenance plans as well as an annual operating schedule; and groundwater monitoring and modeling would be conducted to identify the potential for adverse conditions and inform decisions to modify the recharge or pumping strategy in response to changing conditions over time.

Implementation of the proposed conjunctive-use program should result in higher average groundwater levels in the northern portion of the South Westside Groundwater Basin as a result of the coordinated use of surface water and groundwater. Implementation of the operating agreement(s) would ensure that impacts related to basin overdraft, saltwater intrusion, and land subsidence would be less than significant. Because there are no other planned future uses of groundwater in this portion of the basin, other than the those existing uses described above that would continue, and impacts of the WSIP would be less than significant due to implementation of the proposed operating agreement(s), cumulative groundwater impacts would be less than significant.

Furthermore, as discussed in Section 5.6, the San Mateo County Environmental Health Division would not grant a well permit for a large well[10] that could potentially cause overdraft of the South Westside Groundwater Basin or be located in an area subject to a specific and localized groundwater problem. Thus, groundwater pumping under the WSIP would not contribute to cumulative impacts related to basin overdraft and associated adverse conditions and no mitigation would be necessary. Therefore, WSIP effects on groundwater resources in the South Westside Groundwater Basin would not be cumulatively considerable and would be considered *less than significant*.

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[10] A large well means any individual well that pumps an amount equal to or greater than 50 gallons per minute or 1,000 gallons per day, or multiple small wells on the same land use parcel which cumulatively pump an amount equal to or greater the 50 gallons per minute or 1,000 gallons per day.

## 5.7.6 Climate Change and Global Warming

The issue of global warming/climate change has become an important factor in water resources planning in California, and it is being considered during planning for the SFPUC regional water system. There is evidence that increasing concentrations of greenhouse gases[11] have caused and will continue to cause a rise in temperatures around the world, which will result in a wide range of changes in climate patterns. Climate scientists agree that a warming trend occurred during the latter part of the 20th century and will likely continue through the 21st century. These changes will have a direct effect on water resources in California, and numerous studies on climate and water in California have been conducted to determine the potential impacts.

A literature review of recent studies on global warming was conducted for this PEIR to identify the current status of available information and to determine potential impacts of global warming on implementation of the WSIP. **Table 5.7-21** summarizes the major articles reviewed that are relevant to global warming and the SFPUC regional water system.

Based on these articles, global warming could result in the following types of water resources impacts in California, including impacts on the SFPUC regional water system and associated watersheds:

- Reductions in the average annual snowpack due to a rise in the snowline and a shallower snowpack in the low- and medium-elevation zones, such as in the Tuolumne River basin, and a shift in snowmelt runoff to earlier in the year
- Changes in the timing, intensity, and variability of precipitation, and an increased amount of precipitation falling as rain instead of as snow
- Long-term changes in watershed vegetation and increased incidence of wildfires that could affect water quality
- Sea level rise and an increase in saltwater intrusion
- Increased water temperatures with accompanying adverse effects on some fisheries
- Increases in evaporation and concomitant increased irrigation need
- Changes in urban and agricultural water demand

However, other than the general trends listed above, there is no clear scientific consensus on exactly how global warming will quantitatively affect California water supplies, and current models of California water systems generally do not reflect the potential effects of global warming. The Hetch Hetchy/Local Simulation Model (HH/LSM) used in the PEIR for the water supply and system operations analysis remains the best available tool for assessing the impacts of the WSIP.

[11] Greenhouse gases are gaseous constituents in the atmosphere that contribute to the “greenhouse effect,” and include carbon dioxide, methane, nitrous oxide, ozone, and water vapor. The greenhouse effect occurs when greenhouse gases absorb radiant energy from the sun, trap the radiation reflected back from the earth’s surface, and warm the surrounding atmosphere. Human activities such as deforestation and the burning of fossil fuels have increased the levels of greenhouse gases in the atmosphere, particularly carbon dioxide, resulting in a warming trend in atmospheric temperatures around the world.

**TABLE 5.7-21**
**ANNOTATED BIBLIOGRAPHY ON CLIMATE CHANGE/GLOBAL WARMING**

| Author, Title, Date | Summary and Relevance to Regional Water System |
|---|---|
| California Department of Water Resources, *Technical Memorandum Report: Progress on Incorporating Climate Change into Management of California's Water Resources,* July 2006. | This report is DWR's response to the governor's 2005 order establishing targets for greenhouse gas emissions and requiring biennial reporting by state agencies. This report describes progress made in the effort to incorporate climate change into water resources planning and management tools and methodologies. |
| California Department of Water Resources, *California Water Plan Update 2005*, Volume 4, Maurice Roos, "Accounting for Climate Change," 2005. | Evidence that climate change will have significant effects on water resources in California has continued to accumulate in recent years. Some of the more important changes would arise from temperature increases, which would raise snow elevations in temperate zones and change the pattern of runoff from mountain watersheds, thereby affecting reservoir operation. Other consequences include: a rise in sea level, which could adversely affect the Sacramento–San Joaquin River Delta, a major source of water supply for the state; possibly more extreme precipitation and flood events; changes in water consumption by crops and wildlands; and water temperature problems for anadromous fish. |
| California Energy Commission, California Climate Change Center, *Climate Warming and Water Supply Management in California,* March 2006. | A modeled future dry climate scenario is compared with a future normal climate scenario that follows historical trends for population growth through 2050. Effects on the overall economy from the drier scenario would not be drastic for urban areas but would severely affect rural and agricultural regions. |
| California Energy Commission, *Climate Change Impacts and Adaptation in California,* June 2005. | This report presents a short review of literature on climate change impacts and adaptation options for California. Future changes in precipitation cannot be accurately determined at this time. However, it is predicted that precipitation will shift towards falling more as rain than as snow, which would increase flood frequencies. Runoff/snowpack melting would increase in the winter season and decrease in the spring and summer due to general atmospheric warming. Many sources reviewed came from the California Energy Commission's Public Interest Energy Research program. |
| California Energy Commission, prepared by the University of California, Berkeley, *Climate Change and Water Supply Reliability,* March 2005a. | The purpose of the study was to assess impacts of climate change on urban and agricultural water agencies. It describes preliminary work on methods for measuring current water supply reliability and methods for projecting changes in supply reliability caused by climate change. This research differs from other studies in that researchers gathered and analyzed data from individual water districts. This analysis is relevant because there is considerable heterogeneity among water districts in California with regard to source of water, the nature and age of water rights, cost of operations, finances, price structures, and other terms of service. |
| California Energy Commission, prepared by Pacific Institute, *Climate Change and California Water Resources: A Survey and Summary of the Literature,* August 2005b. | This study surveyed existing literature related to impacts of climate change on California water resources. It provides recommendations for future water management under warming conditions. |
| California Energy Commission, Center for Environmental and Water Resource Engineering, Department of Civil and Environmental Engineering, Department of Agricultural and Resource Engineering, University of California, Davis, *Climate Warming & California's Water Future,* March 20, 2003. | Effects of climate change on the long-term performance and management of California's water system are examined. Modeling took into account potential changes in the water management system, including changes in population, land use, and agricultural practices. |
| California Environmental Protection Agency, California Climate Change Center, *Our Changing Climate, Assessing the Risks to California,* August 2006. | This study summarizes recent findings of the California Climate Change Center's "Climate Scenarios," a project analyzing a range of impacts that projected warming would have on California. One section focused specifically on water resources. |

**TABLE 5.7-21 (Continued)
ANNOTATED BIBLIOGRAPHY ON CLIMATE CHANGE/GLOBAL WARMING**

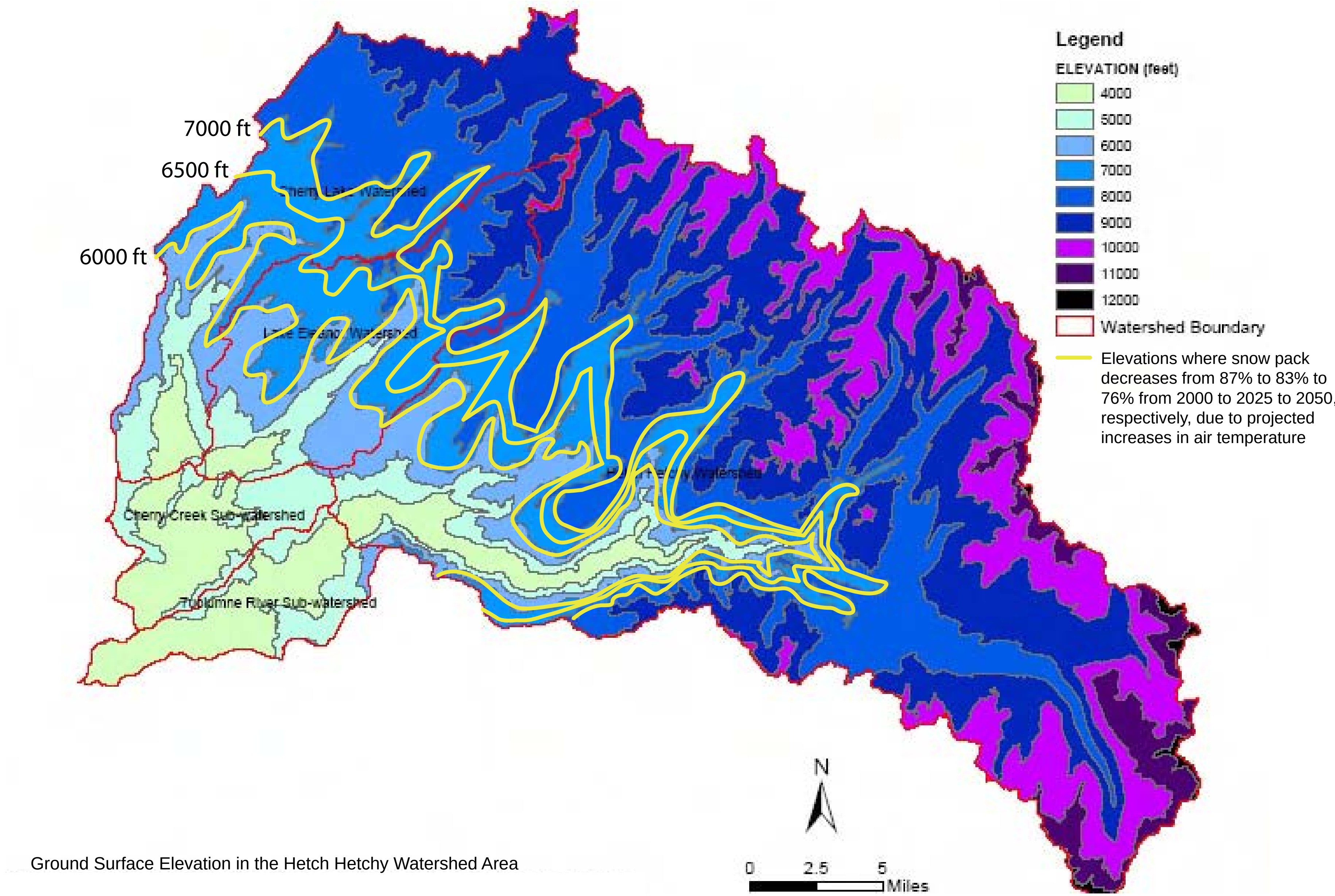
| Author, Title, Date | Summary and Relevance to Regional Water System |
|---|---|
| Hayhoe, Katharine et al., “Emission Pathways, Climate Change, and Impacts on California,” Proceedings of the National Academy of Sciences, August 24, 2004. | This study looked at the magnitude of future climate change in California using the highest and lowest United Nations Intergovernmental Panel on Climate Change emissions pathways. |
| Miller, Norman et al., *Journal of the American Water Resources Association,* “Potential Impacts of Climate Change on California Hydrology,” August 2003. | Hydrologic calculations were performed for a set of California river basins that extend from the coastal mountains and Sierra Nevada northern region to the southern Sierra Nevada region. Results indicate that for all snow-producing cases, a larger proportion of the stream flow volume will occur earlier in the year. The amount and timing is dependent on the characteristics of each basin, particularly the elevation. Increased temperatures lead to a higher freezing line, and therefore less snow accumulation and increased melting below the freezing height. |
| San Francisco Public Utilities Commission, Special Commission Meeting, “Discussion of Global Warming Impacts: San Francisco Water System,” available online at http://sanfrancisco.granicus.com/ViewPublisher.php?view_id=22, August 8, 2006. | Introductory discussion of global warming by the commission. Three main topics were discussed: (1) impacts on SFPUC water supply storage due to possible loss of snowpack; (2) impacts related to a rise in sea level and effects on sewage treatment plants in San Francisco; and (3) effects due to changes in the intensity and duration of storms and potential flooding. The SFPUC has established climate change as an area for discussion for years to come. Current operation of the Hetch Hetchy system is able to accommodate a range of climate conditions; however, the SFPUC has started preliminary studies to look at warming patterns and effects on the system. |

SOURCE: ESA+Orion, 2006.

Nevertheless, independent of the HH/LSM, SFPUC staff performed an initial evaluation of the effect on the regional water system of a 1.5-degree Celsius (°C) temperature rise between 2000 and 2025 (SFPUC, 2006a). The temperature rise of 1.5 °C is based on a consensus among many climatologists that current global climate modeling suggests a 3 °C rise will occur between 2000 and 2050 and a rise of 6 °C will occur by 2100. The evaluation predicts that an increase in temperature of 1.5 °C will raise the snowline approximately 500 feet every 25 years.

The elevation of the watershed draining into Hetch Hetchy Reservoir ranges from 3,800 to 12,000 feet above mean sea level, with about 87 percent of the watershed area above 6,000 feet, as shown in **Figure 5.7-5**. In 2000 (a normal hydrologic year in the 82-year period of historical record), the average snowline in this watershed was approximately 6,000 feet during the winter months. Therefore, the SFPUC evaluation indicates that a rise in temperature of 1.5 °C between 2000 and 2025 will result in less or no snowpack between 6,000 and 6,500 feet and faster melting of the snowpack above 6,500 feet. Similarly, a temperature rise of 1.5 °C between 2025 and 2050 will result in less or no snowpack between 6,500 and 7,000 feet and faster melting of the snowpack above 7,000 feet. The change in snowline that would result from the projected rise in temperature between 2000 and 2050 is highlighted in Figure 5.7-5.

The SFPUC climate change modeling indicates that about 7 percent of the runoff currently draining into Hetch Hetchy Reservoir will shift from the spring and summer seasons to the fall and winter seasons in the Hetch Hetchy basin by 2025. This percentage is within the current




SOURCE: SFPUC, 2006

SFPUC Water System Improvement Program . 203287

**Figure 5.7-5**
Projected Decreases in Snow Pack in the Hetch Hetchy Watershed Due to Climate Change, 2000 to 2050

interannual variation in runoff and is within the range accounted for during normal runoff forecasting and existing reservoir management practices. The additional change between 2025 and 2030 will not be detectible. The predicted shift in runoff timing is similar to the results found by other researchers modeling water resource impacts in the Sierra Nevada due to warming trends associated with climate change.

Based on these preliminary studies and the results of the literature review, the potential impacts of global warming on the regional water system are not expected to affect the proposed WSIP operations through 2030, either directly or in combination with the cumulative projects previously described. This is because the predicted changes in stream flow and reservoir water levels in the Hetch Hetchy watershed attributable to climate change during this period are within the same range that occurs under both the existing and proposed operations and management of the system. SFPUC hydrologists are involved in ongoing monitoring and research regarding climate change trends and will continue to monitor the changes and predictions, particularly as these changes relate to the proposed operations and management of the regional water system.

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