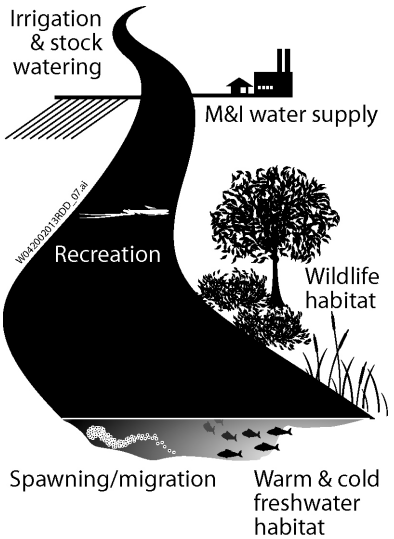
3.3 Water Resources

3.3.1 Surface-water Hydrology and Management

RBDD is located on the Sacramento River about 2 miles southeast of the City of Red Bluff. The Sacramento River is the largest river in California, flowing more than 300 miles southward from Lake Shasta to Collinsville in the Delta, and serving as the main drainage for the Sacramento River Basin.

The Delta is the region of lowest elevation in the Central Valley and consists of a maze of channels, sloughs, and dredger cuts covering an area of about 1,200 square miles. The Sacramento and the San Joaquin River systems join at the Delta and flow through Susuin Bay and the Carquinez Straights into the San Francisco Bay and eventually into the Pacific Ocean (USFWS et al., 1999).

The Sacramento River has an average annual runoff of 22.4 million acre-feet (maf) and yields 35 percent of the state's water supply (DWR, 1994). The Sacramento River is also the largest contributor of surface water within the Delta's watershed, providing approximately 80 percent of all the inflow to the Delta. The annual flow into the Delta varies from year to year; however, average annual flow into the Delta is approximately 21 maf per year. This volume represents approximately 42 percent of all surface water in California. Average outflow from the Delta is slightly higher at approximately 21.7 maf (30,000 cfs); but in summer months of critically dry years, flows can decrease ten-fold to approximately 3,000 cfs.



Flows in the upper Sacramento River are largely controlled by upstream CVP storage facilities that are operated by USBR and local irrigation districts. CVP facilities affecting upper Sacramento flows include Shasta, Keswick, Trinity, Lewiston, Whiskeytown, and Spring Creek Debris dams; RBDD; and TC and Corning canals.

Flows in the upper Sacramento River are primarily regulated by Shasta Dam, and are re-regulated 15 miles downstream at Keswick Dam. The watershed above Shasta Dam drains approximately 6,650 square miles with an average runoff of 5.7 maf (USFWS et al., 1999). Shasta Dam, which was completed in 1944, provides floodwater control and stores surplus winter runoff in Shasta Lake for irrigation use in the Sacramento and San Joaquin valleys. With a capacity of 4.6 maf, Shasta Lake is larger than any other reservoir in the state. Releases range from approximately 9 maf in wet years to 3 maf in dry years (USFWS et al., 1999).

Flows released into the Sacramento River support a variety of beneficial uses including: Municipal and industrial water supply, navigation and electric generation, agricultural practices of irrigation and stock

watering, recreational uses, warm and cold freshwater habitat, warm- and cold-water fishery migration, and spawning and wildlife habitat. Minimum releases are determined most frequently on the basis of river temperature objectives and Delta water quality objectives, and occasionally on hydropower requirements, irrigation, or navigation needs. The Sacramento River Basin and it tributaries are shown on Figure 3.3-1.

Affected Environment

RBDD is located approximately 60 river miles downstream from Shasta and Keswick dams. Much of the river in the reach between RBDD and Keswick Dam flows through confined canyons, although portions have a broader floodplain. About 40 miles below Keswick Dam, the river widens to about 500 feet before entering the alluvial plains of the Sacramento Valley below the City of Red Bluff (Figure 3.3-1). Shasta and Keswick dams are the ultimate barriers to anadromous fish migrations in the Sacramento River. More than 75 percent of naturally spawning Chinook salmon in the Sacramento River use the reach from Kewsick Dam to RBDD (CALFED Bay-Delta Program, 1999).

The reach of the Sacramento River that extends from Keswick Dam to RBDD receives inflow from Bear, Cow, Inks, Stillwater, Anderson, Battle, and Paynes creeks. These creeks drain on the east side of the river. To the west, this reach of the Sacramento River receives flow from Anderson, Clear, Cottonwood, and Spring creeks, which drain portions of the Klamath Mountains and the northern Coast Range Mountains.

Shasta and Keswick dams are the ultimate barriers to anadromous fish migrations in the Sacramento River.

The gates on RBDD are in place from mid-May to mid-September (gates-in period). When RBDD gates are in, the water level in the Sacramento River just above the dam rises and is maintained at an elevation of 252.5 feet above msl, which results in the formation of Lake Red Bluff. The lake is considered a major recreational feature in the City of Red Bluff, and when the water level reaches its full pool, the lake contains approximately 3,900 acre-feet of water and extends approximately 6 miles upstream through the City of Red Bluff.

Along with forming the lake, the lowering of RBDD gates also allows for the diversion of up to 2,530 cfs of irrigation water into the Corning Canal and the TC Canal. The Anderson-Cottonwood Irrigation District's (ACID) flashboard dam in Redding operates as a second diversion dam along the upper Sacramento River. The ACID dam diverts approximately 400 cfs. In addition to the gravity diversions provided by RBDD and ACID, several other pumped water diversions are located along the mainstem Sacramento River (see Figure 3.3-2). The largest is Glenn-Colusa Irrigation District's Hamilton City Pumping Plant on an oxbow off of the Sacramento River. It diverts up to 3,000 cfs of water into the Glenn-Colusa Canal. In addition, hundreds of unscreened diversions

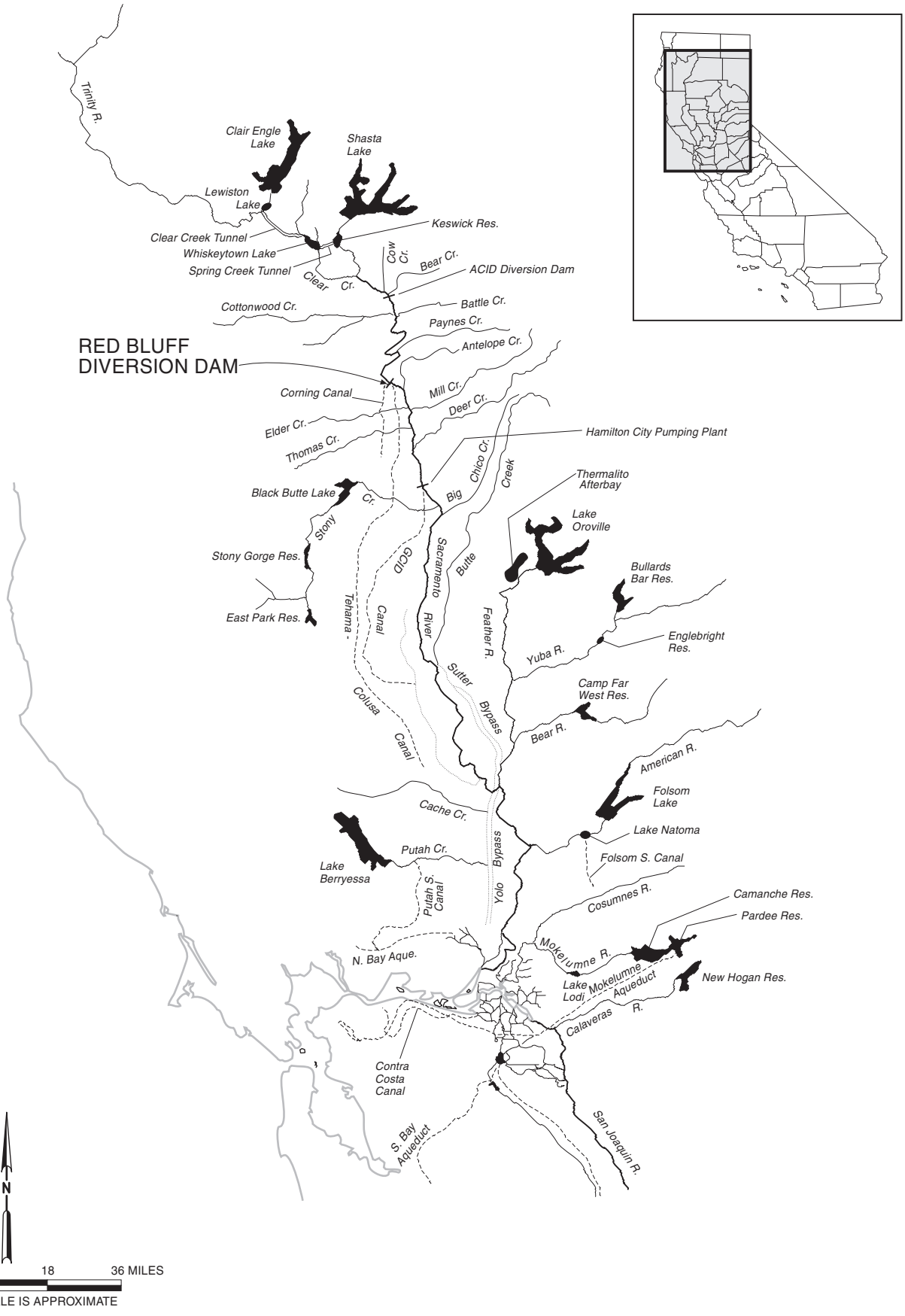


FIGURE 3.3-1
SACRAMENTO RIVER BASIN AND TRIBUTARIES
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

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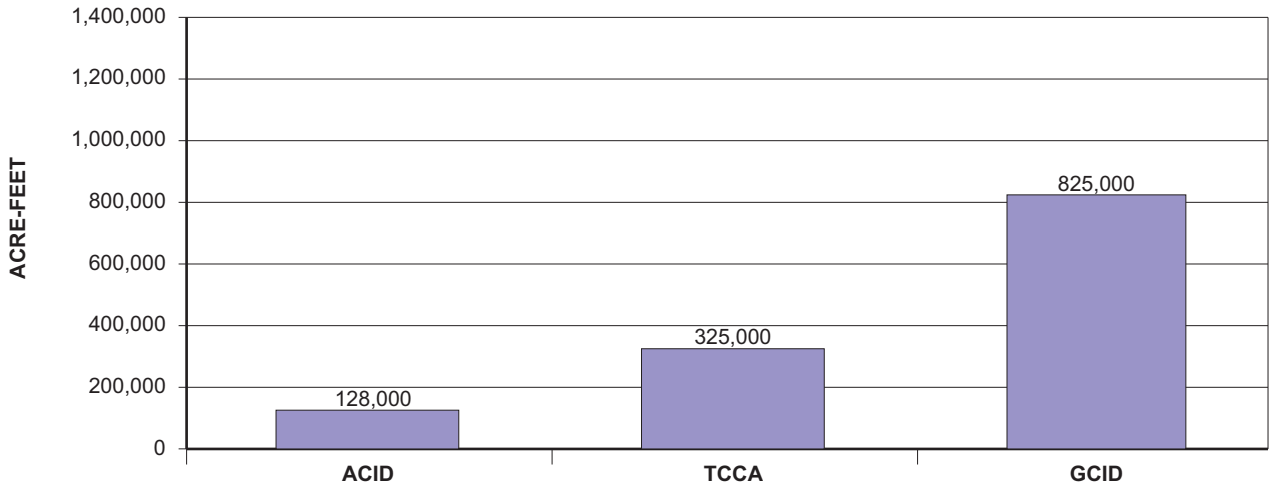

FIGURE 3.3-2 *(REVISED)*
CVP WATER CONTRACT VOLUMES FROM THE SACRAMENTO RIVER (VICINITY OF RBDD)
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

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located along the river operate primarily in the spring through fall irrigation season. Approximately 20 of these are considered large diversions (>250 cfs), and the majority of these, accounting for about 80 percent of the volume diverted, are screened (CALFED Bay-Delta Program, 1999). All other water diversions along the river are shoreline diversions.

The following sections summarize the flows measured in the Sacramento River in the vicinity of RBDD. The summary of the flow measurements presented below includes the period prior to the construction of RBDD and the flows following construction of the RBDD. Flow conditions in the Sacramento River before and after the construction of RBDD are shown as average monthly flows. The hydrologic data used in this analysis were derived from daily stream gage records collected by both DWR and U.S. Geological Survey (USGS) at the USGS gaging station on the Sacramento River at Bend Bridge upstream of the present RBDD. Creek and groundwater in-flows between Bend Bridge and RBDD also contribute to the total flow of the Sacramento River, but were not quantified in this assessment. The location of RBDD and the Bend Bridge gaging station is presented on Figure 3.3-3.

Sacramento River Flow Conditions Prior to RBDD Construction

The average monthly flow of the Sacramento River for the period prior to the construction of RBDD was determined by analyzing flow data for a 15-year interval ranging from 1945 to 1960. This interval was selected because it spans the interval from the completion of Shasta Dam in 1944 to a time just before the startup of construction on RBDD in 1962, and thus, represents a period of unrestricted Sacramento River flow in the local area of RBDD.

The average monthly flow of the Sacramento River for the period prior to the construction of RBDD was determined by analyzing flow data for a 15-year interval ranging from 1945 to 1960.

Average monthly flow data that were recorded at the Bend Bridge gage from 1940 to 2000 are presented on Figure 3.3-4. A comparison of the monthly average flow in the Sacramento River prior to and following the construction of the dam is displayed on Figure 3.3-5. The average daily flows recorded during the periods considered are the basis for the monthly averages illustrated on these figures. The difference in the pre- and post-RBDD flows reflect both the natural variations in winter rainfall and evolving operational changes during the summer months.

Sacramento River Flow Following RBDD Construction

Figure 3.3-6 provides a comparison of the minimum, average, and maximum recorded flows in the Sacramento River following construction of RBDD. These data are presented for the period 1980 to 2000; as with the data presented for the period prior to dam construction, this information was determined on a monthly basis. The time period from 1980 to 2000 was selected to coincide with the completion of Reach

Eight, the final section of the TC Canal and diversion of water to the reach. Reach Eight was completed on May 30, 1980. Similar to the data presented on Figures 3.3-4 and 3.3-5, the average daily flow data were compiled by month to develop the statistical results presented on Figure 3.3-6.

Sacramento River Floodplain at RBDD

RBDD impacts river surface elevations upstream of the dam.

RBDD impacts river surface elevations upstream of the dam. During the gates-in period (May 15 through September 15), the surface-water elevation at the dam is maintained at 252.5 feet. During the gates-out period (September 16 through May 14), surface-water elevations at RBDD range from approximately 238.5 feet (at 4,000 cfs) to 254 feet (at 100,000 cfs). The estimated 100-year flood elevation at RBDD is 262.3 feet (at 206,000 cfs) (CH2M HILL, 2001). Figure 3.3-7 presents the current 100-year floodway and the 100- and 500-year floodplains in the vicinity of RBDD.

Stony Creek

As an interim measure, CVP water stored in Black Butte Reservoir is released to Stony Creek for subsequent rediversion to the TC Canal.

As an interim measure, CVP water stored in Black Butte Reservoir is released to Stony Creek for subsequent rediversion to the TC Canal. This diversion is conducted to partially offset the loss of gravity flow diversion at RBDD. Black Butte Reservoir diversions can be made only when the water is available, and does not represent a reliable water diversion into the TC Canal. Regular use of these diversions is planned to be discontinued as soon as a permanent solution is implemented at RBDD.

Since April 1993, water has been diverted from the Black Butte Reservoir through a CHO that is located on the canal at the Stony Creek Canal siphon. The CHO is used as the diversion point on Stony Creek to direct releases from Black Butte Reservoir into the TC Canal. Although it has never been used for its intended purpose, the CHO was originally installed to enhance aquatic habitat conditions through the release of TC Canal water into Stony Creek (USBR, 1998). A maximum of 38,296 acre-feet (approximately 53 cfs) may be diverted annually from Stony Creek to TC Canal (Stamets, 2001, pers. comm.).

In 1993, USBR first applied for a permanent change to the point of diversion permit with SWRCB to redivert water from Stony Creek to TC Canal. A temporary permit was granted by SWRCB, and CHO rediversion subsequently commenced on April 25, 1993. A second temporary permit for diversion was granted by SWRCB for the spring and fall of 1994. USBR again filed a petition for a permanent permit in June 1995. The permanent permit was issued by SWRCB on April 1, 1996 (USBR, 1998).

Stony Creek rediversions during 1993 and 1994 partially overlapped with the gates-in period at RBDD, complementing the concurrent

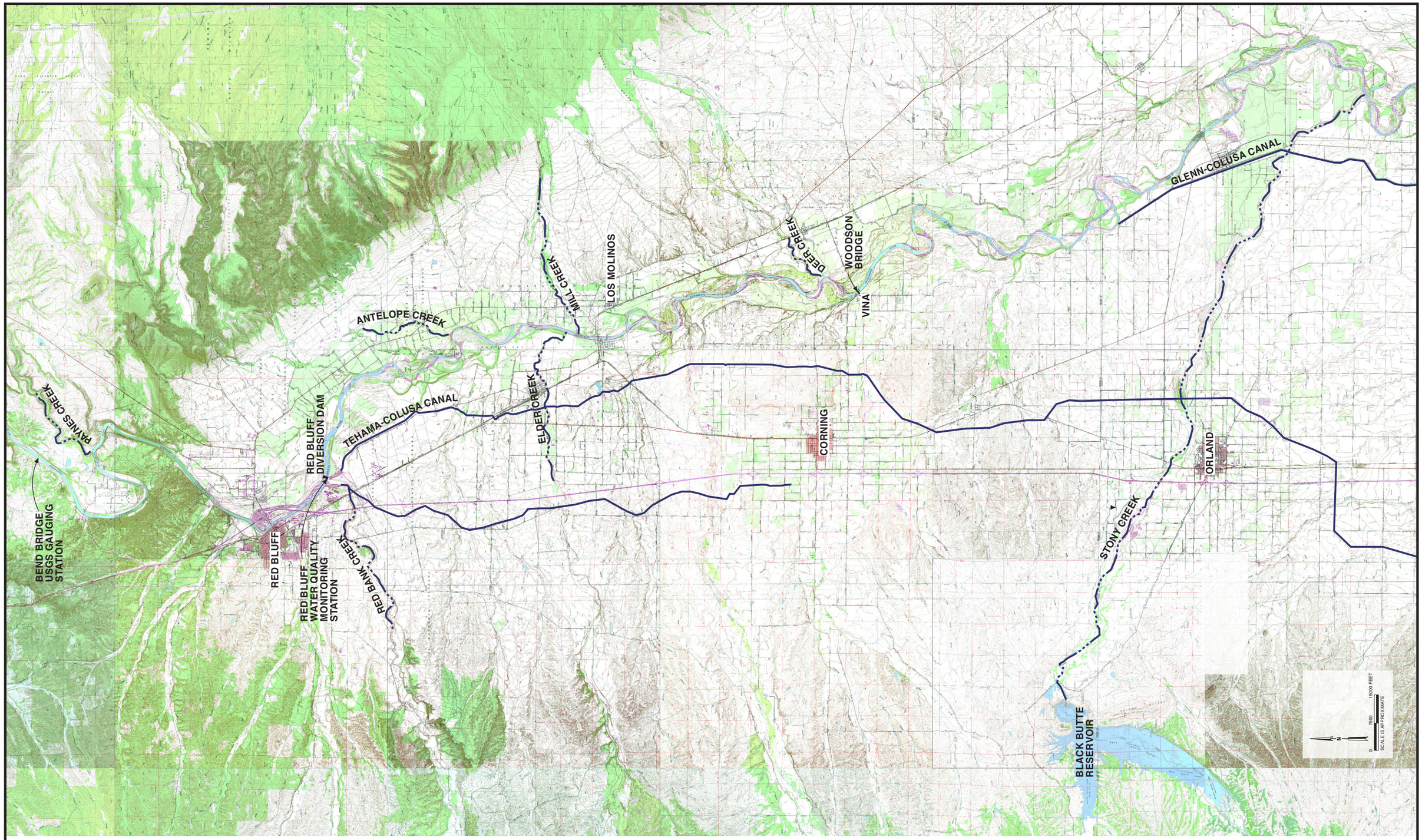

FIGURE 3.3-3
USGS GAGING STATIONS
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

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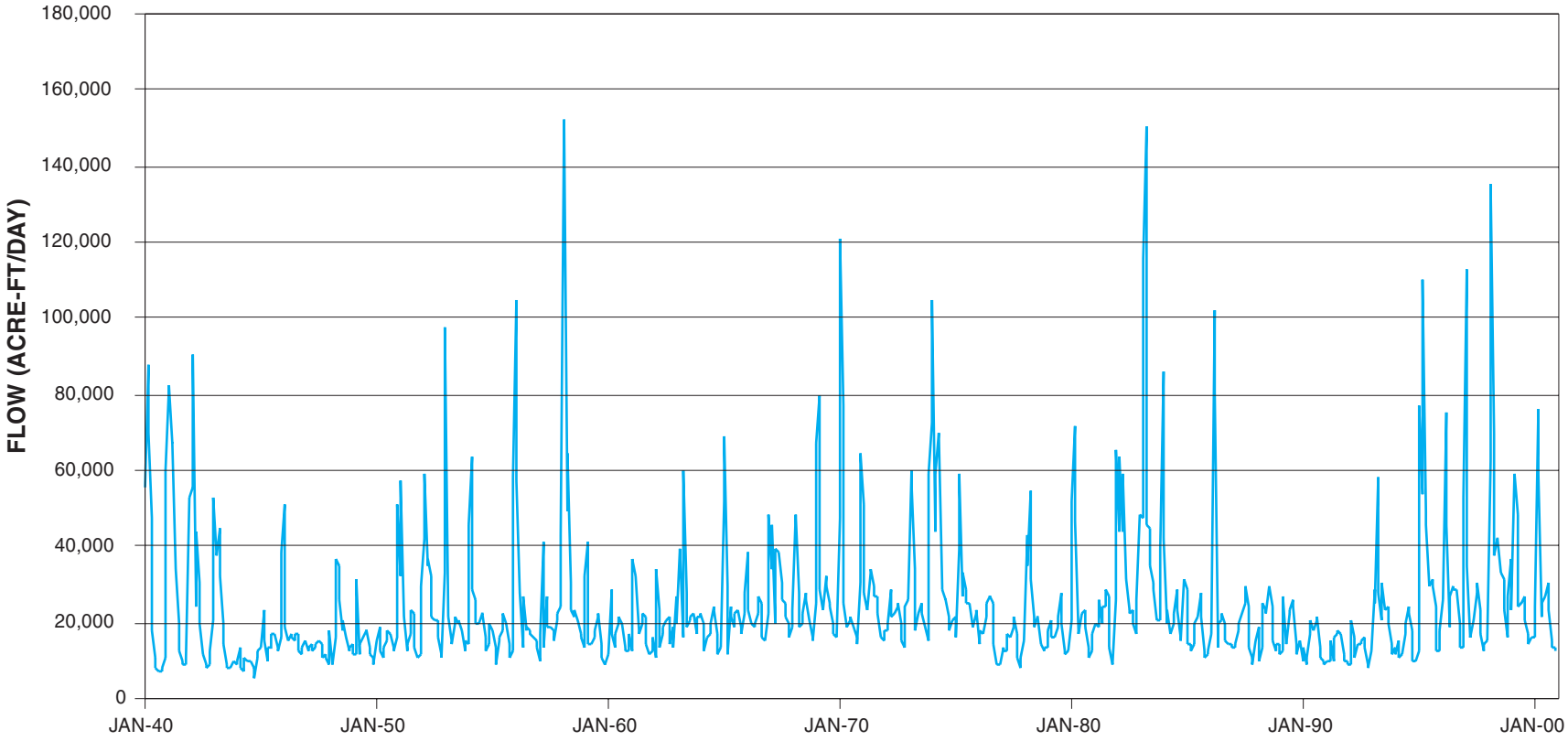

FIGURE 3.3-4
AVERAGE MONTHLY SACRAMENTO RIVER FLOW AS MEASURED AT BEND BRIDGE
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

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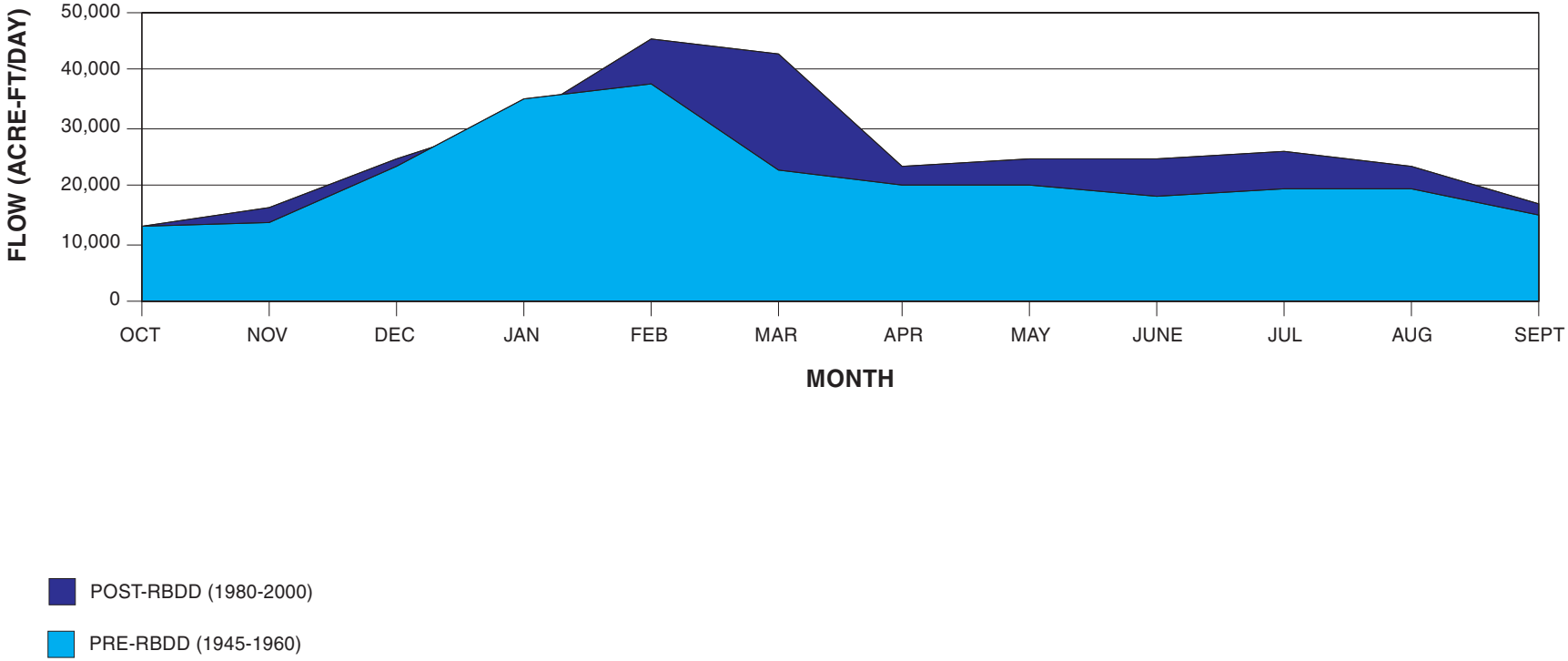

FIGURE 3.3-5
SACRAMENTO RIVER FLOW AS MEASURED AT BEND BRIDGE GAGING STATION
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

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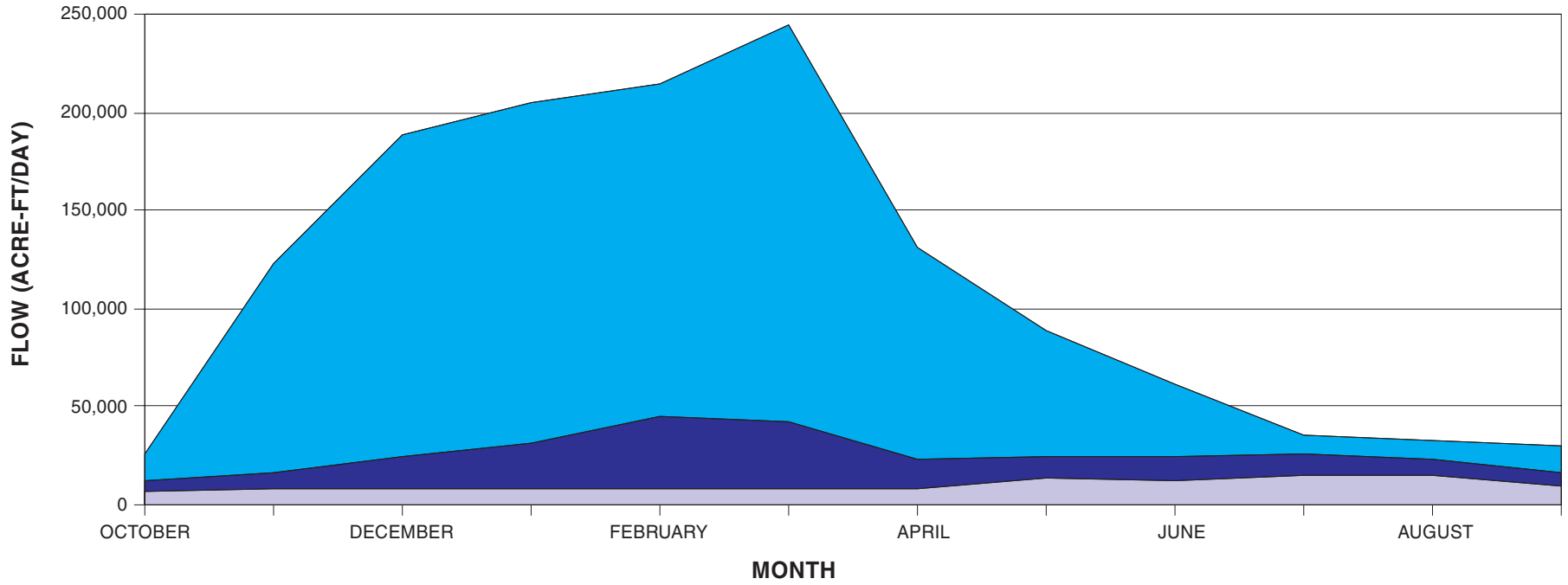

FIGURE 3.3-6
MINIMUM, AVERAGE, AND MAXIMUM MONTHLY SACRAMENTO RIVER FLOWS FOLLOWING RBDD CONSTRUCTION (1980 TO 2000)
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

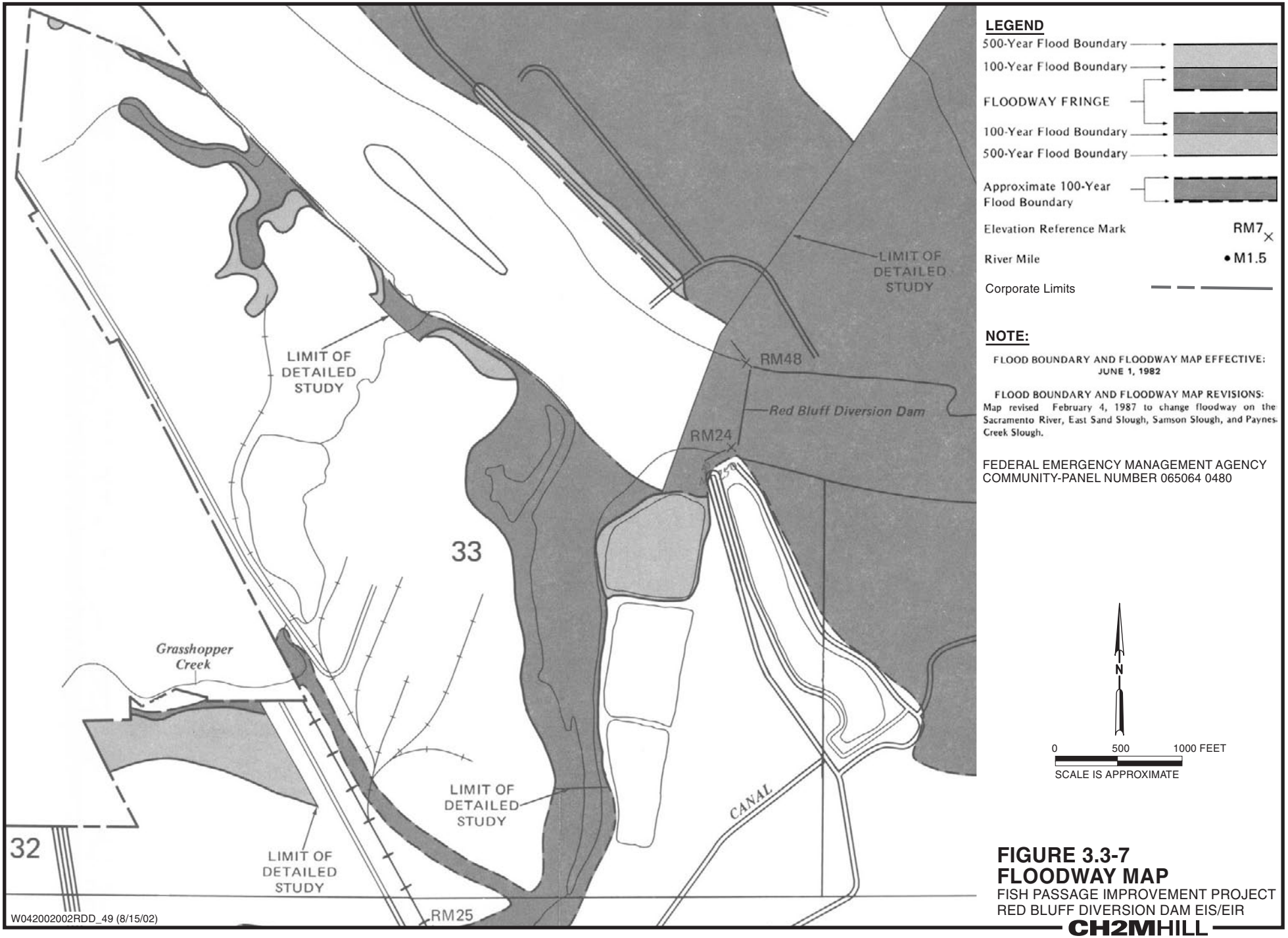

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FIGURE 3.3-7
FLOODWAY MAP
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

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diversions from the Sacramento River. Since 1994, rediversions from Stony Creek have only occurred during gates-out intervals to extend the period of delivery to water districts. Rediversions are currently limited by permit to the 45-day periods between April 1 and May 15 and between September 15 and October 29, although water has not been diverted from Stony Creek during the fall since 1996. An average of approximately 14,800 acre-feet per year has been rediverted from Stony Creek since rediversions were initiated, with the exception of 1998, when no water was rediverted from Stony Creek. The greatest volume of annual diversions occurred in 1996, when 26,168 acre-feet of water was diverted from Stony Creek. Figure 3.3-8 presents the contributions of the Stony Creek rediversion water to the total monthly TC Canal diversion flow for the years 1993 through 2000.

Environmental Consequences

Methodology. Potential impacts to hydrology and water management were assessed through the review of existing documents, flood maps, contacts with resource agencies, and database reviews.

Significance Criteria. Standards of significance represent the thresholds that were used to identify whether an impact would be potentially significant. These criteria are based on Appendix G of the *CEQA Guidelines* and professional judgment with regard to the study area.

Impacts on surface-water hydrology and management would be significant if they would result in any of the following:

- 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 pre-existing nearby wells would drop to a level that would not support existing land uses or planned uses for which permits have been granted).
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner that would result in substantial erosion or siltation on- or offsite.
- Create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff.
- Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map.

- Place within a 100-year flood hazard area structures or vegetation that would impede or redirect flood flows.
- Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam.
- Expose people or structures to a significant risk of loss, injury, or death from inundation by seiche, tsunami, or mudflow.

No Action Alternative

No changes to hydrology or surface-water management would occur. Gates would be operated during the current 4-month gates-in period. Construction activity would be limited to the installation of the fourth pump at RPP. No other construction activity would occur as a result of the No Action Alternative.

1A: 4-month Improved Ladder Alternative

Construction-related Impacts.

Impact 1A–WR1: Hydrology and Water Management. Construction of the proposed facilities under Alternative 1A would not affect hydrology or water management in the project area.

There would be no construction-related impacts on hydrology or water management; therefore, no mitigation is required.

Operations-related Impacts.

Impact 1A–WR2: Hydrology and Water Management. Operations of the left bank and right bank fish ladders would not change basic hydrology or water management of the project area. Operation of the pump station associated with Alternative 1A would potentially increase the amount of water diverted from the Sacramento River, although this would be offset by a decrease in diversions from Stony Creek, particularly in the May 1 through 14 period. The net effect of increased Sacramento River diversion capacity in the May 1 through 14 period would be less than significant.

The impacts from operations on hydrology and water management would be less than significant; therefore, no mitigation is required.

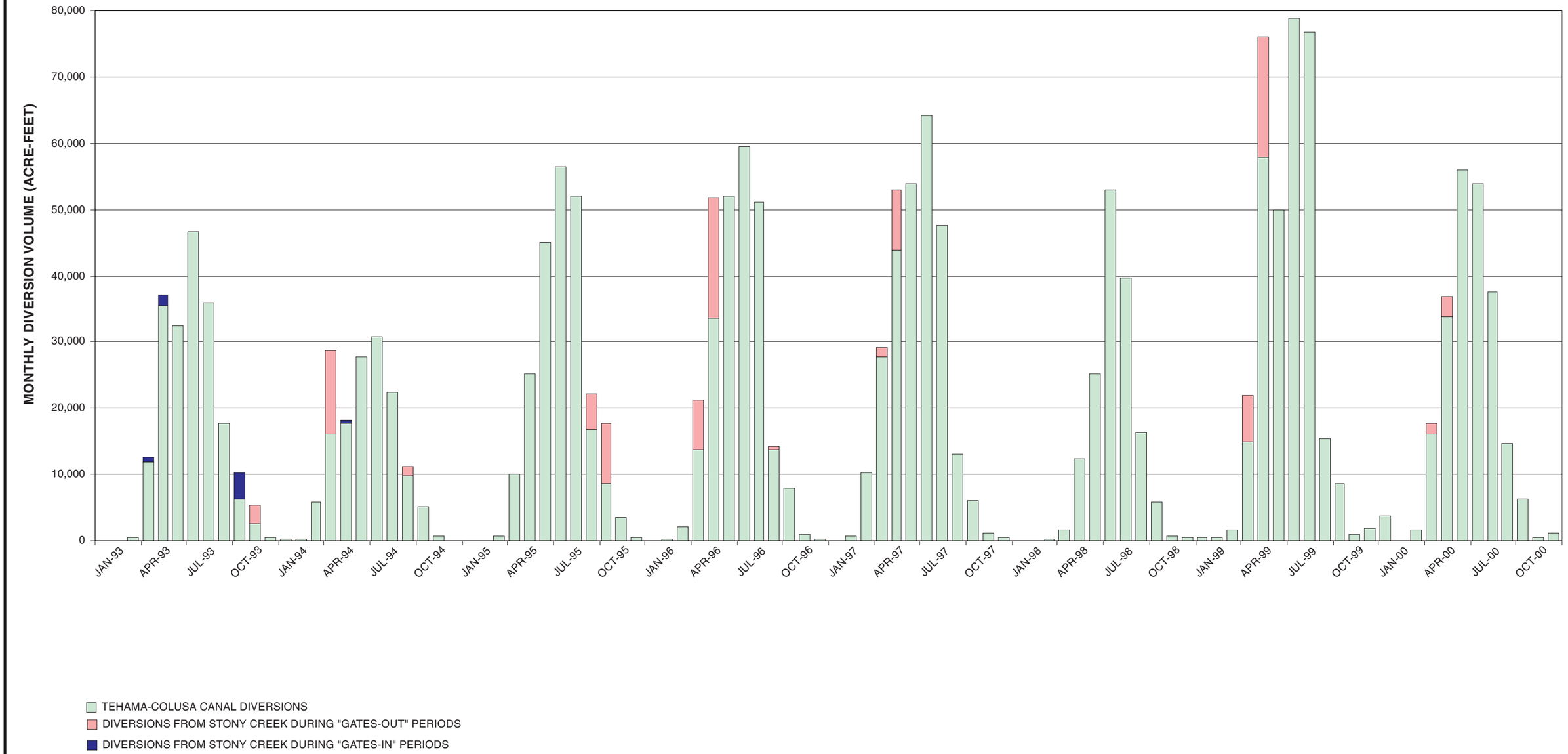

FIGURE 3.3-8
STONY CREEK CONTRIBUTIONS TO TC CANAL DIVERSION FLOW
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

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1B: 4-month Bypass Alternative

Construction-related Impacts.

Impact 1B–WR1: Hydrology and Water Management. The impacts from construction on hydrology and water management under Alternative 1B would be the same as those identified for Alternative 1A (see Impact 1A–WR1).

There would be no construction-related impacts on hydrology or water management; therefore, no mitigation is required.

Operations-related Impacts.

Impact 1B–WR2: Hydrology and Water Management. The impacts from operations on hydrology and water management under Alternative 1B would be the same as those identified for Alternative 1A (see Impact 1A–WR2).

The impacts from operations on hydrology and water management would be less than significant; therefore, no mitigation is required.

2A: 2-month Improved Ladder Alternative

Construction-related Impacts.

Impact 2A–WR1: Hydrology and Water Management. The impacts from construction on hydrology and water management under Alternative 2A would be the same as those identified for Alternative 1A (see Impact 1A–WR1).

There would be no construction-related impacts on hydrology or water management; therefore, no mitigation is required.

Operations-related Impacts.

Impact 2A–WR2: Hydrology and Water Management. Operations of the left bank and right bank fish ladders would not change basic hydrology or water management of the project area. Operation of pump station associated with this alternative would potentially increase the capacity to pump water from the Sacramento River, although this would be offset by a decrease in diversions from Stony Creek, particularly in the May 1 through 14 period. Additionally, under the 4-month gate operation, there is greater capacity for diverting water than under a 2-month gate operation; therefore, there is actually a reduction in usable capacity under this alternative. The net effect of increased Sacramento River diversion capacity in the May 1 through 14 period would be less than significant.

The impacts from operation on hydrology and water management would be less than significant; therefore, no mitigation is required.

2B: 2-month with Existing Ladders Alternative

Construction-related Impacts.

Impact 2B–WR1: Hydrology and Water Management. The impacts from construction on hydrology and water management under Alternative 2B would be the same as those identified for Alternative 1A (see Impact 1A–WR1).

There would be no construction-related impacts on hydrology or water management; therefore, no mitigation is required.

Operations-related Impacts.

Impact 2B–WR2: Hydrology and Water Management. The impacts from operations on hydrology and water management under Alternative 2B would be the same as those identified for Alternative 1A (see Impact 1A–WR2).

The impacts from operation on hydrology and water management would be less than significant; therefore, no mitigation is required.

3: Gates-out Alternative.

Construction-related Impacts

Impact 3–WR1: Hydrology and Water Management. The impacts from construction on hydrology and water management under Alternative 3 would be the same as those identified for Alternative 1A (see Impact 1A–WR1).

There would be no construction-related impacts on hydrology or water management; therefore, no mitigation is required.

Operations-related Impacts.

Impact 3–WR2: Hydrology and Water Management. Alternative 3 would not require fish ladders. Operations of the pump station associated with this alternative would potentially increase the capacity to pump water from the Sacramento River, although this would be offset by a decrease in diversions from Stony Creek, particularly in the May 1 through 14 period. Additionally, under the 4-month gate operation, there is greater capacity for diverting water than under a 0-month gate operation; therefore, there is actually a reduction in usable capacity under this alternative. The net effect of increased Sacramento River diversion capacity in the May 1 through 14 period would be less than significant.

The impacts from operations on hydrology and water management would be less than significant; therefore, no mitigation is required.

Mitigation

No negative impacts from construction or operations of the proposed alternatives have been identified; therefore, no mitigation is provided.

3.3.2 Water Quality

The following sections summarize water quality data including temperature, dissolved oxygen, and turbidity for the Sacramento River in the vicinity of RBDD. These data were collected from a water quality monitoring station located immediately upstream of RBDD (see Figure 3.3-3).

Water temperature is an important factor in controlling survival, development, and growth of fish during all life history stages, and is the only water quality constituent in the Sacramento River at RBDD that regularly exceeds state water quality standards or objectives.

Water temperature is an important factor in controlling survival, development, and growth of fish during all life history stages, and is the only water quality constituent in the Sacramento River at RBDD that regularly exceeds state water quality standards or objectives. According to SWRCB's Order 90-5, the temperature objective for the operation of CVP for the upper Sacramento River from Keswick Dam to RBDD is less than or equal to 56°F (CALFED Bay-Delta Program, 1999).

The water temperature objective that was stipulated by Order 90-5 was exceeded 85 percent of the time during the gates-in period for 1998 through 2000. The average temperature of Lake Red Bluff for the gates-in period during this interval was 56.7°F.

The range of temperatures measured by DWR at the RBDD monitoring station from January 1998 through December 2000 is presented on Figure 3.3-9. The average year-round temperature during this period was 53.8°F, with roughly 38 percent of the data exceeding the 56°F water temperature standard. The highest temperature recorded during this period was 60.8°F (on September 18, 2000). Temperatures greater than 60°F are unsuitable for some fish species (see Section 3.2 Fishery Resources).

The trend in average daily temperature at RBDD, as shown on Figure 3.3-9, illustrates that temperatures have decreased since 1990. While temperatures in Lake Red Bluff peaked at 62°F to 63°F during the 1990 through 1992 gates-in period, temperatures recorded for the same period during more recent years have declined and peaked at 58°F to 59°F. Only three daily average measurements exceeded 60°F during the period of 1998 through 2000.

This reduction in temperature is most likely attributed to the actions taken as a result of the 1993 NMFS Biological Opinion for endangered winter-run Chinook salmon, one of which was the temperature control device located at the Shasta Dam. The Biological Opinion designated 56°F as the temperature to be maintained in the river from Keswick Dam to Bend Bridge, and requires a gates-out operation for a greater portion of the year. A decrease in water temperature followed the transition of the gates-out period from 4 months per year to 8 months per year. This decrease is likely caused by a reduction in the warming of water in Lake Red Bluff that may have occurred because of a decrease in retention time of water in the pool behind RBDD.

Data suggest that RBDD has a warming effect on the Sacramento River.

For comparison, Figure 3.3-9 also includes year-round temperature data from the same period for Bend Bridge, which is located upstream of RBDD. The average water temperature at Bend Bridge for the entire January 1998 through December 2000 period was 52.8°F, with 13.5 percent of the data exceeding the water temperature standard of 56°F. The average temperature during gates-in is 53.8°F. These data further suggest that RBDD has a warming effect on the Sacramento River, as temperatures measured at RBDD (in Lake Red Bluff) are, on average, approximately 3°F higher than temperatures measured at Bend Bridge during the gates-in period.

Dissolved Oxygen

Average dissolved oxygen concentrations at RBDD exceed minimum water quality criteria, and thus, do not pose a significant risk to the aquatic habitat in the Sacramento River.

Average dissolved oxygen (DO) concentrations at RBDD exceed minimum water quality criteria, and thus, do not pose a significant risk to the aquatic habitat in the Sacramento River. According to the Regional Water Quality Control Board Basin Plan (Basin Plan) for the Sacramento and San Joaquin basins, DO water quality objectives for the Sacramento River from Keswick Dam to Hamilton City are set at 9.0 milligrams per liter (mg/L) for the period from June 1 to August 31. (The Basin Plan also stipulates that when natural conditions lower DO levels below 9.0 mg/L, the concentration shall be maintained at or above 95-percent saturation.) In comparison, the average DO concentration during the gates-in periods in 1999 and 2000 was 10.0 mg/L, while the average gates-out DO concentration for the November 1998 through December 2000 period was 11.0 mg/L. The average overall DO concentration for the entire gates-in and gates-out period from November 1998 through December 2000 was 10.9 mg/L. Only 1.0 percent of DO measurements during this interval was less than 2 mg/L.

For comparison, DO data collected by DWR at Bend Bridge on the Sacramento River were also analyzed. The average concentration at Bend Bridge was 10.8 mg/L for the period from November 1998 through December 2000, with only 1.9 percent of DO measurements during this interval being less than 2.0 mg/L. The average DO concentration during gates-in periods during this interval was 7.9 mg/L, while the average gates-out DO concentration was 9.0 mg/L. DO concentrations at RBDD and Bend Bridge during this interval are shown on Figure 3.3-10.

Turbidity and Sediment Deposition

The Basin Plan does not set specific turbidity levels for the Sacramento River, but rather, it prescribes limits that are based on incremental increases in turbidity over natural conditions. According to a review of water quality data and comparison to the limits in the Basin Plan, the turbidity of the Sacramento River is not a water quality concern, although it does contribute to sediment deposition upstream of RBDD. Figure 3.3-11 illustrates the average monthly turbidity measurements

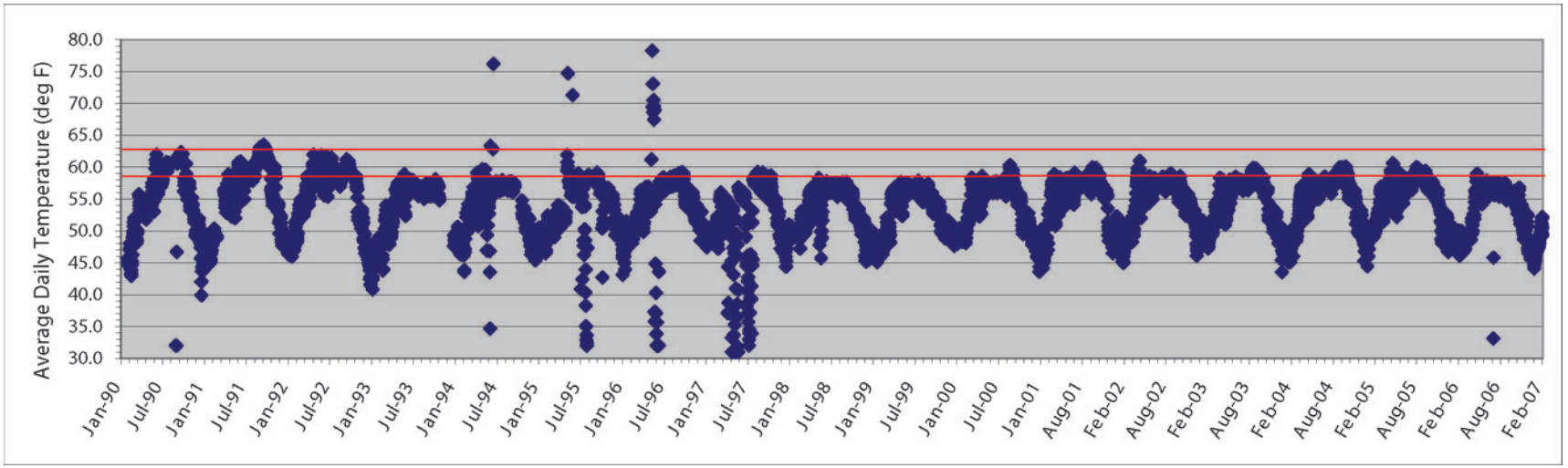

FIGURE 3.3-9 *(REVISED)*
TEMPERATURE AT RBDD
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

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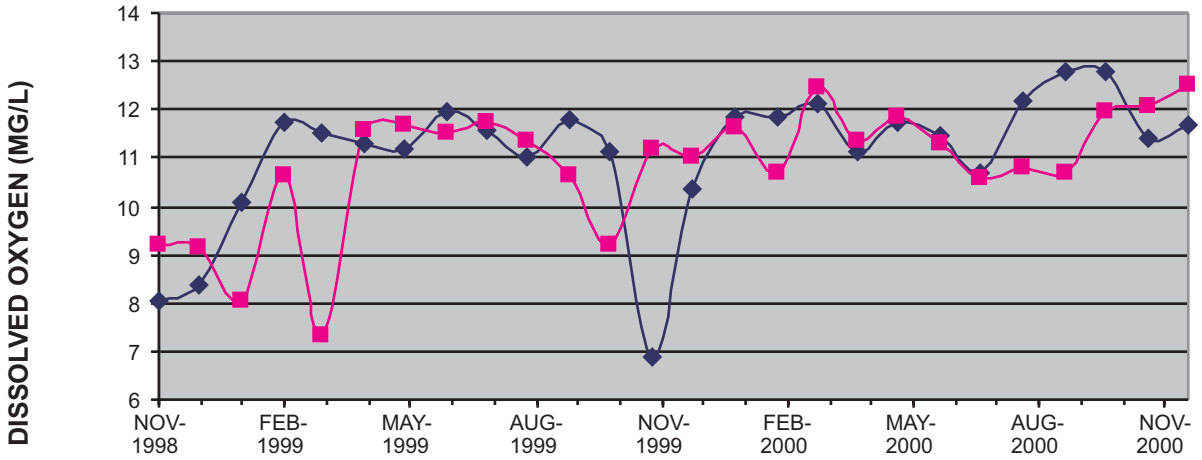

FIGURE 3.3-10
AVERAGE MONTHLY DISSOLVED OXYGEN AT RBDD AND BEND BRIDGE
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

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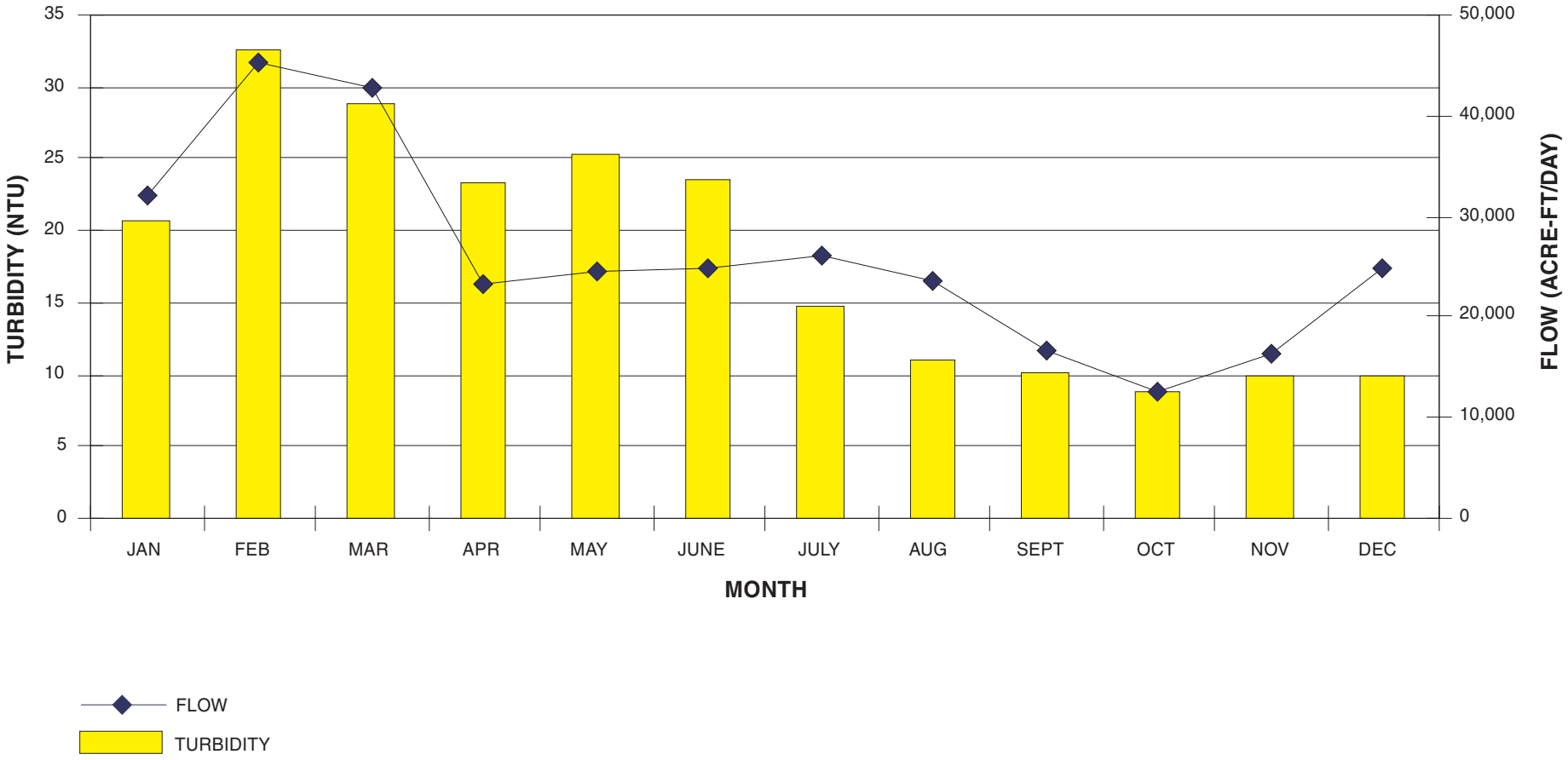

FIGURE 3.3-11
AVERAGE MONTHLY TURBIDITY AND FLOW AT RBDD
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

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CH2MHILL

for 1990 through 2000 and provides a baseline for current conditions within the vicinity of RBDD. (It should be noted that data collected from July 1994 to May 1998 were not used in this evaluation because, according to DWR, the data are unreliable because of technical difficulties. In addition, data collected from August 8 to September 12, 1999, were determined to be unrepresentative of typical turbidity conditions and were therefore not included in this analysis.)

The turbidity of the Sacramento River is not a water quality concern, although it does contribute to sediment deposition upstream of RBDD.

Red Bank Creek (as shown on Figure 3.3-3), which enters the Sacramento River just upstream of RBDD, contributes a large amount of sediment to the river. The average annual contribution of sediment to the Sacramento River by Red Bank Creek is 66,000 CY (USBR, 1992). Bedload sediment depths upstream of the RBDD foundation have been measured at 3 to 7 feet deep (Stodolski, 1999, pers. comm.).

Environmental Consequences

Methodology. Potential impacts to hydrology and water management were assessed through the review of existing documents, contacts with resource agencies, and database reviews.

Significance Criteria. Standards of significance represent the thresholds that were used to identify whether an impact would be potentially significant. These criteria are based on Appendix G of the *CEQA Guidelines* and professional judgment with regard to the study area.

Impacts on water quality would be significant if they would result in any of the following:

- Violate any water quality standards or waste discharge requirements.
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner that would result in substantial erosion or siltation on- or offsite.
- Otherwise substantially degrade water quality.

No Action Alternative

No changes to hydrology or surface-water management would occur. Gates would be operated during the current 4-month gates-in period. Construction activity would be limited to the installation of the fourth pump at RPP. No other construction activity would occur as a result of the No Action Alternative.

1A: 4-month Improved Ladder Alternative

Construction-related Impacts.

Impact 1A–WQ1: Increased Erosion as a Result of Grading and Excavating. Construction of the proposed facilities would require extensive grading

and excavation. Impacts to surface waters could occur during grading and excavation necessary for construction of the proposed fish ladders, as well as the proposed pumping plant and associated conveyance facilities.

Impacts on water quality would potentially occur from site grading and excavation.

Impact 1A–WQ2: Increased Potential for Spill of Hazardous Materials. Construction efforts would include use of materials and equipment that require hazardous materials. Examples include diesel fuel and cleaning solvents. Although not intentional, it is possible that the use and handling of hazardous materials could result in spills that could impact nearby waterways.

Impacts from construction on water quality would potentially occur from spills of hazardous materials.

Operations-related Impacts.

Impact 1A–WQ3: Water Quality. Operations of the proposed facilities under Alternative 1A would not affect local water quality in the project area.

There would be no operations-related impacts on water quality; therefore, no mitigation is required.

1B: 4-month Bypass Alternative

Construction-related Impacts.

Impact 1B–WQ1: Increased Erosion as a Result of Grading and Excavating. Impacts from construction under Alternative 1B would be the same as those identified for Alternative 1A (see Impact 1A–WQ1).

Impacts on water quality would potentially occur from site grading and excavation.

Impact 1B–WQ2: Increased Potential for Spill of Hazardous Materials. Impacts from spill of hazardous materials during construction under Alternative 1B would be the same as those identified for Alternative 1A (see Impact 1A–WQ2).

Impacts from construction on water quality would potentially occur from spills of hazardous materials.

Operations-related Impacts.

Impact 1B–WQ3: Water Quality. Impacts from operations on water quality under Alternative 1B would be the same as those identified for Alternative 1A (see Impact 1A–WQ3).

There would be no operations-related impacts on water quality; therefore, no mitigation is required.

2A: 2-month Improved Ladder Alternative

Construction-related Impacts.

Impact 2A–WQ1: Increased Erosion as a Result of Grading and Excavating. Impacts from construction under Alternative 2A would be the same as those identified for Alternative 1A (see Impact 1A–WQ1).

Impacts on water quality would potentially occur from site grading and excavation.

Impact 2A–WQ2: Increased Potential for Spill of Hazardous Materials. Impacts from spill of hazardous materials during construction under Alternative 2A would be the same as those identified for Alternative 1A (see Impact 1A–WQ2).

Impacts from construction on water quality would potentially occur from spills of hazardous materials.

Operations-related Impacts.

Impact 2A–WQ3: Water Quality. Impacts from operations on water quality under Alternative 2A would be the same as those identified for Alternative 1A (see Impact 1A–WQ3).

There would be no operations-related impacts on water quality; therefore, no mitigation is required.

2B: 2-month with Existing Ladders Alternative

Construction-related Impacts.

Impact 2B–WQ1: Increased Erosion as a Result of Grading and Excavating. Impacts from construction under Alternative 2B would be the same as those identified for Alternative 1A (see Impact 1A–WQ1).

Impacts on water quality would potentially occur from site grading and excavation.

Impact 2B–WQ2: Increased Potential for Spill of Hazardous Materials. Impacts from spill of hazardous materials during construction under Alternative 2B would be the same as those identified for Alternative 1A (see Impact 1A–WQ2).

Impacts from construction on water quality would potentially occur from spills of hazardous materials.

Operations-related Impacts.

Impact 2B–WQ3: Water Quality. Impacts from operations on water quality under Alternative 2B would be the same as those identified for Alternative 1A (see Impact 1A–WQ3).

There would be no operations-related impacts on water quality; therefore, no mitigation is required.

3: Gates-out Alternative

Construction-related Impacts.

Impact 3–WQ1: Increased Erosion as a Result of Grading and Excavating. Impacts from construction under Alternative 3 would be the same as those identified for Alternative 1A (see Impact 1A–WQ1).

Impacts on water quality would potentially occur from site grading and excavation.

Impact 3–WQ2: Increased Potential for Spill of Hazardous Materials. Impacts from spill of hazardous materials during construction under Alternative 3 would be the same as those identified for Alternative 1A (see Impact 1A–WQ2).

Impacts from construction on water quality would potentially occur from spills of hazardous materials.

Operations-related Impacts.

Impact 3–WQ3: Water Quality. Operations of the proposed facilities would not affect local water quality in the project area.

Section 402(b) of the Clean Water Act establishes the framework for regulating stormwater discharges under the National Pollutant Discharge Elimination System (NPDES) Program. The regulations require that stormwater associated with industrial activity that discharges directly to surface waters must be regulated by a NPDES permit. If necessary, a Stormwater Pollution Prevention Plan (SWPPP) would be prepared for the plant. The general permit that would be required includes development and implementation of a SWPPP emphasizing Best Management Practices (BMP). The General Permit requires development and implementation of a monitoring program to sample stormwater locations. Monitoring would be required of the discharge of any stormwater from the site, and would include at a minimum total suspended solids, pH, specific conductance, and oil and grease.

There would be no operations-related impacts on water quality; therefore, no mitigation is required.

Mitigation

This section discusses mitigations for each significant impact described in Environmental Consequences.

1A: 4-month Improved Ladder Alternative

Mitigation 1A–WQ1. The following mitigation measure would reduce the potential for sedimentation in the Sacramento River or Red Bank Creek to a less than significant level:

- Construction contractor shall obtain a General Construction Storm Water Permit, to comply with Clean Water Act Section 402(b) for

construction of all facilities. As part of this permit, the contractor shall prepare a SWPPP, which would include the following BMPs:

- All ground-disturbing activities would be limited to the dry season (mid-May through mid-October) to the extent possible
- Vegetation would be left in place to the degree possible to reduce potential sedimentation
- All stockpiled material would be placed so that potential erosion is minimized
- Filter fabric, straw bales, and/or sediment basins would be used to reduce erosion and the potential for in-stream sedimentation
- Seeding and re-vegetation would be initiated as soon as possible (timed properly to coincide with fall/winter precipitation) after construction completion

Mitigation 1A–WQ2. Implementation of construction BMPs and development of a Spill Prevention Control and Countermeasures would minimize the risk of an uncontrolled spill and consequent contamination of the creek during project operations. The identification of staging areas for fueling and maintenance of heavy equipment would limit potential spills to designated areas where observation and cleanup could be readily accomplished. Should an oil or fuel spill occur during construction or maintenance activities, all work would cease immediately; the Central Valley RWQCB, CDFG, and USBR would be notified immediately if the quantity of the spill were above state and/or federal reporting requirements; and cleanup procedures would begin immediately.

1B: 4-month Bypass Alternative.
Mitigation 1B–WQ1. See Mitigation 1A–WQ1.

Mitigation 1B–WQ2. See Mitigation 1A–WQ2.

2A: 2-month Improved Ladder Alternative.
Mitigation 2A–WQ1. See Mitigation 1A–WQ1.

Mitigation 2A–WQ2. See Mitigation 1A–WQ2.

2B: 2-month with Existing Ladders Alternative.
Mitigation 2B–WQ1. See Mitigation 1A–WQ1.

Mitigation 2B–WQ2. See Mitigation 1A–WQ2.

3: Gates-out Alternative.
Mitigation 3–WQ1. See Mitigation 1A–WQ1.

Mitigation 3–WQ2. See Mitigation 1A–WQ2.

3.3.3 Groundwater and Groundwater Quality

Affected Environment

The depth to groundwater increases from the central portions of the basin toward the margins. Levels are usually highest in the spring and lowest in the fall.

The significant water-producing geologic units of the Sacramento Valley trough in the vicinity of RBDD, are the unconsolidated to semi-consolidated non-marine sediments. These units range in age from the Oligocene to Miocene epochs (13 to 25 million years ago) to recent time. Generally, unconfined groundwater exists in the relatively shallow alluvial fan, floodplain, and stream channel deposits of these units. It is partially confined in and under the flood-basin deposits and is confined beneath impervious clay and mudflow strata in the older Pleistocene and Pliocene (1.8 to 5 million years ago) formations.

The depth to groundwater increases from the central portions of the basin toward the margins. Levels are usually highest in the spring and lowest in the fall. Permeability values for the claybound soils range from 10^{-5} to 10^{-7} centimeters per second, indicating relatively impermeable strata (RWQCB, 1990).

Data Collection Activities. Groundwater elevation data and groundwater quality data have been collected at regular intervals since the early 1990s in the vicinity of RBDD. Specifically, quarterly monitoring is conducted at five established monitoring wells located within and adjacent to the Pactiv Corporation (Pactiv) paper sludge landfill (see Figure 3.3-1). Water level data and water quality data collected at the Pactiv landfill from 1996 through 1999 were summarized in the *Groundwater Monitoring Data Report* produced by URS Corporation in March 2000.

Locally, groundwater in the immediate vicinity of Lake Red Bluff is greatly affected by the annual filling of the lake.

CH2M HILL (2002) conducted an environmental site investigation from February through May 2002 specifically to address the area potentially impacted by the project alternatives. One of the objectives of this investigation was to characterize groundwater flow direction and groundwater quality. Data collected from this investigation and the results of prior monitoring were used to describe site conditions and evaluate potential impacts.

Groundwater Flow. Regionally, groundwater replenishment occurs through deep percolation of streamflow, precipitation, and applied irrigation water. Most of the recharge occurs in the north and east sides of the valley where precipitation is the greatest. Regionally, groundwater in the North Valley moves in the general direction of the Sacramento River. In the valley south of Sutter Buttes, the groundwater gradient is nearly flat, sloping toward the Sacramento River or the Delta; however, intensive development of groundwater has created pumping depressions along the east side from Marysville to Sacramento County and on the west side of Solano County.

Locally, groundwater in the immediate vicinity of Lake Red Bluff is greatly affected by the annual filling of the lake (groundwater area of influence). As discussed in Section 3.3.1, the filling of Lake Red Bluff coincides with the gates-in period from May 15 through September 15 of each year. This change in the surface elevation of the Sacramento River, which subsequently becomes Lake Red Bluff, corresponds to a change in the groundwater hydraulic gradient and direction. This gradient change is evidenced by recent groundwater elevation measurements presented in Tables 3.3-1 and 3.3-2 obtained during the gates-in and gates-out periods. These data are graphically displayed on Figures 3.3-12 and 3.3-13, which include estimated groundwater elevation contours and flow direction for the gates-in and gates-out scenarios, respectively.

Data collected from monitoring wells (MW) in the vicinity of RBDD during the gates-out periods from 1996 to 2001 indicate that the mean lateral hydraulic gradient ranges from 0.002 to 0.005 foot per foot generally to the north to northeast. The mean lateral hydraulic gradient during gates-in periods from 1996 to 2001 ranged from 0.002 to 0.008 foot per foot to the west to northwest. Data were collected during the 2002 site investigation during the week immediately following the lowering of the RBDD gates to determine the affect on groundwater flow gradients. These water level data were collected on May 17 and May 22, 2002, two and seven days after lowering the gates. As expected, much steeper groundwater flow gradients of 0.024 and 0.01 foot per foot, with flows generally to the west, were observed during this period.

TABLE 3.3-1
Groundwater Elevation Measurements during Gates-in Period

	Monitoring Well Piezometric Elevations (feet above mean sea level)					
Date	**MW-1**	**MW-2**	**MW-3**	**MW-4**	**MW-5**	**River Level**
Apr-90	252.39	252.43	243.38	248.13	251.25	252.6
Jun-96	252.52	252.41	248.01	--	251.84	252.58
Sep-96	252.51	252.42	247.51	--	251.35	252.55
Jun-97	252.45	252.37	247.92	--	251.51	252.56
Jun-98	252.62	252.55	250.63	--	253.49	252.64
Jun-99	252.49	252.39	248.65	--	252.71	252.51
May-00	252.43	252.32	247.92	250.65	252.36	252.46
Aug-00	252.48	252.33	247.58	249.47	252.14	252.48
May-01	252.4	252.29	245.87	--	250.75	252.54
Aug-01	252.41	252.28	246.73	247.1	251.41	252.4
16-May-02	250.19	249.52	238.76	244.8	248.17	--
17-May-02	251.94	251.94	239.39	245.06	248.87	--
22-May-02	252.3	252.22	244.78	245.78	249.98	--
11-Jul-02	--	--	--	245.27	248.65	--
Average	**252.24**	**252.11**	**245.93**	**247.03**	**251.03**	**252.53**

TABLE 3.3-2
Groundwater Elevation Measurements during Gates-out Period

	Monitoring Well Piezometric Elevations (feet above mean sea level)					
Date	**MW-1**	**MW-2**	**MW-3**	**MW-4**	**MW-5**	**River Level**
Dec-89	239.93	243.14	244.3	248.1	247.9	240.2
Mar-96	241.99	243.85	243.84	--	249.08	241.58
Dec-96	242.77	243.96	241.92	--	247.24	243.09
Mar-97	241.41	243.27	242.06	--	248.01	241.21
Sep-97	241.54	243.16	242.12	--	247.21	241.38
Dec-97	242.03	243.5	239.64	--	247.53	241.85
Mar-98	242.84	244.99	246.79	--	251.49	242.53
Sep-98	242	243.82	243.63	--	247.91	241.76
Dec-98	243.41	244.58	246.64	--	248.47	243.34
Mar-99	245.32	245.35	244.47	--	250.41	246.15
Sep-99	241.66	243.23	243.31	--	248.52	243.87
Dec-99	241.25	242.83	239.65	--	246.84	241.1
Jan-00	242.6	244.43	245.07	--	250.34	242.3
Nov-00	241.18	242.67	239.4	--	246.84	241
Feb-01	242.73	243.68	240.3	--	248.04	242.78
Nov-01	241.17	241.99	237.82	243.07	245.08	241.15
15-Mar-02	241.85	242.99	241.04	245.27	246.49	--
Average	**242.10**	**243.61**	**242.47**	**245.48**	**248.08**	**242.21**

Data indicate that the surface elevation of the Sacramento River increases approximately 10 feet during the gates-in period.

The data above indicate that the surface elevation of the Sacramento River increases approximately 10 feet during the gates-in period. This difference in surface elevation is consistent with the difference in groundwater elevation observed in MW-1 (located about 100 feet south of the riverbank). The influence of the river level is less discernable at MW-5 (1,300 feet south of the riverbank) where an increase of about 3 feet in piezometric surface elevation is observed during the gates-in period.

Groundwater Quality. ~~Groundwater quality is generally excellent in the region.~~ An analysis of groundwater conditions conducted in 1991 indicated that, total dissolved solids (TDS) in the Red Bluff area were classified as less than 200 mg/L, which is below U.S. Environmental Protection Agency (EPA) and SWRCB Maximum Contaminant Levels (MCL) for drinking water. ~~No evidence of elevated levels of boron, nitrates, arsenic, or selenium has been found in the groundwater in the Red Bluff area.~~

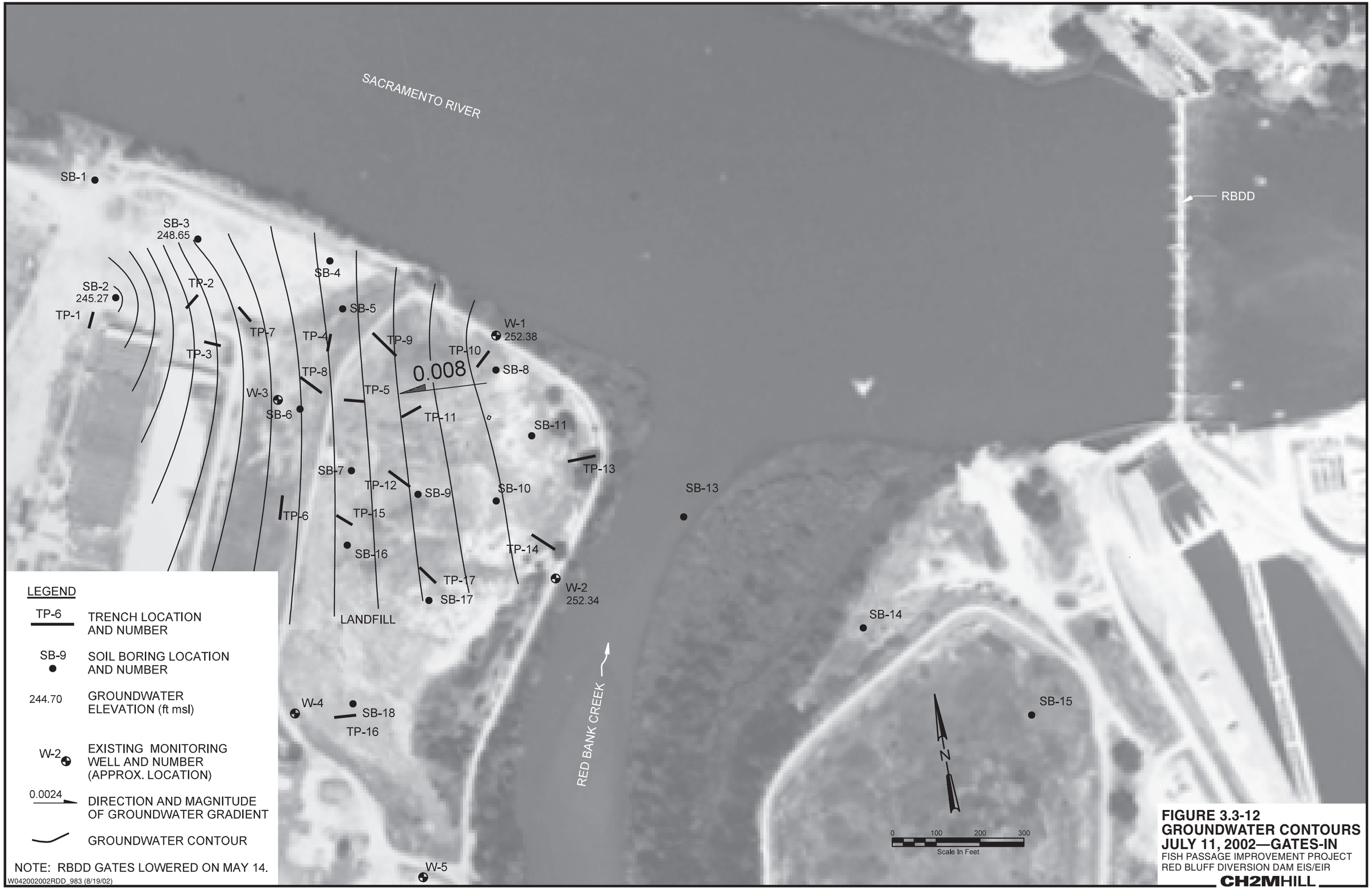

FIGURE 3.3-12
GROUNDWATER CONTOURS
JULY 11, 2002—GATES-IN
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

CH2MHILL

SACRAMENTO RIVER

RBDD

SB-1

SB-3
237.75

SB-4

SB-2
244.70

TP-2

SB-5

TP-1

TP-7

TP-4

TP-9

W-1
241.35

TP-10

TP-3

SB-8

TP-8

TP-5

W-3
241.04

SB-6

TP-11

SB-11

SB-7

TP-12

SB-9

TP-13

SB-13

SB-10

TP-6

TP-15

0.0034

SB-16

TP-14

W-2
242.99

TP-17

LANDFILL

SB-17

SB-14

RED BANK CREEK

SB-18

W-4
245.27

TP-16

SB-15

N

0 100 200 300
Scale in Feet

W-5
246.49

LEGEND

TP-6 — TRENCH LOCATION AND NUMBER

SB-9 ● — SOIL BORING LOCATION AND NUMBER

244.70 — GROUNDWATER ELEVATION (ft msl)

W-2 ⊕ — EXISTING MONITORING WELL AND NUMBER (APPROX. LOCATION)

0.0024 — DIRECTION AND MAGNITUDE OF GROUNDWATER GRADIENT

GROUNDWATER CONTOUR

NOTE: RBDD GATES LOWERED ON MAY 14.

W042002002RDD_982 (8/19/02)

FIGURE 3.3-13
GROUNDWATER CONTOURS
MARCH 15, 2002—GATES-OUT
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

CH2MHILL

A site investigation and groundwater sampling program conducted by CH2M HILL in 2002 indicated the presence of toluene in groundwater near the Mill Site. Groundwater samples were analyzed for a suite of organic and inorganic compounds. However, analytical results from the groundwater samples revealed that toluene concentrations are well below the EPA's MCL of 150 micrograms per liter (µg/L) for toluene in drinking water. All other volatile organic compounds, semivolatile organic compounds, polychlorinated biphenyls, diesel range total petroleum hydrocarbons, and motor oil were below detection limits.

Trace concentrations of barium, nickel, vanadium, and chromium were also detected in groundwater at the Mill Site. It is uncertain if the metals concentrations represent background (natural) conditions or if the metals concentrations originate from the landfill. However, it should be noted that these concentrations are all well below EPA's Preliminary Remediation Goals (PRG) for cleaning up industrial sites.

Soil Contamination. CH2M HILL (2002) advanced 14 soil borings and completed 8 test pits (see Figure 3.3-12) within the project site to assess the quality of soils that may be impacted as the result of project construction. In general, soil was found to be free of significant contamination throughout the site. However, motor oil was detected in several soil samples, chromium was found to exceed state hazardous waste criteria in one soil sample, and polychlorinated biphenyls were detected above the EPA Region IX industrial PRG in one sample.

The only organic compound detected in groundwater samples collected from the site was toluene.

With the exception of the high chromium found in one of the test pits at the Mill Site (TP-12), all other sample locations contained metals below their respective PRG values. Contaminants such as volatile and semivolatile organic compounds were below method reporting limits in all samples analyzed.

In general, soil was found to be free of significant contamination throughout the site.

Mineral Resources. Mineral resources in the vicinity of the site include two gravel and sand quarries. The Red Bluff Quarry is located approximately 7 miles south of the site, and Valley Rock Products is located in Corning, approximately 27 miles south of the site. This project is not anticipated to impact quarry operations at these two locations.

Water Supply Wells. Three water supply wells were identified in the project vicinity by Woodward-Clyde (1989). Two of these wells are on the Pactiv property (owned by Meyer-Crest, Ltd., also known as Meyer Motels) and a third on the Meyer Motels property. Pactiv operates two water supply wells to supply drinking water and process water for its manufacturing plant (URS Corporation, 2000). The two wells were installed between 1956 and 1960, and each pumps approximately 1,200 gallons per minute (gpm). The wells operate, one at a time, on a 24-hour basis. The two wells are completed at about 600 feet below ground surface (URS Corporation, 2000).

Environmental Data Resources, Inc., (EDR) searched for publicly available information on wells within a 0.5-mile radius of the Pactiv property (EDR, 2000). EDR did not identify any active wells in the search area. The fact that the two Pactiv water supply wells were not identified by EDR suggests that the databases and information searched may not include records on some older wells.

Environmental Consequences

Significance Criteria. Standards of significance represent the thresholds that were used to identify whether an impact would be potentially significant. These criteria are based on Appendix G of the *CEQA Guidelines* and professional judgment with regard to the study area. Impacts on groundwater resources would be significant if they would result in the following:

- Cause any water quality standards or waste discharge requirements to be exceeded.
- 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 pre-existing nearby wells would drop to a level that would not support existing land uses or planned uses for which permits have been granted).
- Otherwise substantially degrade water quality.

No Action Alternative

No changes to hydrology or surface-water management would occur. Gates would be operated during the current 4-month gates-in period. Construction activity would be limited to the installation of the fourth pump at RPP. No other construction activity would occur as a result of the No Action Alternative.

1A: 4-month Improved Ladder Alternative

Construction-related Impacts.

Impact 1A–GW1: Contaminants. Soil contamination at the Pactiv site represents potential impacts to local groundwater resources if contaminated soil is allowed to come in contact with groundwater as a result of project construction activities. Additionally, leaching of soluble or mobile contaminants from soil to groundwater may occur over time if contaminated soil is stockpiled onsite for a long period of time or relocated to a disposal area onsite, through infiltration and other transport processes.

Groundwater quality could be significantly impacted if soil contaminants come in contact with groundwater at the Mill Site.

Operations-related Impacts.

Impact 1A–GW2: Groundwater Quality. No impacts involving groundwater are expected from the operations of Alternative 1A.

There would be no operations-related impacts on groundwater; therefore, no mitigation is required.

1B: 4-month Bypass Alternative

Construction-related Impacts.

Impact 1B–GW1: Contaminants. Impacts on groundwater from construction under Alternative 1B would be the same as those identified for Alternative 1A (see Impact 1A–GW1).

Groundwater quality could be significantly impacted if soil contaminants come in contact with groundwater at the Pactiv site.

Operations-related Impacts.

Impact 1B–GW2: Groundwater Quality. Impacts on groundwater quality from operations under Alternative 1B would be the same as those identified for Alternative 1A (see Impact 1A–GW2).

There would be no operations-related impacts on groundwater; therefore, no mitigation is required.

2A: 2-month Improved Ladder Alternative

Construction-related Impacts.

Impact 2A–GW1: Contaminants. Impacts on groundwater from construction under Alternative 2A would be the same as those identified for Alternative 1A (see Impact 1A–GW1).

Groundwater quality could be significantly impacted if soil contaminants come in contact with groundwater at the Pactiv site.

Operations-related Impacts.

Impact 2A–GW2: Groundwater Quality. Impacts on groundwater quality associated with varying the periods of time the RBDD gates would be insignificant. Groundwater in the vicinity is generally clean and does not present a significant threat to surface-water quality regardless of gradient and flow direction.

The reduced gates alternative would result in a reduction in the amount of time Lake Red Bluff would be formed. This would ultimately change seasonal elevations of groundwater in the project area.

In the vicinity of the project, two water supply wells were identified, both on the Pactiv property. The existence of these wells do not appear to have a significant affect on the flow direction or gradient of the shallow groundwater system (URS Corporation, 2000). These are deep wells and are located between 1,400 and 2,000 feet from the banks of the Sacramento River. A deep groundwater aquifer supplies these wells

with up to 1,200 gpm year-round, regardless of the RBDD gates position.

Additional wells could exist in the vicinity of Lake Red Bluff that have not been identified during the development of this EIS/EIR. Wells that depend on the additional groundwater recharge and head provided by Lake Red Bluff could require alternate water supplies if the gates remain out during the dry season. However, because the gates are currently out most of the year, wells in the aquifer areas influenced by the filling of Lake Red Bluff are probably already designed to supply water regardless of gates position.

The amount of groundwater available for beneficial use will not be significantly impacted by changes in gate operations.

2B: 2-month with Existing Ladders Alternative

Construction-related Impacts.

Impact 2B–GW1: Contaminants. Impacts on groundwater from construction under Alternative 2B would be the same as those identified for Alternative 1A (see Impact 1A–GW1).

Groundwater quality could be significantly impacted if soil contaminants come in contact with groundwater at the Pactiv site.

Operations-related Impacts.

Impact 2B–GW2: Groundwater Quality. Impacts on groundwater quality from operations under Alternative 2B would be the same as those identified for Alternative 2A (see Impact 2A–GW2).

The amount of groundwater available for beneficial use will not be significantly impacted by changes in gate operations.

3: Gates-out Alternative

Construction-related Impacts.

Impact 3–GW1: Contaminants. Impacts on groundwater from construction under Alternative 3 would be the same as those identified for Alternative 1A (see Impact 1A–GW1).

Groundwater quality could be significantly impacted if soil contaminants come in contact with groundwater at the Pactiv site.

Operations-related Impacts.

Impact 3–GW2: Groundwater Quality. Impacts on groundwater quality from operations under Alternative 3 would be the same as those identified for Alternative 2A (see Impacts 2A–GW2).

The amount of groundwater available for beneficial use will not be significantly impacted by changes in gate operations.

Mitigation

This section discusses mitigations for each significant impact described in Environmental Consequences.

1A: 4-month Improved Ladder Alternative.
Mitigation 1A–GW1. In the event that contaminated soil is encountered, the contractor shall follow and comply with all applicable federal, state, and local regulations. Soil should be removed immediately from the project area and taken to an appropriate disposal area. If soil should be temporarily stockpiled in the project area, an impermeable liner should be used to prevent direct contact with non-contaminated areas.

The following mitigation measures would reduce the potential for contamination in groundwater in the proposed project area to a less than significant level:

- Construction contractor shall obtain a General Construction Storm Water Permit, to comply with Clean Water Act Section 402(b) for construction of all facilities. As part of this permit, the contractor shall prepare an SWPPP, which will include the following BMP:
  - All ground-disturbing activities would be limited to the dry season (mid-May through mid-October) to the extent possible.
  - All stockpiled material would be placed so that potential erosion and contamination is minimized. Methods shall include, but not be limited to:
    - Covering the stockpile with plastic sheeting or tarps
    - Installing a berm around the stockpile to prevent runoff from leaving the area
    - Plant temporary vegetation if stockpiled material would be kept onsite for a longer duration of time

4B: 4-month Bypass Alternative.
Mitigation 1B–GW1. See Mitigation 1A–GW1.

2A: 2-month Improved Ladder Alternative.
Mitigation 2A–GW1. See Mitigation 1A–GW1.

Mitigation 2A–GW2. If it is determined that wells in the project area are affected by the seasonal fluctuation of Lake Red Bluff, these wells could be relocated or extended to greater depths to meet continuous or seasonal water demands. This would reduce the impact to a less than significant level.

2B: 2-month with Existing Ladders Alternative.
Mitigation 2B–GW1. See Mitigation 1A–GW1.

Mitigation 2B–GW2. See Mitigation 2A–GW2.

3: Gates-out Alternative.

Mitigation 3–GW1. See Mitigation 1A–GW1.

Mitigation 3–GW2. See Mitigation 2A–GW2.

3.4 Biological Resources

This section describes existing conditions within the project study area regarding biological resources including special-status wildlife species, special-status plant species, and special or unique habitats.

3.4.1 Affected Environment

Wildlife Habitat and Wildlife

The project area consists of approximately 100 acres near and adjacent to RBDD. RBDD spans the Sacramento River near Red Bluff, California, and the project area consists of land on both sides of the Sacramento River. The area is predominantly agricultural or formerly agricultural. The few areas of native vegetation generally occur adjacent to or near the river corridor, in old river meanders, or in natural low-lying wet areas. The project site contains seven primary habitats:

The project area consists of approximately 100 acres near and adjacent to RBDD. RBDD spans the Sacramento River near Red Bluff, California, and the project area consists of land on both sides of the Sacramento River.

- Riparian
- Freshwater marsh
- Mixed woodland
- Restored
- Annual grassland
- Disturbed
- Parkland

Each of these habitats and the associated wildlife is described below.

Riparian Habitat. Riparian forests are a special habitat type represented by transitional areas between aquatic and upland zones, encompassing sharp environmental gradients, unique ecological processes, and diverse communities (Naimen et al., 1993). Riparian zones provide important resources to both riparian species and upland species. Species diversity is typically higher in riparian zones than in upland vegetated zones, and the diversity of wildlife species using these zones is related to habitat diversity.

Riparian habitat along the Sacramento River has been substantially reduced as a result of flood control, water supply projects, and urban and agricultural development that have altered the native riparian landscape. Remaining areas of riparian habitat generally consist of narrow bands of vegetation along levee banks. The largest and most significant tract of riparian forest remaining along the Sacramento River is a stretch between Chico Landing and Red Bluff. Maintenance of riparian communities along the Sacramento River is dependent upon the occurrence of appropriate flow regimes.

The immediate project area contains about 26 acres of riparian habitat. Most of the riparian habitat occurs along Red Bank Creek, with additional narrow bands located along the mainstem of the Sacramento River.

The immediate project area contains about 26 acres of riparian habitat. Most of the riparian habitat occurs along Red Bank Creek, with additional narrow bands located along the mainstem of the Sacramento River (Figure 3.4-1). Primary plant species are cottonwoods *(Populus fremontii*), willows (*Salix* sp.), and sycamores (*Platamus racemosa*). The riparian zone also contains many non-native species, including star thistle, sticky weed, tree-of-heaven, pyracantha, and pampas grass. As with much of the Sacramento River, blackberries are found in abundance on the banks and levees.

The campground on the north (left) bank of the Sacramento River has retained some mature sycamores, but shrubs and native forbs or grasses are largely absent. Blackberry (*Rubus* sp.) bushes also are common in association with these riparian plant species.

Nine elderberry shrubs and/or groups of shrubs occur in riparian habitat in the project area on both the left and right banks of the Sacramento River (Figure 3.4-2). Five of the shrubs or groups of shrubs occur in the project footprint.

In addition to the riparian habitat in and adjacent to the dam site, small amounts of riparian habitat occur adjacent to Lake Red Bluff. This is a seasonal lake created when the gates at RBDD are down. Under current operation, the gates at RBDD are down from mid-May to mid-September. The lake is formed as the areas adjacent to the current riverbed and an old river meander are inundated. Isolated cottonwood trees and riparian shrubs such as willows and blackberry occur in a narrow band on the margins of the lake. The portion of the lake that is seasonally inundated lacks vegetation. A number of elderberry shrubs occur on the elevated riparian area west of the dam that becomes an island when gates are in the water, and is accessible by land when gates are out of the water. These are not in the project footprint (Figure 3.4-2). Many species of terrestrial wildlife use the remaining strips of riparian vegetation in the Sacramento Valley for foraging, cover, nesting, and roosting. Wildlife associated with riparian areas include a variety of songbirds and raptors, and mammals such as muskrat (*Ondatra zibethica*), otter (*Lutra canadensis*), mink (*Mustela vison*), and beaver (*Castor canadensis*). Special-status species associated with riparian habitat along the Sacramento River include, among others, Swainson's hawk (*Buteo Swainsoni*), bald eagle (*Haliaectus leucocephalus*), bank swallow (*Riparia riparia*), western yellow-billed cuckoo (*Coccyzus americanus occidentalis*), and valley elderberry longhorn beetle (VELB) (*Desmocerus californicus dimorphus*).

The value of the riparian habitat in the project area to wildlife is limited because it occurs as small, isolated patches and has limited species diversity. In addition, riparian habitat in the project area receives recreational use or is adjacent to industrial lands that collectively further limit

RED BLUFF
DIVERSION DAM

Legend

- DISTURBED/RUDERAL
- GRASSLAND
- MARSH
- MIXED WOOD
- PARKLAND
- RESTORED HABITAT
- RIPARIAN

N

400 200 0 400
Feet

FIGURE 3.4-1
HABITAT TYPES IN PROPOSED PROJECT AREA
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

CH2MHILL

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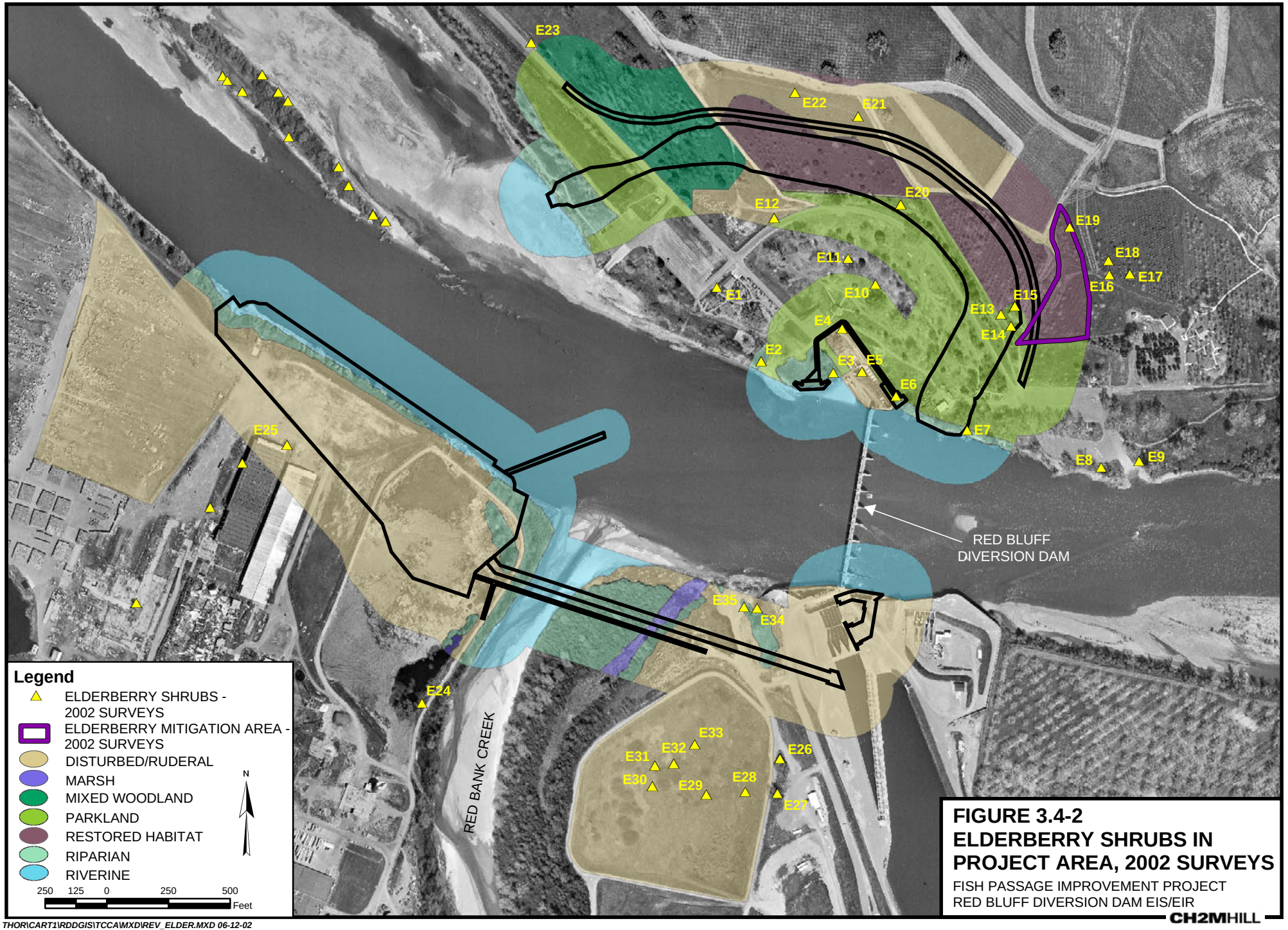

FIGURE 3.4-2
ELDERBERRY SHRUBS IN PROJECT AREA, 2002 SURVEYS

FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

CH2MHILL

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the value of riparian habitat for wildlife. As a result of these conditions and area disturbance, sensitive species are unlikely to occur in the project area. Nonetheless, diverse wildlife species are using the area.

Freshwater Marsh Habitat. Historically, the Central Valley contained about 4 million acres of freshwater marshes. About 1.5 million acres in the Delta and the Tulare Basin were permanent marshes, and the remaining 2.5 million acres were seasonal marshes created by winter rains and spring snowmelt from the Sierra Nevada. Today, about 300,000 acres (or 13 percent of the historical acreage) of marshlands remain; 100,000 acres are publicly owned by state and federal refuges, and 200,000 acres are privately owned (USBR, 1989).

Freshwater marshes are characterized by specialized plant species that require moist soils and inundation but are tolerant of periodic drying. Species composition within and among marshes varies according to hydroperiod, soils, water chemistry, and climate, among other factors. The outermost margins of marshes are saturated and inundated only periodically. Moist-soil plant species such as big leaf sedge (*Carex amplifolia*), baltic rush (*Juncus balticus*), redroot (*Cyperus erythrorhizos*), and nutgrass (*Cyperus esculentus*) inhabit these portions of wetlands. On wetter sites or in portions of marshes with deeper or more regular inundation, cattail (*Typha* spp.), tule (*Scirpus* spp.), bulrush (*Scirpus* spp.), and arrowhead (*Sagitaria* spp.) species dominate. Thus, the characteristics of freshwater marshes are intimately linked with the marsh's water regime.

The project site supports about 2.1 acres of freshwater marsh habitat in two distinct areas.

The project site supports about 2.1 acres of freshwater marsh habitat in two distinct areas (Figure 3.4-1). The larger area (1.56 acres) is located in a low-lying band parallel to the right bank of Red Bank Creek and is adjacent to a disturbed area located just southwest of RBDD. The second and much smaller area (0.45 acre) occurs on the west side (left bank) of Red Bank Creek in the adjacent industrial area. This is an artificially created marsh, established from the drainage area of the Pactiv plant. Plant species in both marshes consist of cattail, willow, and some patches of spike rush (*Scirpus acutus*). The larger marsh adjacent to Red Bank Creek likely meets the criteria of jurisdictional wetlands under the Clean Water Act. Because of the artificial origin of the marsh on Pactiv property, this smaller marsh is not likely jurisdictional. Jurisdictional waters are discussed further in Chapter 5.

Freshwater marsh habitats are among the most productive wildlife habitats in California. They provide food, cover, and water for more than 160 species of birds, and numerous mammals, amphibians, and reptiles. Wildlife commonly found in this habitat include waterfowl, songbirds, and a variety of amphibians and rodents. Several species of raptors often visit marshes while foraging. The marsh habitat in the project area provides little wildlife value because of its small size and

location adjacent to highly disturbed areas. As a result, the diversity and abundance of wildlife using the marshes in the project area is low.

The project area contains one area best characterized as mixed woodland. This 7.5-acre area occurs as an isolated block northwest of RBDD adjacent to the road entering the campground.

Mixed Woodland Habitat. The project area contains one area best characterized as mixed woodland. This 7.5-acre area occurs as an isolated block northwest of RBDD adjacent to the road entering the campground (Figure 3.4-1). Vegetation consists of a mix of ponderosa pine *(Pinus ponderosa)*, Oregon white oak *(Quercus garryanus)*, and sycamore. Larger trees are clustered in two general areas, with shrubs and grasses covering the remainder of the area. It is surrounded by disturbed land, parkland, grassland, and restored habitat.

The large trees and structural complexity added by shrubs and smaller trees make this area potentially attractive to a variety of wildlife, including ground squirrel (*Spermophilus beecheyi*), red fox (*Vulpes vulpes*), western fence lizard (*Sceloporus occidentalis)*, and many bird species including red-tailed hawk (*Buteo jamaicencis*), scrub jay (*Aphelocoma californica*), California quail (*Callipepla californica*), oak titmouse (*Baeolophus inornatus*), Bewick's wren (*Thryomanes bewickii*), bushtit (*Psaltriparus minimus*), and acorn woodpecker (*Melanerpes formicivorus*). However, the area's small size, current isolation, and proximity to human activity reduce its wildlife habitat value. As the adjacent areas of restored habitat develop, the value of mixed woodland for wildlife will increase as a larger, contiguous block of woodland vegetation develops.

Restored habitat comprises about 64 acres of the project site.

Restored Habitat. Restored habitat consists of mitigation plantings to create oak woodland and riparian forest habitat. This habitat comprises about 64 acres of the project site on the north side of the river adjacent to the campground (Figure 3.4-1). Plants used in the mitigation sites consist of oak, sycamore, pine, and cottonwood trees. Restoration areas have an orchard-like appearance, as they are planted in rows and are either currently irrigated or were previously irrigated. These mitigation sites have been established for less than 10 years. As the plants develop, the restoration sites will augment the existing mixed woodland habitat. A number of elderberry shrubs have been planted at the restoration site. Three elderberry shrub groupings occur in the project area (Figure 3.4-2), with one grouping occurring in the project footprint. The restoration sites currently provide only limited habitat value for wildlife because of their young age. Species using open habitats and early successional-stage riparian habitat probably use these areas. Such species could include ground squirrel, red fox, scrub jay, western fence lizard, and red-tailed hawk. As the restoration sites develop, they will provide habitat for species associated with riparian habitat and oak woodland.

Annual Grassland Habitat. Annual grassland habitats are open habitats composed primarily of annual grass species. Many of these species also occur as understory plants in valley oak woodland and other habitats.

Introduced annual grasses are the dominant plant species in this habitat and include wild oat (*Avena fatua*), soft chess (*Bromus mollis*), ripgut brome (*Bromus diandrus*), wild barley (*Hordeum marinum* sp. *cussoneanum*), and foxtail fescue (*Festuca megalura*). Common forbs include broadleaf filaree (*Erodium moschatum*), redstem filaree (*Erodium cicutarium*), turkey mullein (*Eremocarpus setigerus*), clover (*Trifolium* sp.), and many others. California poppy (*Eschscholzia californica*) is often found in this habitat.

Most of the project site consists of disturbed areas. About 79 classified acres of disturbed habitat occurs on both sides of the Sacramento River.

Wildlife species that can occur in annual grasslands are the western fence lizard, common garter snake (*Thamnophis sirtalis*), western rattlesnake (*Crotalus viridis*), black-tailed jackrabbit (*Lepus californicus*), California ground squirrel, Botta's pocket gopher (*Thomomys bottae*), western harvest mouse (*Reithrodontomys megalotis*), California vole (*Microtus californicus*), badger (*Taxidea taxus*), and coyote (*Canis latrans*). Common birds that use grassland habitat include horned lark (*Eremophilia alpestris*), western meadowlark (*Sturnella neglecta*), turkey vulture (*Cathartus aura*), northern harrier (*Circus cyaneus*), American kestrel (*Falco sparverius),* white-tailed kite (*Elanus leucurus*), and prairie falcon (*Falco mexicanus*).

Annual grassland occurs on about 9.25 acres of the project area and is adjacent to the mixed woodland habitat (Figure 3.4-1). Star thistle (*Centaurea solstitialis*) and other exotic grasses have invaded the grassland and limit its value to wildlife. Three elderberry shrubs (one with a stem greater than 3 inches) occur in grassland habitat within the project area (Figure 3.4-2), but outside of the project footprint (Figure 3.4-2).

Disturbed Habitat. Most of the project site consists of disturbed areas. Disturbed habitat occurs on both sides of the Sacramento River (Figure 3.4-1). About 79 acres are classified as disturbed habitat. The disturbed areas were created as a result of activities associated with former agricultural use, the mitigation plantings (i.e., plowed fields), long-term disturbance related to maintenance of RBDD, pre-dam land uses, and long-term disturbance related to the Mill Site. Of the 79 acres, 51 acres are bare ground, 13 acres are dominated by star thistle, and 15 acres are dominated by blackberry bushes. Less than 1 acre is covered by a riprap pile, which is remnant dam-building material.

Habitat value of disturbed areas is very low. In areas where blackberries occur, the potential for providing habitat for small rodents and birds is greater. The riprap pile also could be used by small mammals and reptiles. Sites devoid of vegetation are little used by wildlife. The abandoned catchment basin on the west side Red Bank Creek, while dominated by ruderal species, does contain six elderberry shrubs that could provide habitat for VELB (Figure 3.4-2).

Parkland comprises approximately 38 acres on the north side of the Sacramento River adjacent to RBDD.

Parkland Habitat. Parkland comprises approximately 38 acres on the north side of the Sacramento River adjacent to RBDD (Figure 3.4-1). Ornamental shrubs and trees have been planted, including pines and native shrubs. A number of large, mature sycamore trees have been retained in the park, predominantly in and adjacent to the parking lots. Aside from a few ornamental shrubs, understory vegetation consists of a grassy lawn. Six elderberry shrubs or groups of elderberry shrubs occur in parkland habitat (Figure 3.4-2).

Habitat value of the park is low because of the high level of human use, low plant species diversity, and limited vegetation structural diversity. As a result, wildlife species using the park consist of those tolerant of human activity such as gray squirrels (*sciurus griseus*), scrub jays, and crows (*corvus* sp.). The borders of the park could provide habitat used by deer and a greater variety of rodent and bird species.

Special-status Species

For the purposes of this evaluation, special-status species include species that are (1) listed as threatened or endangered by the state or federal governments, (2) proposed or petitioned for federal threatened or endangered status, (3) state or federal candidates for threatened or endangered status, (4) identified by USFWS as species of concern, or (5) identified by CDFG as Species of Special Concern. Special-status plant species are vascular plants that are (1) designated as rare, threatened, or endangered by the state or federal governments; (2) proposed for rare, threatened, or endangered status; (3) state or federal candidate species; (4) listed as species of concern by USFWS; or (5) included on the California Native Plant Society (CNPS) List 1A, 1B, or 2 (Skinner and Pavlik, 1994).

Special-status species potentially occurring in the project area were identified by querying the California Natural Diversity Database (CNDDB) and the CNPS Electronic Inventory, reviewing a USFWS species list for the project (USFWS, 2000; see Appendix C), discussing the subject with resource agency personnel, and performing field surveys. Table 3.4-1 lists the 58 special-status wildlife species and 15 special-status plant species that were identified as having the potential to occur in or near the project area, the status of each species, general habitat associations, and the habitat types in the project area where they have the potential to occur (all terms are defined at the bottom of the table). Appendix D provides additional information on the natural history and occurrence of special-status species potentially occurring in the project area.

TABLE 3.4-1
Special-status Species

Species	Status	General Habitat Association	Project Habitat
Birds			
American Bittern *Botaurus lentiginosus*	Federal – SC State – none	Freshwater and brackish wetlands with dense vegetation	Freshwater Marsh
Black-crowned Night Heron *Nycticorax nycticorax*	Federal – SC State – none	Freshwater and brackish wetlands, occasionally rice fields	Freshwater Marsh
White-faced Ibis *Plegadis chihi*	Federal – SC State – CSC	Freshwater wetlands and irrigated fields	Freshwater Marsh
Aleutian Canada Goose *Branta canadensis leucopareia*	Federal – D State – none	Freshwater wetlands and agricultural fields	Freshwater Marsh
Cooper's Hawk *Accipiter cooperii*	Federal – none State – CSC	Woodlands, riparian forests, and agricultural fields	Mixed Woodland, Riparian, Restored
Sharp-shinned Hawk *Accipiter striatus*	Federal – none State – CSC	Woodlands, riparian forests, and shrub thickets	Mixed Woodland, Riparian, Restored
Northern Goshawk *Accipter gentilis*	Federal – SC State – CSC	Montane conifer forests and woodlands	Mixed Woodland, Restored
Golden Eagle *Aquila chrysaetos*	Federal – none State – CSC; FP	Grasslands, open woodland, chaparral, wetlands, and agricultural areas	Annual Grassland, Mixed Woodland, Riparian, Restored
Ferruginous Hawk *Buteo regalis*	Federal – SC State – CSC	Grasslands and agricultural fields	Annual Grassland
Swainson's Hawk *Bueto swainsoni*	Federal – none State – T	Mature riparian forests, oak groves, and agricultural fields	Riparian, Restored
Northern Harrier *Circus cyaneus*	Federal – none State – CSC	Marshes, grasslands, and agricultural fields	Freshwater Marsh, Annual Grassland
White-tailed Kite *Elanus leucurus*	Federal – SC State – CSC; FP	Grasslands, oak savannas and woodl-ands, and open riparian areas and agricultural fields	Annual Grassland, Mixed Woodland, Restored
Bald Eagle *Haliaeetus leucocephalus*	Federal – T State – E; FP	Open water habitats, lakes, rivers, and marshes	Freshwater Marsh, River
Osprey *Pandion haliaetus*	Federal – none State – CSC	Open water habitats, lakes, and rivers	River
Prairie Falcon *Falco mexicanus*	Federal – none State – CSC	Grasslands, agricultural fields, river embankment, and open savannas	Annual Grassland
Peregrine Falcon *Falco peregrinus anatum*	Federal – D State – E	Wetlands, lakes, rivers, grasslands, and agricultural fields	Freshwater Marsh, Annual Grassland, River
Black Tern *Chlidonias niger*	Federal – SC State – CSC	Freshwater lakes and wetlands	Freshwater Marsh
Western Yellow-billed Cuckoo *Coccyzus americanus occidentalis*	Federal – FC State – E	Riparian forests with abundant canopy cover of willow and cottonwood	Riparian
Short-eared Owl *Asio flammeus*	Federal – SC State – CSC	Wetlands, wet meadows, grasslands, open shrublands, savannas, and agricultural fields	Freshwater Marsh, Annual Grassland
Western Burrowing Owl *Athene cunicularia hypougea*	Federal – SC State – CSC	Grasslands, pastures, agricultural fields, road embankments, and near open urban areas	Annual Grassland, Disturbed
Vaux's Swift *Chaetura vauxi*	Federal – SC State – CSC	Mixed oak and conifer woodlands, forage over grasslands, lakes, and streams	Mixed Woodland, Restored, Annual Grassland
Black Swift *Cypseloides niger*	Federal – SC State – CSC	Coastal bluffs and mountain canyons	None
Rufus Hummingbird *Selasphorus rutus*	Federal – SC State – none	Riparian areas, open woodlands, chaparral, orchards, and gardens	Riparian, Mixed Woodland, Restored, Parkland

TABLE 3.4-1
Special-status Species

Species	Status	General Habitat Association	Project Habitat
Lewis' Woodpecker *Melanerpes lewis*	Federal – SC State – none	Open woodlands, savannas, and riparian areas	Mixed Woodland, Restored, Riparian
Olive-sided Flycatcher *Contopus borealis*	Federal – SC State – none	Montane conifer forests and woodlands	Mixed Woodland
Little Willow Flycatcher *Empidonax traillii brewsteri*	Federal – none State – E	Montane riparian areas and wet meadows, in dense willows	Riparian
California Horned Lark *Eremophila alpestris actia*	Federal – none State – CSC	Grasslands and open woodlands	Annual Grassland, Restored
Purple Martin *Progne subis*	Federal – none State – CSC	Grasslands, wet meadows, wetlands, woodlands, and riparian areas	Annual Grassland, Freshwater Marsh, Mixed Woodland, Riparian
Bank Swallow *Riparia riparia*	Federal – none State – T	Riparian areas, nest in friable soils of vertical streambanks	Riparian
Bewick's Wren *Thryomanes bewickii*	Federal – SC State – none	Chaparral, woodlands, conifer forests, and riparian areas	Mixed Woodland, Riparian, Restored
Loggerhead Shrike *Lanius ludovicianus*	Federal – SC State – CSC	Grasslands, savannas, and chaparral	Annual Grassland
Tri-colored Blackbird *Agelaius tricolor*	Federal – SC State – CSC	Wetlands in dense emergent vegetation	Freshwater Marsh
Grasshopper Sparrow *Ammodramus savavvarum*	Federal – SC State – none	Grasslands and hay fields	Annual Grassland
Lark Sparrow *Chondestes grammacus*	Federal – SC State – none	Savannas, chaparral, foothill woodlands, and conifer forests	Mixed Woodland, Restored
Hermit Warbler *Dendroica occidentalis*	Federal – SC State – none	Montane conifer forests, woodlands	Mixed Woodland
Yellow Warbler *Dendroica petechia*	Federal – none State – CSC	Riparian areas	Riparian
Yellow-breasted Chat *Icteria virens*	Federal – none State – CSC	Riparian areas	Riparian
Yellow-headed Black Bird *Xanthocephalus xanthocephalus*	Federal – none State – none	Wetlands in dense emergent vegetation	Freshwater Marsh
Lawrence's Goldfinch *Carduelis lawrencei*	Federal – SC State – none	Foothill woodlands	Mixed Woodland
Reptiles			
Western Pond Turtle *Clemmys marmorata*	Federal – SC State – CSC	Wetlands, ponds, irrigation ditches, rivers, and streams	Freshwater Marsh, Riparian, River
Giant Garter Snake *Thamnophis gigas*	Federal – T State – T	Wetlands, sloughs, irrigation ditches, rice fields	Freshwater Marsh
California Horned Lizard *Phrynosoma coronatum frontale*	Federal – SC State – CSC	Grasslands, chaparral, and riparian areas	Annual Grassland, Riparian
Amphibians			
Western Spadefoot Toad *Scaphiopus hammodii*	Federal – SC State – CSC	Quiet streams and pools in grasslands and woodlands	None
California Red-legged Frog *Rana aurora draytonii*	Federal – T State – CSC	Streams, ponds, marshes, and stock ponds	None
Foothill Yellow-legged Frog *Rana boylii*	Federal – SC State – CSC	Large streams with open gravel bars and rocks	None
Invertebrates			
Vernal Pool Fairy Shrimp *Branchinecta lynchi*	Federal – T State – none	Vernal pools	None
Leech's Skyline Diving Beetle *Hydroporus leechi*	Federal – SC State – none	Freshwater ponds, shallow water of streams, marshes, and lakes	None

TABLE 3.4-1
Special-status Species

Species	Status	General Habitat Association	Project Habitat
Sacramento Anthicid Beetle *Anthicus sacramento*	Federal – SC State – none	Sandbars and sandy riparian areas	River Banks
Valley Elderberry Longhorn Beetle *Desmocercus californicus dimorphus*	Federal – T State – none	Valley elderberry shrubs in riparian areas, savannas, and woodlands	Riparian, Mixed Woodland
Mammals			
Pale Big-eared Bat *Corynorhinus townsendii palescens*	Federal – SC State – CSC	Grasslands, chaparral, woodlands, and conifer forests	Annual Grassland, Mixed Woodland
Townsend's Western Big-eared Bat *Corynorhinus townsendii townsendii*	Federal – SC State – CSC	Grasslands, chaparral, woodlands, and conifer forests	Annual Grassland, Mixed Woodland
Spotted Bat *Euderma maculatum*	Federal – SC State – CSC	Grasslands and mixed conifer forests	Annual Grassland, Mixed Woodland
Small-footed Myotis *Myotis ciliolabrum*	Federal – SC State – none	Open forests, woodlands, and chaparral	Mixed Woodland
Long-eared Myotis *Myotis evotis*	Federal – SC State – none	Chaparral, woodlands, and conifer forests	Mixed Woodland
Fringed Myotis *Myotis thysanodes*	Federal – SC State – none	Foothill woodlands and mixed conifer-hardwood forests	Mixed Woodland
Long-legged Myotis *Myotis volans*	Federal – SC State – none	Chaparral, woodlands, and conifer forests	Mixed Woodland
Yuma Myotis *Myotis yumanensis*	Federal – SC State – CSC	Open forests and woodlands, open waters	Mixed Woodland
San Joaquin Pocket Mouse *Perognathus inornatus inornatus*	Federal – SC State – none	Grasslands and oak savannas	Annual Grassland, Restored
Plants			
Silky Cryptantha *Cryptantha crinita*	Federal – SC State – none CNPS – 1B	Riparian areas and gravelly streambeds	Riparian
Dwarf Downingia *Downingia pusilla*	Federal – none State – none CNPS – 2	Vernal pools and wet meadows	Freshwater Marsh
Henderson's Bent Grass *Agrostis hendersonii*	Federal – SC State – none CNPS	Vernal pools and grasslands	Annual grassland
Scalloped Moonwort *Botrychium crenulatum*	Federal – SC State – none CNPS – 2	Freshwater marshes and swamps	Freshwater marsh
Woolly Meadowfoam *Limnanthes floccosa* sp. *Floccosa*	Federal – none State – none CNPS – 2	Vernal pools and wet meadows	Freshwater Marsh
Red Bluff Dwarf Rush *Juncus leiospermus* var. *Leiospermus*	Federal – SC State – none CNPS – 1B	Vernal pools and wet meadows, riparian areas, chaparral, and woodlands	Freshwater Marsh, Riparian, Mixed Woodland
Adobe Lily *Fritillaria pluriflora*	Federal – SC State – none CNPS – 1B	Grassland, chaparral, and woodlands	Annual Grassland, Mixed Woodland
Hairy Orcutt Grass *Orcuttia pilosa*	Federal – E State – E CNPS – 1B	Vernal pools	None

TABLE 3.4-1
Special-status Species

Species	Status	General Habitat Association	Project Habitat
Slender Orcutt Grass *Orcuttia tenuis*	Federal – T State – E CNPS – 1B	Vernal pools	None
Green's Tuctoria *Tuctoria greenei*	Federal – E State – R CNPS – 1B	Vernal pools	None
Hoover's Spurge *Chamaesyce hooveri*	Federal – T State – none CNPS – 1B	Vernal pools	None
Indian Valley Brodiaea *Brodiaea coronaria* sp.*rosea*	Federal – none State – E CNPS – 1B	Chaparral, woodlands, and conifer forests/serpentine	None
Oregon Fireweed *Epilobium oreganum*	Federal – SC State – none CNPS – 1B	Wetlands and lower montane conifer forests/mesic	Freshwater Marsh, Mixed Woodland
Butte Fritillary *Fritillaria eastwoodiae*	Federal – SC State – none CNPS – 1B	Chaparral, woodlands, open conifer forests	Mixed Woodland
Lengenere *Lengenerre limosa*	Federal – SC State – none CNPS – 1B	Vernal Pools	None
Red-flowered Lotus *Lotus rubriflorus*	Federal – SC State – none CNPS – 1B	Woodlands and grasslands	Mixed Woodland, Annual Grassland
Ahart's Paronychia *Paronychia ahartii*	Federal – SC State – none CNPS – 1B	Woodlands, grasslands, and vernal pools	Mixed Woodland, Annual Grassland
Valley Sagittaria S*agittataria sanfordii*	Federal – SC State – none CNPS – 1B	Wetlands	Freshwater Marsh
Tracy's Sanicle *Sanicula tracyi*	Federal – SC State – none CNPS – 1B	Woodlands and open conifer forests	Mixed Woodland
Baker's Navarretia *Navarretia leucocephala* sp. *Bakerii*	Federal – SC State – none CNPS – 1B	Woodlands, open conifer forests, grasslands, and vernal pools	Mixed Woodland, Annual Grassland

Status
Federal: E = Endangered
T = Threatened
SC = Species of Concern (Former Category 2 Candidates)
D = Delisted
PD = Proposed for Delisting
FC = Candidate for Federal Listing
State: E = Endangered
T = Threatened
R = Rare
CSC = California Species of Concern
FP = California Fully Protected

CNPS –1B = Rare or Endangered in California or elsewhere
CNPS – 2 = Rare or Endangered in California, more common elsewhere

Figure 3.4-3 shows the location of special-status species that were observed in the project vicinity in 2002 surveys or have been historically observed in the project area and have been recorded in CNDDB.

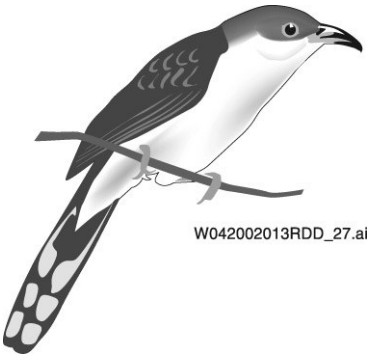
Federal- and State-listed Species

As shown in Table 3.4-1, 14 species that are state or federal listed as threatened or endangered were identified as potentially occurring in the project area on the USFWS species list for the project area. The list includes species associated with the Red Bluff East Quadrangle and from Tehama County (USFWS, 2000 and updated in 2002 provided as Appendix B). Eight of these species (California red-legged frog [*Rana aurora draytonii*], giant garter snake [*Thamnophis gigas*], bank swallow, hairy orcutt grass [*Orcuttia pilosa*], slender orcutt grass [*Orcuttia tenuis*], Green's tuctoria [*Tuctoria greenei*], Hoover's spurge [*Chamaesyce hooveri*], and Indian Valley brodiaea [*Brodiaea coronaria* sp. *rosea*]) were determined not to have the potential to occur in the project area because the project area does not support suitable habitat, and/or the project area is outside the species' range. These eight species were not further evaluated. The potential for the remaining six species to occur in the project area is discussed below.

The six species (out of 14 federal or state threatened or endangered species) with potential to occur in the project area are the little willow, flycatcher, western yellow-billed cuckoo, bald eagle, Swainson's hawk, peregrine falcon, and valley elderberry longhorn beetle.

Little Willow Flycatcher. The little willow flycatcher (*Empidonax traillii brewsteri*) is a rare to uncommon summer resident in California from May through September. In California, it predominantly breeds in the Sierra Nevada mountains with more limited breeding in the Klamath and Siskiyou mountains in the northwestern portion of the state. Preferred breeding habitats include willow thickets along the margins of wet montane meadows, ponds and back waters, and riparian areas. During the spring (May through June) and fall (August through September) migrations, they are more common at lower elevations and less selective of habitat type. Habitats used during migration include narrow riparian corridors as well as shrubs and trees in parks and gardens. The little willow flycatcher is a state endangered species.

Little willow flycatchers would only be expected to occur in the project area during spring and fall migrations. If they migrate through the project area, they most likely use riparian habitat and potentially the mixed woodland habitat.



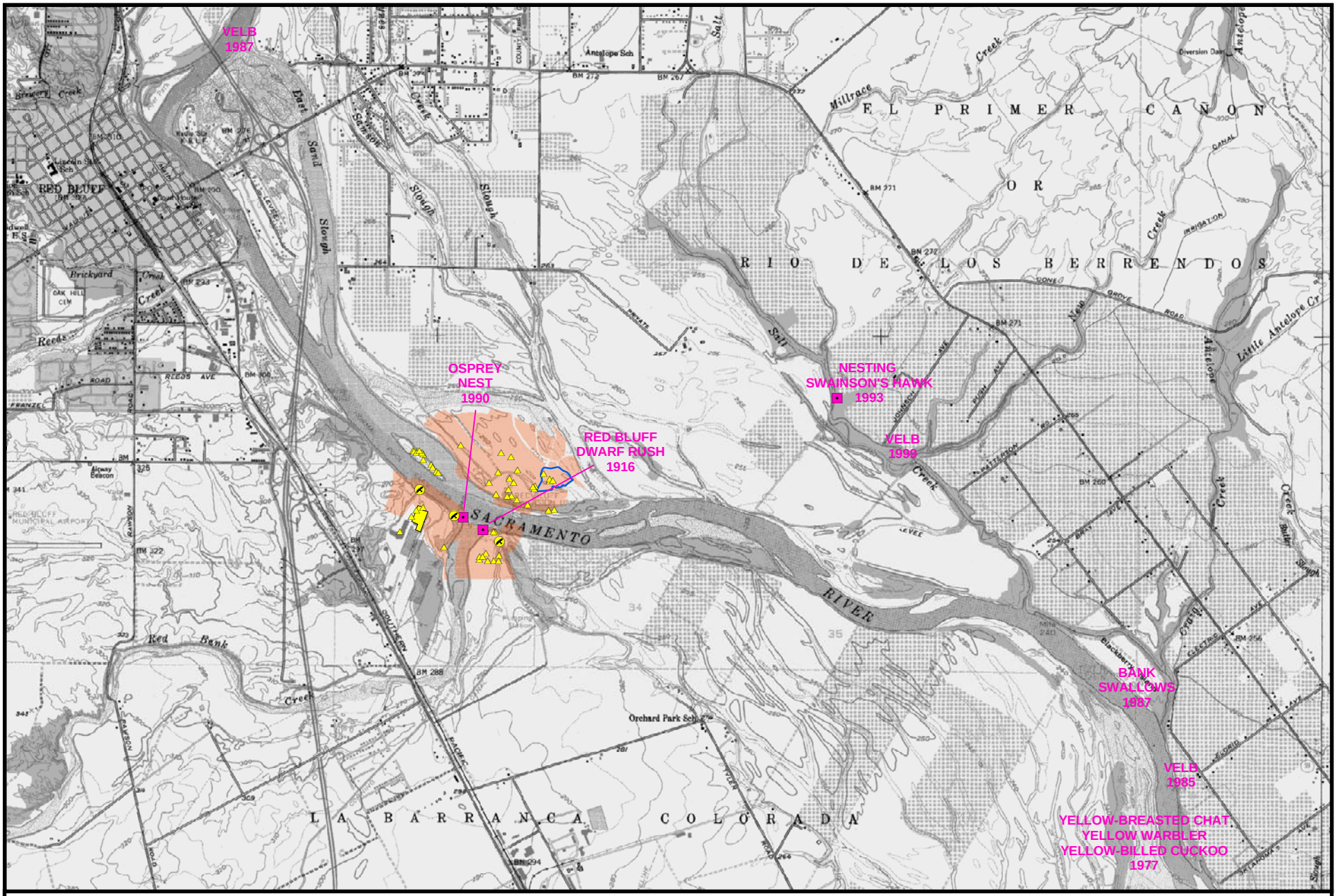
Western Yellow-billed Cuckoo. Historically, the western yellow-billed cuckoo was widespread throughout the western United States. However, the extensive loss of mature riparian forest has resulted in dramatic declines of this species. In California, it is now an uncommon to rare summer resident in scattered locations of its former range. The western yellow-billed cuckoo uses mature, dense cottonwood-willow stands for nesting sites. Cuckoos maintain large territories, and suitable habitat of at least 25 acres could be required for breeding. The western yellow-billed cuckoo is a California state endangered species.

This species historically nested at Todd and Mooney islands, several miles to the southeast of the project area (CDFG, 2001), but there have been no recent observations in the vicinity of the project area. Riparian habitat in the project area provides poor habitat for the western yellow-billed cuckoo because it does not consist of mature and dense cottonwood-willow stands. Also, the riparian habitat occurs as narrow bands along the Sacramento River and Red Bank Creek that would not accommodate the species' breeding territory. Thus, western yellow-billed cuckoos are not likely to nest in the project area. Individuals could occur sporadically in the project area during spring and fall migrations.

Bald Eagle. In western North America, bald eagles are year-round resident species from northern California to Alaska. Breeding populations in California are restricted to the northeast part of the state, with half of the wintering population found in the Klamath Basin (Zeiner et al., 1990). Bald eagles predominantly prey on fish, although small mammals, waterfowl, reptiles, and carrion are also taken. For foraging, eagles require trees or snags near foraging sites. In the project area, bald eagles could use riparian trees as perch sites from which to forage for fish in the Sacramento River. The bald eagle is a federal threatened and California state endangered species.

Bald eagles are only rare breeders in Tehama County and are not known to nest in or near the project area. They are more common during the winter and were observed in Red Bluff during the 1999 Audubon Christmas bird counts.

Swainson's Hawk. Swainson's hawks are widespread throughout much of central and western North America. They are summer residents in the Central Valley, migrating to South America in winter. Although this species was historically widespread throughout California, most of the populations are now restricted to the Central Valley and Great Basin areas of the state. Nest sites occur in mature riparian forests, oak groves, or in large trees adjacent to grasslands or agricultural fields. Breeding season begins in late March, and fall migration begins in August. Insects are an important prey item, especially during the nonbreeding season, and large flocks of Swainson's hawks often congregate in fields to forage. During the breeding season, small mammals, birds, lizards, and amphibians are taken. Loss of nesting habitat throughout California and pesticide use throughout the wintering range are the two most significant factors affecting the decline of this species. Swainson's hawks are a state threatened species.



LEGEND

- CNDDB OCCURRENCES
- 2001 TO 2002 SURVEYS
  - OSPREY NEST
  - ELDERBERRY
  - BATS
- PROJECT SITE
- ELDERBERRY MITIGATION AREA

3,500 1,750 0 3,500 Feet

N

FIGURE 3.4-3
SPECIAL-STATUS SPECIES IN PROJECT VICINITY, 2001 TO 2002 SURVEYS AND CNDDB OCCURRENCES

FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

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One nesting pair was observed approximately 1.5 miles northeast of the project site along Salt Creek in 1993 (CDFG, 2001) (see Figure 3.4-3). Some of the trees in riparian areas in the project area are large enough to support nesting by Swainson's hawks. However, their potential use by Swainson's hawks is probably low because of the high level of human activity and the lack of suitable foraging habitat in the immediate vicinity of potential nest sites.


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Peregrine Falcon. The American peregrine falcon (*Falco peregrinus anatum*), which is the most southerly subspecies of peregrine falcon in North America, breeds south of the arctic tundra of Canada and from Alaska to Mexico. In the winter and during migration, the American peregrine falcon extends its range southward to the Caribbean and parts of South America. In California, it is a resident species throughout the Coast Range and Sierra Nevada, and a winter migrant throughout the Central Valley. Breeding season occurs between March and August. Nests are predominantly located on cliffs, rock ledges, bridges, and tall buildings; and trees, snags, or old raptor nests are used occasionally. Wetlands are habitat for this species as foraging areas (Zeiner et al., 1990). Peregrine falcons prey mostly on birds, but will also take small mammals, fish, and insects.

Pesticide use led to the earlier dramatic population decline of this species, but the population has made a significant recovery in recent decades and has been delisted by USFWS. Peregrine falcons remain listed as endangered by the State of California. This species is not known to nest in the vicinity of the project area but was observed in the Red Bluff area during the 1999 Audubon Christmas bird counts and has been observed on rare occasions during breeding bird surveys in the area.

Valley Elderberry Longhorn Beetle. VELB are entirely dependent on its host plant, elderberry, for food and reproduction. Mating occurs on the plants, and eggs are laid in the cracks and crevices of the bark. Upon emergence, the larva bore into the plant and remain in the spongy pith of the plant for the majority of their lifetime. The developing beetles remain inside the plant for up to two years after which time the adults emerge and reproduce. Adults emerge in March and feed on foliage and flowers until late June. The VELB is a federal threatened species.

There are several known occurrences of elderberry shrubs along the Sacramento River in the vicinity of the project area (CDFG, 2001). During 2002 surveys, shrubs and/or groups of shrubs were identified at 35 locations in the project area. Included in this count is an elderberry mitigation planting area that has been interplanted with other riparian tree species in an area located on the northeast side of the park (left bank). Some of these shrubs are within the project footprint and have the potential to be impacted; others are outside of the project footprint

During 2002 surveys, two pair of osprey were observed to have active nests on the south side of the Sacramento River near RBDD. One other inactive osprey nest located on a constructed platform occurs west of both occupied nests.

and would be avoided during construction activities. Additional plants were observed in the larger project vicinity, but outside the project footprint (Figure 3.4-2). The 35 elderberry shrubs or groups of shrubs all appeared in good condition, and stems ranged in size from less than 1 inch to over 20 inches at ground level. In some areas, the shrubs are relatively isolated; whereas, in other areas, they occur in dense clusters. A summary of stem counts for all shrubs. within the project area, temporary work areas, or in proximity to the work zones is provided in Table 3.4-2. Potential VELB exit holes were observed on five of the shrubs. For a detailed description of the survey, refer to Appendix E.

Other Special-status Species

During the course of general biological surveys of the project area in May 2001, osprey *(Pandion haliaetus)* (state species of concern) and bats (possible federal or state species of concern) were observed.

Osprey. The osprey is a widespread species and has an extensive breeding range throughout northern California. During the winter, osprey migrate to more southern latitudes of California, the Gulf Coast, and Central and South America. Large trees, snags, and utility poles are used as nest sites. Osprey feed predominately on fish, and nest sites are generally located close to open water. The breeding season begins in late March and continues through April. Fall migration may begin as soon as September and continue through mid-November, but the peak migration period occurs between late September and early October. Osprey are a state species of concern.

Two pair of osprey have active nests on the south side of the Sacramento River near RBDD. The pairs were observed on the nests, as well as foraging and feeding along the Sacramento River during 2002 surveys. The nests are on platforms, erected specifically for osprey nesting, and are located on the south side of the river near the weir structure and just north of the old Mill Site. One other inactive osprey nest located on a constructed platform occurs west of both occupied nests (Figure 3.4-4).

The presence of three bat species was visually confirmed, and a fourth species was acoustically detected. Roost locations were documented in the two abandoned storage buildings at the Mill Site.

Bats. Bat species potentially occurring in the project area were identified by querying CNDDB, reviewing a USFWS list for the project, reviewing information from the USFS and Bureau of Land Management, and performing field surveys (Table 3.4-3). The presence of three species was visually confirmed, and a fourth species was acoustically detected. Numerous roost locations were documented in the two abandoned storage buildings at the Mill Site. Evidence was found that bats roost in some of the hydroelectric structures of RBDD in concrete weep holes and under metal overhangs. Several areas appeared to provide potential roosting and foraging habitat: the camping and recreational park area on the north side of the Sacramento River, the upland vegetation and open grasslands on the southwest

TABLE 3.4-2
Characteristics of Elderberry Shrubs Observed in the Project Area

ID No.	Stems 1"	Stems >1" and <3"	Stems >3" and <5"	Stems >5"	No. VELB Exit Holes	Growth Form[a]	Habitat	Impact Area[b]	Notes
E1	1	1	0	2	0	S, S	Parkland	O	Next to Discovery Center.
E2	0	1	0	0	0	S, S	Riparian	O	Next to willows near old boat ramp.
E3	1	4	4	4	0	S, C	Riparian	F	Cluster of several shrubs, abundant new growth, many stems <1 inch near proposed left fish ladder.
E4	1	1	0	2	1 (?)[c]	S, S	Parkland	F	Possible exit hole observed in dead stem. Near fish visitor center.
E5	1	0	2	0	0	S, C	Ruderal	F	Shrubs within fenced area next to existing left fish ladder. Stem count is estimated.
E6	0	1	4	0	0	S, C	Riparian	F	Shrubs within fenced area near existing left fish ladder. Stem count is estimated.
E7	1	0	0	0	0	S, S	Riparian	F	On shoreline downstream of dam.
E8	5	15	0	0	0	S, C	Riparian	O	Cluster of several shrubs outside of project area.
E9	Several shrubs at east end of parking area, outside project boundary.						Parkland	O	
E10	1	16	9	3	0	S, C	Parkland	B	Several shrubs within campground clustered next to large oak tree.
E11	All stems less than 1" diameter					S, S	Parkland	B	Within campground area.
E12	0	2	1	1	0	S, S	Ruderal	B	Next to campground perimeter road.
E13	0	3	2	1	0	S, C	Parkland	F	Next to pump house.
E14	0	0	9	3	0	S, C	Parkland	F	Two shrubs next to pump house.
E15	2	12	2	4	1	S, C	Parkland	F	Cluster of four shrubs next to pump house.
E16	0	4	0	0	0	S, S	Mitigation Planting	O	Solitary shrub at south end of planting area.
E17	3	7	6	0	0	S, C	Mitigation Planting	O	Cluster of three shrubs.
E18	0	6	4	1	0	S, C	Mitigation Planting	O	Cluster of three shrubs.
E19	6	15	0	1	0	S, C	Mitigation	B	Cluster of eight shrubs.

TABLE 3.4-2
Characteristics of Elderberry Shrubs Observed in the Project Area

ID No.	Stems 1"	Stems >1" and <3"	Stems >3" and <5"	Stems >5"	No. VELB Exit Holes	Growth Form[a]	Habitat	Impact Area[b]	Notes
							Planting		
E20	0	2	1	1	2	S, S	Parkland	F	Next to log, north of campground area.
E21	2	5	0	0	0	S, S	Grassland	F	Near dirt road on the north side of the park.
E22	All stems less than 1" diameter.					S, S	Grassland	B	Near dirt road on the north side of the park.
E23	0	0	0	1	0	S, S	Grassland	B	Along roadway entrance to campground.
E24	1	2	0	1	0	S, S	Riparian	O	Pactiv property.
E25	0	3	0	1	0	S, S	Ruderal	B	Pactiv property, next to building.
E26	3	3	0	0	0	S, S	Ruderal	O	Along roadway next to large oak.
E27	3	7	1	0	0	S, C	Ruderal	O	Cluster of four shrubs, along roadway next to large oak.
E28	0	8	4	0	0	T, S	Ruderal	B	Sediment basin.
E29	0	0	0	1	Multiple	T, S	Ruderal	B	Sediment basin. Estimated to be 20" diameter at ground surface.
E30	1	1	1	1	1	T, S	Ruderal	B	Sediment basin.
E31				1 (?)	?	T, S	Ruderal	B	Sediment basin; tree was surrounded by very dense blackberry, could not get stem count.
E32				1 (?)	?	T, S	Ruderal	B	Sediment basin; tree was surrounded by very dense blackberry, could not get stem count.
E33				1	2	T, S	Ruderal	B	Sediment basin. Estimated to be 15" diameter at ground surface.
E34	0	5	1	0	0	S, C	Riparian	B	Next to large sycamore tree.
E35	All stems less than 1" diameter.					S, S	Riparian	B	Next to large sycamore tree.

[a] Growth Form: S = Shrub.
T = Tree.
C = Cluster.

[b] Impact Area F = Within footprint of new facility.
B = Within 200-foot buffer area.
O = Outside of project area.

[c] ? = Exit hole of uncertain origin. Assumed to be VELB exit hole.

BATS

OSPREY NEST 1990

RED BLUFF DWARF RUSH 1916

RED BLUFF DIVERSION DAM

LEGEND

- CNDDB OCCURRENCES
- OSPREY NEST - 2002 SURVEYS
- ELDERBERRY SHRUBS - 2002 SURVEYS
- BATS - 2002 SURVEYS
- ELDERBERRY MITIGATION AREA
- DISTURBED/RUDERAL
- GRASSLAND
- MARSH
- MIXED WOODLAND
- PARKLAND
- RESTORED HABITAT
- RIPARIAN

N

400 200 0 400 Feet

FIGURE 3.4-4
SPECIAL-STATUS SPECIES IN PROJECT AREA, 2002 SURVEYS AND CNDDB OCCURRENCES
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

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TABLE 3.4-3
Bat Species Potentially Occurring in the Project Area

Species	Status	Habitat in Project Area	Comments
Mexican free-tailed bat *Tadarida brasiliensis*	NA	Oak woodland	Over 600 observed emerging after sunset, more are present
Townsend's big-eared bat *Corynorhinus townsendii*	CDFG – SC USFWS – C USFS – S BLM – S	Oak woodland, riparian, active agricultural areas	Suitable habitat present, no evidence found
Spotted bat *Euderma maculatum*	CDFG – SC USFWS – C	Mixed conifer forest	Not likely to be present, lack of suitable roosting habitat
Pallid bat *Antrozous pallidus*	CDFG – SC USFS – S BLM – S	Oak woodland, grasslands	Desiccated carcass found
Big brown bat *Eptesicus fuscus*	NA	Agricultural areas, oak woodland, pasture	Possible evidence of presence
Silver-haired bat *Lasionycteris noctivagans*	NA	Conifer/hardwood forests, drier habitats in winter and during seasonal migrations in low elevation	Possibly migrating along river
Red bat *Lasiurus blossevillii*	CDFG – SC USFWS – C USFS – S	Riparian and edge habitats adjacent to streams, open fields, or orchards	Potential habitat present
Hoary bat *Lasiurus cinereus*	NA	Forested habitats, oak woodland	Potential habitat present
Yuma myotis *Myotis yumanensis*	USFWS – C	Associated with rivers and streams, riparian, oak woodland, forests	*Myotis* sp. bats were observed, likely to be present
Little brown bat *Myotis lucifugus*	NA	Woodlands and conifer forests	Not likely to be present, more common at higher elevations
Long-legged myotis *Myotis volans*	USFWS – C	Woodlands and conifer forests	Not likely to be present, more common at higher elevations
Fringed myotis *Myotis thysanodes*	CDFG – SC USFWS – C	Oak woodland	*Myotis* sp. bats were observed, potential evidence of presence
Long-eared myotis *Myotis evotis*	CDFG – SC USFWS – C	Agricultural areas, conifer forests, oak woodland	*Myotis* sp. bats were observed, potentially present
California myotis *Myotis californicus*	NA	Conifer forests, oak woodland	*Myotis* sp. bats were observed, likely to be present
Small-footed myotis *Myotis ciliolabrum*	USFWS – C	Riparian, conifer forests, oak woodland	*Myotis* sp. bats were observed, possible evidence of presence

CDFG – SC California Department of Fish and Game Species of Special Concern
USFWS – C U.S. Fish and Wildlife Service Species of Concern
USFS – S U.S. Forest Service Sensitive Species
BLM – S Bureau of Land Management Sensitive Species

side of the river, and riparian and wetlands areas. Figure 3.4-5 illustrates the location of potential bat foraging and roosting habitat in the project area.

Abandoned Storage Buildings. One abandoned, enclosed storage building consisted of a row of 25 (numbered) large bays made of concrete blocks (Figure 3.4-6). Each bay provided a large, dark, cave-like environment, similar to a mine adit. Bats are roosting inside almost all of the bays during the day and at night, as revealed by guano (excrement) deposits on the floor. Day roost sites consisted of crevices and cavities formed by crumbling cement plaster on the interior walls. Often the crevices opened up into cavities within the walls (Figure 3.4-7). In two of the bays, bats roosted in large cracks in the cement frame of the bay openings. These day roosts were probably also occupied at night. In addition, guano deposits scattered along the floor and urine stains high on the walls indicated that bats night roost along the bay walls in the mid-section and in or on the rear wall.

Three guano types were distinguishable, that of myotis (*Myotis* sp.), Mexican free-tail bats (*Tadarida brasiliensis*), and a larger type, probably pallid bats (*Antrozous pallidus*) or big brown bats (*Eptesicus fuscus*). There was evidence that bats were also roosting in the corners at either side of the bay openings, and the guano type here was usually pallid bat, or possibly big brown bat since the guano did not have discarded prey remains, which is characteristic of pallid bat roosts.

The second abandoned storage building was a large, open, corrugated metal roof structure supported by a wooden frame (Figure 3.4-8). This open-roofed structure had some interior walls of plywood and corrugated plastic sheets, and one relatively short exterior wall that appeared to have been louvered windows that were backed by plywood squares. A few myotis and Mexican free-tail bats were observed roosting on the plywood behind the louvers and in the window frames. Greater numbers of bats were observed roosting here on May 11, 2001, and the guano deposits below suggested greater numbers. Also, myotis bats were roosting under a loose board on an upright pole. Video of the myotis bats under the board possibly revealed more than one species (based on morphology). Capture would be necessary for further identification.

Behavior Observations. Over 600 Mexican free-tail bats were observed emerging from Bays 1 through 3. Up to 10 bats appeared to be a larger size than the rest, and the carcass discovery indicated they were pallid bats or possibly big brown bats. Bats flew in and out of adjacent bays. About 1.5 hours after sunset, myotis bats were seen flying in and out of Bay 8, which contained the rear wall roost site (evidence of night roosting).