DRAFT INITIAL STUDY AND PROPOSED NEGATIVE DECLARATION FOR THE
ONE-YEAR EXTENSION OF THE SAN JOAQUIN RIVER AGREEMENT IN 2011

Prepared for:
San Joaquin River Group Authority
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January 2011
NEGATIVE DECLARATION

The Project Administrator for the San Joaquin River Group Authority ("SJRGA"), Dennis W. Westcot, prepares, makes, declares, and publishes this Negative Declaration for the following prescribed project:

One-Year Extension of the San Joaquin River Agreement in 2011

The objective of the Proposed Project is to continue providing water supply for the Vernalis Adaptive Management Program (VAMP) by extending the San Joaquin River Agreement (SJRA) one year through 2011 for the purpose of completing the VAMP as authorized under State Water Resources Control Board Water Rights Decision 1641 (D-1641). A complete EIR/EIS and supplemental EIR/EIS were done for the 1999-2010 SJRA. Project objectives of the 1999-2010 SJRA are described on pages 2-3 of the EIR/EIS.

Specifically, the water would be used for:

• A pulse flow for a 31-day period at Vernalis during April and May, with the exact timing determined annually by the San Joaquin River Technical Committee (SJRTC); and
• Other flows identified by the Central Valley Project Improvement Act (CVPIA) water acquisition plan, with concurrence by the U. S. Fish and Wildlife Service (Service), to facilitate migration and attraction of anadromous fish, including fall attraction flows and other flows as needed by the adaptive management study, with concurrence by the Service, to support anadromous fish and provide environmental benefits in the project area.

Project Location: The immediate Project Area is comprised of portions of the Stanislaus, Tuolumne, and Merced rivers and the San Joaquin River from the Mendota Pool to Vernalis.

Determination: The SJRGA has determined that the analysis in the EIS/EIR for the 1999-2010 SJRA is adequate to support VAMP flows through 2011. In particular, changes from the flows originally analyzed in the EIS/EIR would not occur. Any impacts would be within the range of impacts already analyzed in the EIS/EIR. Furthermore, no additional impacts would occur as a result of implementing the SJRA for one additional year. Therefore, the previous decision for CEQA compliance and associated documentation relied on for that decision adequately described the impacts of continuing the VAMP flows for one additional year.

Public Review: The Draft Initial Study/Negative Declaration has been prepared in compliance with the California Environmental Quality Act (CEQA) and contains an environmental review of
potential impacts of the proposed project. This Draft Initial Study/Negative Declaration is being circulated for 30 days from February 14, 2011. Comments on the Draft Initial Study/Negative Declaration may be directed to:

Dennis W. Westcot  
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San Joaquin River Group Authority  
716 Valencia Ave.  
Davis, CA 95616-0153  
(530) 758-8633 (phone)  
(530)  297-2603 (fax)  
westcot-sjrga@sbcglobal.net  

- Comments will be reviewed by the SJRGA, the Draft Initial Study/Negative Declaration will be revised, as appropriate, prior to adoption of the proposed Negative Declaration by the SJRGA.
- This environmental review process and Negative Declaration filing is pursuant to Title 14, Division 6, Chapter 3, Article 6, §15070 of the California Administrative Code.
- A copy of this document may be reviewed/obtained at the Modesto Irrigation District, at 1231 11th Street, Modesto, CA 95354.

Dennis W. Westcot  
Project Administrator  
San Joaquin River Group Authority

By:  

Dennis W. Westcot
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1. Project Summary

Project Title: One-Year Extension of the San Joaquin River Agreement in 2011

Project Location: Counties of Fresno, Madera, Mariposa, Merced, San Joaquin, Stanislaus, Tuolumne

Lead Agency: San Joaquin River Group Authority (SJRGA)

Agency Carrying Out Project: San Joaquin River Group Authority (SJRGA)

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2. Environmental Factors Potentially Affected

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a “Potentially Significant Impact” as indicated by the Environmental Checklist.

- [ ] Land Use and Planning
- [ ] Population and Housing
- [ ] Geological Problems
- [ ] Water
- [ ] Air Quality
- [x] Transportation/Circulation
- [ ] Biological Resources
- [ ] Energy and Mineral Resources
- [ ] Hazards
- [ ] Noise
- [ ] Public Services
- [ ] Utilities and Service Systems
- [ ] Aesthetics
- [ ] Cultural Resources
- [ ] Recreation
- [ ] None Identified
<table>
<thead>
<tr>
<th>Abbreviation</th>
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<tr>
<td>AF</td>
<td>Acre-Feet</td>
</tr>
<tr>
<td>BIOP</td>
<td>Biological Opinion</td>
</tr>
<tr>
<td>CEQA</td>
<td>California Environmental Quality Act</td>
</tr>
<tr>
<td>CCSF</td>
<td>City and County of San Francisco</td>
</tr>
<tr>
<td>cfs</td>
<td>cubic feet per second</td>
</tr>
<tr>
<td>CVP</td>
<td>Central Valley Project</td>
</tr>
<tr>
<td>CVPIA</td>
<td>Central Valley Project Improvement Act</td>
</tr>
<tr>
<td>D-1641</td>
<td>State Water Resources Control Board Water Right Decision 1641</td>
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<tr>
<td>Day-Delta</td>
<td>Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Plan</td>
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<tr>
<td>FWS</td>
<td>United States Fish &amp; Wildlife Service</td>
</tr>
<tr>
<td>FWA</td>
<td>Friant Water Authority</td>
</tr>
<tr>
<td>HORB</td>
<td>Head of Old River Barrier</td>
</tr>
<tr>
<td>MAF</td>
<td>Million Acre-Feet</td>
</tr>
<tr>
<td>NMFS</td>
<td>National Marine Fisheries Service</td>
</tr>
<tr>
<td>OCAP</td>
<td>Operations Criteria and Plan</td>
</tr>
<tr>
<td>MID</td>
<td>Modesto Irrigation District</td>
</tr>
<tr>
<td>OID</td>
<td>Oakdale Irrigation District</td>
</tr>
<tr>
<td>SJRECWA</td>
<td>San Joaquin River Exchange Contractors Water Authority</td>
</tr>
<tr>
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<td>South San Joaquin Irrigation District</td>
</tr>
<tr>
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<td>Turlock Irrigation District</td>
</tr>
<tr>
<td>Merced ID</td>
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<td>San Joaquin River Group Authority</td>
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<tr>
<td>SWP</td>
<td>State Water Project</td>
</tr>
<tr>
<td>SWRCB</td>
<td>State Water Resources Control Board</td>
</tr>
<tr>
<td>TAF</td>
<td>Thousand Acre-Feet</td>
</tr>
<tr>
<td>USBR</td>
<td>United States Bureau of Reclamation</td>
</tr>
<tr>
<td>VAMP</td>
<td>Vernalis Adaptive Management Plan</td>
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<tr>
<td>WQCP</td>
<td>Water Quality Control Plan</td>
</tr>
</tbody>
</table>
3. Introduction

The San Joaquin River Group Authority (SJRGGA) is the lead agency for preparation of this Draft Initial Study for the proposed continuation of the San Joaquin River Agreement (SJRA). The SJRGA is a joint power authority consisting of the following agencies:

- Oakdale Irrigation District (OID)
- South San Joaquin Irrigation District (SSJID)
- Turlock Irrigation District (TID)
- Modesto Irrigation District (MID)
- Merced Irrigation District (Merced ID)
- City and County of San Francisco (CCSF)
- Friant Water Authority (FWA)
- San Joaquin River Exchange Contractors Water Authority (SJRECWA)

The SJRA is an agreement providing for the release of water necessary to perform the Vernalis Adaptive Management Plan (VAMP), an experiment designed to develop information on the relative effects of flows in the San Joaquin River, Central Valley Project (CVP) and State Water Project (SWP) pumping rates, and operation of a fish barrier at the head of Old River (HORB) on the survival and passage of salmon smolts through the Delta. The VAMP was envisioned in D-1641 and the action analyzed in the completed EIS/EIR for the SJRA was for a 12-year, long-term water supply program and fish survival experiment. The original VAMP program was to commence in 1999 and continue through 2010. Because of a one-year delay in the commencement of the original operations under the SJRA, the SJRA expired in 2010 without completion of the final year of the water supply and fish survival experiment. The operations described in the SJRA are proposed to be extended through 2011 in order to finish the VAMP. The purpose of this Draft Initial Study is to determine whether continuing the SJRA through 2011 could result in any reasonably foreseeable environmental impacts.

A complete EIS/EIR for the SJRA (Attached as Appendix A to this document) was adopted for the 12-year period 1999 through 2010. Due to the delay in commencement of the original operations under the SJRA, it is necessary to extend the SJRA one year to complete the water supply and fish survival experiment as originally envisioned under D-1641. Since the proposed 2011 SJRA extension is an identical project, the 1999-2010 SJRA EIS/EIR will be relied upon, incorporated by reference, and specifically referenced as appropriate. The present

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1 The 1999-2010 EIS/EIR for the SJRA is also available on the SJRGA’s website at [http://www.sjrg.org](http://www.sjrg.org).
Initial Study will focus on where and how conditions have changed and if any new impacts could occur.

4. Project Description

4.1. Project Objectives

The objective of the Proposed Project is to continue providing a water supply for the VAMP by extending the SJRA through 2011 for the purpose of completing the VAMP as envisioned under D-1641. Project objectives of the 1999-2010 SJRA are described on pages 2-3 of the original EIR/EIS. (SJRGA 1999.) Specifically, the water would be used for:

- A pulse flow for a 31-day period at Vernalis during April and May, with the exact timing determined annually by the San Joaquin River Technical Committee (SJRTC); and
- Other flows identified by the Central Valley Project Improvement Act (CVPIA) water acquisition plan, with concurrence by the Fish and Wildlife Service (Service), to facilitate migration and attraction of anadromous fish, including fall attraction flows and other flows as needed by the adaptive management study, with concurrence by the Service, to support anadromous fish and provide environmental benefits in the project area.

This water is needed to support the VAMP and to provide protective measures for fall-run Chinook salmon in the San Joaquin River. The additional water for other flows would be used for ramping around the pulse flow, to assist in the protection of salmon redds, to assist in control of water temperature, and to assist in improving water quality.

4.2. The VAMP

The VAMP is a 12-year experiment designed to gather scientific information on the relative effects and interactions of varied pulse flows in the San Joaquin River at Vernalis, CVP and SWP export pumping rates, and operation of a HORB on the survival and passage of salmon smolts through the Delta. The VAMP also uses “adaptive management,” meaning that flows and timing of flows change annually in response to hydrologic and biologic conditions. As a result, varying amounts of water would be needed. The additional water for other flows is used

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2 The HORB is a temporary rock barrier installed at the confluence of the San Joaquin River and Old River. Without the HORB, about 50 percent of the San Joaquin River’s flow enters Old River and another 5 percent of combined CVP/SWP pumping also enters Old River. If the HORB is installed, only about 10 percent of the San Joaquin River’s flow enters Old River.
for ramping around the pulse flow, to assist in the protection of salmon redds, to assist in control
of water temperature, and to assist in improving water quality.

VAMP flows are guaranteed water supplies for the April-May pulse flow from the
SJRGA members of up to 110,000 acre-feet (AF) per year to support VAMP. The SJRGA
proposes by-pass or release to the San Joaquin River at Vernalis during April and May of 2011,
a 31-day pulse flow period, the amount of water needed to achieve the Target Flow (described
below) or up to 110,000 AF, whichever is less. Additional water (in excess of the required water,
possibly up to a total of 160,000 AF) necessary to achieve VAMP Target Flow may be available
on a “willing seller” basis. The environmental impacts of the need for water in excess of 110,000
AF were considered in the Supplemental EIR/EIS for the 1999-2010 SJRA. (SJRGA 2001.)

- The Pulse Flow Period is defined as a period of 31 continuous days during the months of
  April and May. This is anticipated to be the period that most of the juvenile anadromous
  fish migrate out of the tributaries, through the Delta, and into the Pacific Ocean in order
to continue their life cycle. It is expected to occur most often between mid-April and mid-
  May. The timing of the pulse flow is to coincide with the peak period of time when
  naturally spawned smolts are migrating out of the San Joaquin River Basin.

- The Target Flow is a specific flow regime between 2,000 and 7,000 cubic feet per second
  (cfs) for the Pulse Flow Period. It consists of the existing flow, plus either a single-step
  incremental increase in flow (over existing flow) or a double-step increase, depending on
  hydrologic conditions. Existing flow is defined in Table 2.

The need for “up to” 160,000 AF derives from the mathematics of the double-step target flows
and a cap of 110,000 AF. To illustrate, in the case where the “existing flow” is 4,450 cfs, the
Target Flow for a single-step would be 5,700 cfs while a double-step increment requires a target
flow of 7,000 cfs. The required flow for the double-step would amount to approximately 2,550
cfs to get to 7,000 cfs. This would equate to approximately 156,800 AF during the 31-day Pulse
Flow Period. Willing sellers could provide the 50,000 AF over and above the 110,000 AF cap
when it is available. The environmental impacts of the need for water in excess of 110,000 AF
were considered in the Supplemental EIR/EIS for the 1999-2010 SJRA. (SJRGA 2001.)
Table 2. VAMP Single-Step Flow.

<table>
<thead>
<tr>
<th>Existing Flow (cfs)</th>
<th>Target Flow (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1999</td>
<td>2,000</td>
</tr>
<tr>
<td>2,000-3,199</td>
<td>3,200</td>
</tr>
<tr>
<td>3,200-4,449</td>
<td>4,450</td>
</tr>
<tr>
<td>4,450-5,699</td>
<td>5,700</td>
</tr>
<tr>
<td>5,700-6,999</td>
<td>7,000</td>
</tr>
<tr>
<td>7,000 or greater</td>
<td>Existing Flow</td>
</tr>
</tbody>
</table>

When the existing flow exceeds 7,000 cfs, the SJRGA uses its best efforts to maintain a constant or stable flow rate during the Pulse Flow Period to the extent reasonably possible through cooperating in development of an operations plan and coordination of operations during the Spring Pulse Flow Period. During high flow events, such as those occurring in Spring, 1998 (20,000 cfs), it may not be possible to maintain a constant flow rate at Vernalis during the 31-day Pulse Flow Period.

VAMP flows are also based on the San Joaquin Valley Water Year Hydrologic Classification, which was developed as an index of water year variability and water supply availability within the San Joaquin River basin. The index is mathematically derived as the summation of 0.6 times the current year’s April–July San Joaquin Valley unimpaired runoff, plus 0.2 times the current year’s October–March unimpaired runoff, plus 0.2 times the lesser of 4.5 or the previous year’s index (thus the “60-20-20" reference). (see Table 3.) The streams used in the index are the Stanislaus, Tuolumne, Merced and the San Joaquin. The year type for the

3 “Existing flows” would be determined by the SJRTC. Existing flow is defined as the forecasted flows in the San Joaquin River at Vernalis during the pulse flow period that would exist absent the SJRA or water acquisitions, including but not limited to the following:

- Tributary minimum instream flows pursuant to Davis-Grunsky, Federal Energy Regulatory Commission, or other regulatory agency orders existing on the date of the SJRA;
- Water quality or scheduled fishery releases from New Melones Reservoir;
- Flood control releases from any non-federal storage facility required to be made during the pulse flow period pursuant to its operating protocol with the U.S. Army Corps of Engineers in effect when the SJRA is executed;
- Uncontrolled spills not otherwise recaptured pursuant to water right accretions (less natural depletions) to the system; and/or
- Local runoff.

4 The San Joaquin Valley 60-20-20 Hydrologic Classification unimpaired runoff for the current water year (October 1 of the preceding calendar year through September 30 of the current calendar year), as published in DWR Bulletin 120, is a forecast of the sum of the following locations: Stanislaus River, total inflow to New Melones Reservoir; Tuolumne River, total inflow to Don Pedro Reservoir; Merced River, total inflow to Exchequer Reservoir; San Joaquin River, total inflow to Millerton Lake. Preliminary determinations of year classification shall be made in February, March, and April with final determination in May. These preliminary determinations are based on hydrologic conditions to date plus forecasts of future runoff assuming normal precipitation for the remainder of the year.
preceding water year remains in effect until the initial forecast of unimpaired runoff for the current water year is available. A cap of 4.5 MAF is put on the previous year’s index (Z) to account for required flood control reservoir releases during wet years. The index defines five different year types: wet, above normal, below normal, dry and critical.

**Table 3. San Joaquin River Basin 60-20-20 Hydrologic Year Classification Equation**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Millions of Acre-Feet (MAF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet</td>
<td>Equal to or greater than 3.8</td>
</tr>
<tr>
<td>Above Normal</td>
<td>Greater than 3.1 and less than 3.8</td>
</tr>
<tr>
<td>Below Normal</td>
<td>Equal to or less than 3.1 and greater than 2.5</td>
</tr>
<tr>
<td>Dry</td>
<td>Equal to or less than 2.5 and greater than 2.1</td>
</tr>
<tr>
<td>Critical</td>
<td>Equal to or less than 2.1</td>
</tr>
</tbody>
</table>

Index (MAF) = 0.6 * X + 0.2 * Y + 0.2 * Z
Where:
X = Current year’s April – July San Joaquin Valley unimpaired runoff
Y = Current October – March San Joaquin Valley unimpaired runoff
Z = Previous year’s index

Each of the year types, as defined by the SWRCB San Joaquin Valley 60-20-20 Water Year Hydrologic Classification, has been designated a numeric indicator by the SJRA. (see Table 4.) In any year when the sum of the current year’s 60-20-20 Indicator and previous year’s 60-20-20 Indicator is seven or greater, a “double-step” occurs, in which the annual 31-day out-migration flow target is the Target Flow one level higher than that established by the single-step Target Flow.

**Table 4. SWRCB San Joaquin Valley 60-20-20 Water Year Hydrologic Classification Numeric Indicators**

<table>
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<tr>
<th>SJR Basin 60-20-20 Classification</th>
<th>60-20-20 Indicator</th>
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<tbody>
<tr>
<td>Wet</td>
<td>5</td>
</tr>
<tr>
<td>Above Normal</td>
<td>4</td>
</tr>
<tr>
<td>Below Normal</td>
<td>3</td>
</tr>
<tr>
<td>Dry</td>
<td>2</td>
</tr>
<tr>
<td>Critical</td>
<td>1</td>
</tr>
</tbody>
</table>

If achieving the double-step requires more than the 110,000 AF of supplemental water, additional water from willing sellers, if there are any, on the San Joaquin, Stanislaus, Tuolumne, and Merced rivers (approximately 50,000 AF) may be acquired by the USBR for the Pulse Flow Period.

During years when the sum of the current year’s 60-20-20 indicator and the previous two years’ 60-20-20 Indicator is four (4) or less, the SJRGA members will not be required to make
water available above existing flow (off-ramp year), except as may be provided by Merced ID (fall flow) and Oakdale ID (difference water and additional water) or any of the districts under the willing seller provision of the SJRA. Based on the 2010 San Joaquin River Basin water year classification index of Above Normal, there is no chance that water year 2011 will be an off-ramp year during the 2011 Pulse Flow Period.

4.3. Project Area

Chapter 3 of the 1999-2010 SJRA EIS/EIR contains a complete description of the Project Area, which is unchanged for 2011. (SJRGA 1999, Chapter 4.) The immediate Project Area also remains the same. The immediate Project Area would again be comprised of portions of the Stanislaus, Tuolumne, and Merced rivers and the San Joaquin River from the Mendota Pool to Vernalis. These would remain the primary rivers that would be affected by the additional water. The points of release would still occur primarily at three reservoirs: New Melones Reservoir on the Stanislaus River, New Don Pedro Reservoir on the Tuolumne River, and Lake McClure on the Merced River.

4.4. Existing Conditions

Surface water resources existing in 1999 are discussed in Chapter 4 of the 1999-2010 SJRA EIS/EIR. (SJRGA 1999, Chapter 4.)

4.5. Project History Since 1999.

4.5.1. D-1641

In 1999, the SWRCB adopted D-1641 which completed the water right phase of the Program of Implementation for the 1995 Bay-Delta WQCP. Instead of allocating responsibility for the San Joaquin River spring pulse flow objective, however, D-1641 authorized the USBR, DWR, and some of the SJRGA’s member agencies to conduct the VAMP.\(^5\) Existing studies had not provided satisfactory results on the relative effects of flows and exports on smolt passage and survival. As a result, the pulse flow objectives in the 1995 Bay-Delta WQCP were subjective and based on limited information. Although the flows called for in the VAMP were lower than the 1995 Bay-Delta WQCP pulse flow objectives, information from the VAMP would provide the

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\(^5\) The history of the VAMP and 1999-2010 SJRA, up to 1999, is discussed in detail in Chapter 1 of the EIR/EIS. (see Appendix A, p. 1.)
SWRCB with the information necessary to establish scientifically-based pulse flow objectives. (D-1641, p. 21.)

SWRCB D-1641 required the SJRA parties who, pursuant to the SJRA, agreed to provide water, to do so for as long as the SJRA remained in effect. D-1641 also requires the DWR and the USBR to provide backstops by ensuring, through water purchases or other measures, that the water and operations needed to conduct the VAMP experiment, as modified pursuant to the SJRA, would be provided. (D-1641, p. 26.) SWRCB D-1641 authorized the SJRA parties to conduct the VAMP until December 31, 2011 or until the SJRA terminated, whichever occurred first. (D-1641, pp. 166, 168-170.) The SJRA, however, only provided for the release of water for the VAMP through 2010 unless the SJRA is extended. The parties have agreed to extend the SJRA through 31 December 2011.

4.5.2. State Water Resources Control Board Cases and 2006 Bay-Delta Water Quality Control Plan

In 2006, 3rd District Court of Appeal for California issued the final judgment in the State Water Resources Control Board Cases, (2006) 136 Cal.App.4th 674. With regard to the VAMP, the Court affirmed the ruling of the superior court and held that the SWRCB, by authorizing the VAMP in lieu of the 1995 Bay-Delta WQCP pulse flow objectives, illegally modified and failed to implement the 1995 Bay-Delta WQCP pulse flow objectives. (SWRCB Cases, supra 136 Cal.App.4th at 725-734.)

While the Court’s final opinion was pending, the SWRCB was in the process of reviewing and updating the 1995 Bay-Delta WQCP. In light of the superior court’s judgment and expectations that the Court would issue a consistent ruling, the SWRCB issued the 2006 Bay-Delta WQCP and amended the Program of Implementation to allow for performance of the VAMP through 2011 in lieu of implementing the San Joaquin River spring pulse flow objective. (2006 Bay-Delta WQCP, p. 24.)

In allowing performance of the VAMP, the SWRCB noted that additional data and scientific analyses would be needed to either support or modify the spring flow objectives. (Id.) The VAMP study had by then been ongoing for seven years, but the study had not yet yielded conclusive results regarding needed changes to the Spring pulse flow objectives. (Id.) Nonetheless, it was anticipated that the completed study would provide critical data about flow needs on the San Joaquin River during the Spring pulse flow period. (Id.)
It was intended that, after the SJRA terminated or when adequate information would otherwise exist to support changes, the SWRCB would use the information gained from the VAMP study together with other pertinent information to determine what, if any, changes are needed to the pulse flow objectives. The SWRCB would then make any appropriate changes to the Bay-Delta WQCP and, after a water right proceeding, would assign, as appropriate, long-term responsibility for meeting the pulse flow objectives to water right holders whose water diversions impact the flow of water. (Id. at 25-26.) If the VAMP terminated early pursuant to its terms and the SWRCB took no action, the San Joaquin River pulse flow objectives would take effect and the USBR would be responsible for their implementation. (Id. at 24.)

Table 5. River flow objectives for Fish & Wildlife beneficial uses required for the San Joaquin River at Vernalis.6

<table>
<thead>
<tr>
<th>Year Type</th>
<th>Time Period</th>
<th>Flow (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W,AN</td>
<td>Feb-Apr 14, May 16-Jun</td>
<td>2,130 or 3,420⁷</td>
</tr>
<tr>
<td>BN,D</td>
<td>1,420 or 2,280</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>710 or 1,140</td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>Apr 15- May 15⁸</td>
<td>VAMP Pulse Flow Targets</td>
</tr>
<tr>
<td></td>
<td>Existing Flow</td>
<td>Target Flow</td>
</tr>
<tr>
<td></td>
<td>0-1999</td>
<td>2,000</td>
</tr>
<tr>
<td></td>
<td>2,000-3,199</td>
<td>3,200</td>
</tr>
<tr>
<td></td>
<td>3,200-4,449</td>
<td>4,450</td>
</tr>
<tr>
<td></td>
<td>4,450-5,699</td>
<td>5,700</td>
</tr>
<tr>
<td></td>
<td>5,700-6,999</td>
<td>7,000</td>
</tr>
<tr>
<td></td>
<td>&gt; or = 7000</td>
<td>Existing Flow</td>
</tr>
<tr>
<td>All</td>
<td>Oct</td>
<td>1,000⁹</td>
</tr>
</tbody>
</table>

Since San Joaquin River Flow Objectives were never implemented through a water right action, the specific environmental impacts of implementing the objectives were never evaluated. In modeling supply impacts for the 1995 Bay-Delta WQCP, however, all water necessary to

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6 See 2006 Bay-Delta WQCP, p. 15.
7 The higher flow objective applies when the 2-ppt isohaline (measured as 2.64 mhmhos/cm surface salinity) is required to be at or west of Chipps Island. (2006 Bay-Delta WQCP, p. 16 fn14.)
8 Flows from April 15 through May 15 are based on the VAMP. Existing Flow is determined by the San Joaquin River Technical Committee. It is defined as forecasted flows in the San Joaquin River at Vernalis during the pulse flow period that would exist absent the San Joaquin River Agreement or water acquisitions. (2006 Bay-Delta WQCP, p. 25 fn. 9.) In some years the VAMP may require higher flows based on hydrologic conditions in the current year and the preceding year. (Id.) The San Joaquin River Technical Committee also determines the exact timing of the VAMP, based on whether salmon migrations begin early or late, the availability of coded-wire tagged hatchery fish, and other factors. (Id.)
9 Plus up to an additional 28 TAF pulse/attraction flow during all water year types. The amount of additional water will be limited to that amount necessary to provide a monthly average flow of 2,000 cfs. The additional 28 TAF is not required in a critical year following a critical year.
meet San Joaquin River flow objectives, including the water necessary for the Pulse Flow Objective, was released from New Melones Reservoir, and any additional flow requirements in excess of New Melones capacity were identified only as "additional flows in excess of New Melones releases" required on the San Joaquin River and assumed to be provided by "unspecified sources." (1995 Bay-Delta WQCP Appendix 1, p. VII-11.) Furthermore, the SWRCB anticipated that in 20 of the 71 years modeled, additional flows in excess of New Melones releases would have to be provided by unspecified sources at an average volume of 139,000 AF per year in critical years and 71,000 AF per year for the period as a whole. (Id. at VII-2.) However, specific sources of additional flows in excess of New Melones releases required on the San Joaquin River Flow Objectives and the impacts of obtaining such sources were not considered in the 1995 Bay-Delta WQCP. Such considerations were deferred until the water right phase of the Program of Implementation. Sources of additional flow and the impact of obtaining such sources of supply were similarly not considered when the San Joaquin River Flow Objectives were re-adopted in the 2006 Bay-Delta WQCP. At times, the San Joaquin, Stanislaus, Tuolumne, and Merced rivers are fully appropriated. As a result, requiring flows for other purposes could deprive current uses of present supply.

4.5.3. 2008 U.S. Fish & Wildlife Service (FWS) Biological Opinion (BIOP) on Delta Smelt for the CVP/SWP Operations Criteria and Plan (OCAP)

In December 2008, the FWS issued a new BIOP for the CVP/SWP Operations Criteria and Plan (OCAP) that included, among other measures, a reasonable and prudent alternative for the protection of Delta smelt. The FWS BIOP alleged that, although the HORB has the effect of increasing San Joaquin River flow, it also has the effect of increasing the flow towards the CVP and SWP pumping facilities from Turner and Columbia cuts, which can increase the predicted entrainment risk for particles in the East and Central Delta by up to about 10 percent. (FWS BIOP, p. 225.) In most instances, net flow is directed towards the CVP and SWP pumps and local agricultural diversions. (Id.) The directional flow towards the Banks and Jones Pumping Plants (SWP and CVP) increases the vulnerability of fish to entrainment. (Id.) Larval and

10 A fully appropriated stream system is a lake or other body of water, including its tributaries and contributing sources, wherein the supply of water is fully appropriated and fully applied to beneficial uses and previous water right decisions have determined that no water remains available for appropriation. (Water Code §1205.) All of the stream systems upstream of Vernalis have been fully appropriated, pursuant to SWRCB Water Right Orders 89-25, 91-07, and 98-08, since at least 1989.
juvenile delta smelt are especially susceptible to these flows. (Id.) As a result, the FWS BIOP only permits installation of the spring HORB if the FWS determines Delta smelt entrainment is not a concern. (FWS BIOP, pp. 225, 337.) Even if the HORB is installed, the FWS BIOP requires that the flap gates remain open until May 15th, making them less effective at retaining flow in the San Joaquin River. (FWS BIOP, p. 337.) As a result, it is not anticipated that the HORB will be installed in 2011. An evaluation is ongoing on the use of a Non-Physical Barrier (NPB) to deter salmon smolts from moving into Old River. The VAMP in 2011 is cooperating with the NPB Study to assess its impact on improve salmon smolt survival during the Pulse Flow Period.

4.5.4. 2009 NMFS BIOP

Under the March 6, 1995 NMFS BIOP on the CVP/SWP OCAP, the USBR had a continuing obligation to meet San Joaquin River flows and could acquire water in excess of the amounts provided by SJRGA members under the SJRA. On June 4, 2009, NMFS issued a new BIOP. When the BIOP was issued, the OCAP committed DWR and USBR to continuing “VAMP-like” flows, but the SJRA was still scheduled to expire and, even with flows released from the Stanislaus River to Vernalis, the fishery benefits provided by the SJRA and VAMP would not occur. Under the SJRA, SJRGA member agencies also released flows from the Tuolumne and Merced rivers. With the one-year proposed extension of the SJRA in 2011, the USBR’s obligation will continue, as well as the fishery benefits provided by flow releases from the Stanislaus, Tuolumne, and Merced rivers.

5. Assessment of Environmental Effects and Mitigation

The 1998 EA/IS for the 1999-2010 SJRA determined that the following environmental resources and concerns would potentially be affected:

- Surface Water
- Groundwater
- Terrestrial Resources (Vegetation and Wildlife)
- Aquatic Resources
- Land Use
- Cultural Resources
- Recreation
- Energy Resources
- Indian Trust Assets
• Environmental Justice

Impacts on resources such as climate and air quality, soils and geology, noise, aesthetics, transportation/circulation, growth inducement, and public services were not evaluated in the EIS/EIR because the EA/IS determined these resources would not have been affected by an instream flow project not involving the construction of major new facilities. (SJRGA 1999, p. 4-1.)

The following contains the environmental checklist form presented in Appendix I of the CEQA Guidelines. A discussion follows each environmental issue identified in the project. For this checklist, the following designations are used:

- **Potentially significant impact**: An impact that could be significant, and for which no mitigation has been identified. The lead agency must prepare an EIR if any potentially significant impacts are identified. (Public Resources Code §21080(d).)

- **Potentially Significant Unless Mitigation Incorporated**: An impact that requires mitigation to reduce the impact to a less-than significant level. If any mitigation measures are recommended for incorporation into the Project Description and incorporated after the Draft IS is initially circulated, a Mitigated Negative Declaration must be prepared. (Public Resources Code §21064.5.)

- **Less-Than-Significant Impact**: Any impact that would not be considered significant under CEQA relative to the existing standards. If, in light of the whole record before the lead agency, there is no substantial evidence of a significant impact, a Negative Declaration must be prepared. (Public Resources Code §21080(c).)

- **No Impact**: The project has no impact.

A summary of Significant Environmental Effects and Mitigation for the SJRA is found in the 1999-2010 SJRA EIS/EIR. (SJRGA 1999, p. ES-15.)
5.1. Land Use and Planning.

<table>
<thead>
<tr>
<th>Issues</th>
<th>Potentially Significant Impact</th>
<th>Potentially Significant Unless Mitigation Incorporated</th>
<th>Less-Than-Significant Impact</th>
<th>No Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Would the proposal:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Conflict with General Plan designation or zoning?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>2. Conflict with applicable environmental plans or policies adopted by agencies with jurisdiction over the project?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>3. Be incompatible with existing land use in the vicinity?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>4. Affect agricultural resources or operations (e.g., impacts to soils or farmlands, or impacts from incompatible uses)?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>5. Disrupt or divide the physical arrangement of an established community (including low income or minority community)?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
</tbody>
</table>

Land Use and Planning impacts were discussed in Chapter 4 of the 1999-2010 SJRA EIS/EIR. (SJRGA 1999, pp. ES-12, 4-160, 6-12.) Furthermore, the SJRGA previously assessed the potential impact to such resources in the 1998 EA/IS and determined it was not significant. (SJRGA 1999, p. 4-1.) The SJRA was, and remains, consistent with county land use, goals, objectives, and policies.

5.2. Population and Housing.

<table>
<thead>
<tr>
<th>Issues</th>
<th>Potentially Significant Impact</th>
<th>Potentially Significant Unless Mitigation Incorporated</th>
<th>Less-Than-Significant Impact</th>
<th>No Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Would the proposal:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Cumulatively exceed official regional or local population projections?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>2. Induce substantial growth in an area either directly or indirectly (e.g., through projects in an undeveloped area or extension of major infrastructure)?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>3. Displace existing housing, especially affordable housing?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
</tbody>
</table>

The SJRGA previously assessed the potential impact to such resources in the 1998 EA/IS and determined it was not significant. (SJRGA 1999, p. 4-1.) Then, Population and Housing impacts were further discussed in Chapter 4 of the 1999-2010 SJRA EIS/EIR. (SJRGA 1999, pp. ES-12, 3-128, 4-98.) The SJRA did not impact population or housing. It would not do so now.
5.3. Geology.

<table>
<thead>
<tr>
<th>Issues</th>
<th>Potentially Significant Impact</th>
<th>Potentially Significant Unless Mitigation Incorporated</th>
<th>Less-Than-Significant Impact</th>
<th>No Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Would the proposal result in:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Fault rupture?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>2. Seismic ground shaking?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>3. Seismic ground failure including liquefaction?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>4. Seiche, tsunami, or volcanic hazard?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>5. Landslides or mudflows?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>6. Erosion, changes in topography or unstable soil conditions from excavation, grading, or fill?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>7. Subsidence of the land?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>8. Expansive soils?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>9. Unique geological or physical features?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
</tbody>
</table>

The one-year SJRA Extension in 2011 involves the release of surface water for the VAMP. It would not involve construction, grading, excavating, or other activities that could cause of potentially geological impacts. The SJRGA previously assessed the potential for such impacts in the 1998 EA/IS and determined it was nonexistent. (SJRGA 1999, p. 4-1.)

The potential for subsidence as a result of increased groundwater being used to replace surface water was addressed in the EIS/EIR. (SJRGA 1999, p. ES-9.) Of the SJRGA member agencies, only the OID, Merced ID, and SJRECWA would use groundwater to substitute for surface water used for VAMP flows. (SJRGA 1999, pp. 4-52.) OID anticipated recharging most of the groundwater used with surface water from the Stanislaus River. (Id.) Although Merced ID determined that overdraft could occur if it replaced all of the surface water used for VAMP flows with groundwater, it limited groundwater pumping in overdrafted areas, imported water to supplement loss of groundwater, and expanded groundwater recharging. (Id.) Finally, the SJRECWA estimated that groundwater use could be increased by as much as 11,000 AF and a one-year impact of up to this amount. (Id.) This constitutes less than 2 percent of the SJRECWA’ surface water and ground water resources within the Exchange Contractors are kept in balance through an intensive conjunctive use program. It therefore would not have a significant impact on subsidence. (Id.)

15
5.4. Water.

<table>
<thead>
<tr>
<th>Issues</th>
<th>Potentially Significant Impact</th>
<th>Potentially Significant Unless Mitigation Incorporated</th>
<th>Less-Than-Significant Impact</th>
<th>No Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Would the proposal result in:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Changes in absorption rates, drainage patterns, or the rate and amount of surface runoff?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
</tr>
<tr>
<td>2. Exposure of people to water-related hazards such as flooding?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
</tr>
<tr>
<td>3. Discharge into surface waters or other alteration of surface water quality (e.g., temperature, dissolved oxygen, or turbidity)?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
</tr>
<tr>
<td>4. Changes in the amount of surface water in any water bodies?</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>☐</td>
</tr>
<tr>
<td>5. Changes in currents, or the course or direction of water movements?</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>☐</td>
</tr>
<tr>
<td>6. Change in the quantity of ground waters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations or through substantial loss of groundwater recharge capability?</td>
<td>☐</td>
<td>✓</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>7. Altered direction or rate of flow of groundwater?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
</tr>
<tr>
<td>8. Impacts to groundwater quality?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
</tr>
<tr>
<td>9. Substantial reduction in the amount of groundwater otherwise available for public water supplies?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
</tr>
</tbody>
</table>

5.4.1. Water Delivery Impacts.

The average water allocation across all year types and SJRGA member agencies ranges from 33,530 acre-feet to 44,860 acre-feet; between 1.1 and 1.5 percent of the total water available from these parties (SJRGA 1999, p.4-9.) The greatest potential adverse impact occurs during below normal and dry years with Merced ID exhibiting the largest potential change in water supply. (Id.) Depending upon the water-year type and whether VAMP flows occur in April or May, the Merced ID would provide an average of 4.2 percent to 5.6 percent of their total water supplies to the proposed action. (Id.) The SJRECWA, OID/SSJID, and MID/TID, even with full allocation, provide 1.3 percent, 6.2 percent, and 2.6 percent respectively of their total supplies to meet their obligations under the SJRA. (SJRGA 1999, p.4-9.) This is considered a less-than-significant impact when there are full allocations. (Id.) OID committed to provide up to 26 TAF independent of water year type, but with conjunctive groundwater use, tailwater recovery, and conservation, the impact is less than significant. (Id.)
By comparison, if the SJRA were not extended and the 2006 Bay-Delta WQCP flows implemented instead, the SWRCB would proceed pursuant to the water right priority system. (SJRGA 1999, p.4-9.) An additional 62,000 AF would be required. (Id.) Consistent with the water right priority system, junior appropriators would be required to fully cease diverting, regardless of whether they are willing to cease diverting or able to do so without harm but since the SWRCB never conducted the water right phase of the Program of Implementation for the San Joaquin River Flow Objectives, an objective determination cannot be made, but is nonetheless considered a significant impact. (Id.) This impact is unlikely to occur within the one-year extension of the SJRA as flows will be provided through the SJRA.

5.4.1. Carryover Storage Impacts.

Carryover storage is affected regardless of whether the SJRA is extended. If the SJRA is extended New Melones carryover storage is impacted. (SJRGA 1999, p.4-15.) If the SJRA is not extended, the San Joaquin River Flow Objectives take effect, and diverters must cease diverting, consistent with the water right priority system, then carryover storage in New Don Pedro and New Exchequer would be impacted. (SJRGA 1999, p.4-16.) Whereas New Melones would gain 486,000 AF during a critical period from 1928 through 1934, New Don Pedro would lose 325,000 AF and New Exchequer would lose 47,000 AF.

5.4.2. Water Quality Impacts.

Not extending the SJRA through 2011 would result in the San Joaquin River Flow Objective taking effect. Modeling performed for the 1999-2010 SJRA EIS/EIR showed that salinity at Vernalis would be higher than it would be with VAMP flows at times when the objective would already be met. (SJRGA 1999, p.4-19.) Implementation of the one-year extension would be consistent with the modeling conducted for the 1999-2010 SJRA EIS/EIR that showed an overall reduction in the number of salinity standard exceedences at Vernalis with the most significant occurring in October of each year. The improvement in water quality (salinity) at Vernalis from the high-quality flows from the eastside tributaries should also maintain or improve water quality in the South Delta. (SJRGA 1999, p.4-19-20.)
5.5. Air Quality.

<table>
<thead>
<tr>
<th>Issues</th>
<th>Potentially Significant Impact</th>
<th>Potentially Significant Unless Mitigation Incorporated</th>
<th>Less-Than-Significant Impact</th>
<th>No Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Would the proposal:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Violate any air quality standard or contribute to an existing or projected air quality violation?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>2. Exposure of sensitive receptors to pollutants?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>3. Alter air movement, moisture, or temperature, or cause any change in climate?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>4. Create objectionable odors?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
</tbody>
</table>

Potential air quality impacts were considered in the 1999-2010 SJRA EIS/EIR and none were identified. (SJRGA 1999, pp. ES-4.) The one-year SJRA Extension in 2011 involves the release of surface water for the VAMP. It does not involve activities that would cause or contribute to any violations of air quality standards, alter air movement, moisture or temperature, change climates, or cause any objectionable odors.

5.6. Transport/Circulation.

<table>
<thead>
<tr>
<th>Issues</th>
<th>Potentially Significant Impact</th>
<th>Potentially Significant Unless Mitigation Incorporated</th>
<th>Less-Than-Significant Impact</th>
<th>No Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Would the proposal result in:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Increased vehicle trips or traffic congestion?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>2. Hazards to safety from design features (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>3. Inadequate emergency access or access to nearby uses?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>4. Insufficient parking capacity on-site or off-site?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>5. Hazards or barriers for pedestrians or bicyclists?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>6. Conflicts with adopted policies supporting alternative transportation (e.g., bus turnouts, bicycle racks)?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>7. Rail, waterborne, or air traffic impacts?</td>
<td>☐</td>
<td>☐</td>
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</tr>
</tbody>
</table>

The one-year SJRA Extension in 2011 involves the release of surface water for the VAMP. It does not involve construction, road closures, or other activities affecting or potentially affecting transportation. The SJRGA previously assessed the potential impact to such resources
in the 1998 EA/IS and determined it was not significant. (SJRGA 1999, p. 4-1.) This is not expected to change in 2011.

5.7. Biological Resources.

<table>
<thead>
<tr>
<th>Issues</th>
<th>Potentially Significant Impact</th>
<th>Potentially Significant Unless Mitigation Incorporated</th>
<th>Less-Than-Significant Impact</th>
<th>No Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Would the proposal result in impacts to:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Endangered, threatened or rare species or their habitats (including, but not limited to plants, fish, insects, animals, and birds)?</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
<td>☐</td>
</tr>
<tr>
<td>2. Locally designated species (e.g., heritage trees)?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>3. Locally designated natural communities (e.g., oak forest, coastal habitat, etc.)?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>4. Wetland habitat (e.g., marsh, riparian and vernal pool)?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>5. Wildlife dispersal or migration corridors?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
</tbody>
</table>

A list of special status species is included in the 1999-2010 SJRA EIS/EIR, as well as an analysis of the project’s potential impacts on such species. (SJRGA 1999, p. 3-83 – 3-97.) Furthermore, impacts to terrestrial and aquatic resources were addressed in Sections 4.4 and 4.5 of the 1999-2010 SJRA EIS/EIR. Impacts identified were either beneficial or less than significant. Ramping flow would ensure less than significant impacts to juvenile salmon by lessening the chances of stranding and scouring. (SJRGA 1999, pp. ES-10, 4-84 – 4-85.) These are not expected to change in 2011.


<table>
<thead>
<tr>
<th>Issues</th>
<th>Potentially Significant Impact</th>
<th>Potentially Significant Unless Mitigation Incorporated</th>
<th>Less-Than-Significant Impact</th>
<th>No Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Would the proposal result in impacts to:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Conflict with adopted energy conservation plans?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>2. Use non-renewable resources in a wasteful and inefficient manner?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>3. Result in the loss of availability of a known mineral resource that would be of future value to the region and the residents of the State?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
</tbody>
</table>

The one-year SJRA Extension for 2011 involves the release of surface water for the VAMP. It does not involve mining, new or altered energy use or consumption, or other activities
potentially impacting non-renewable energy resources. Use of stored water for VAMP flows would reduce storage available for hydropower production in New Don Pedro, but the impacts would be less than significant. (SJRGA 1999, p. 4-136.) For New Exchequer, decreased storage greater than 10 percent in Critical, Dry, and Below Normal years in June, July, and August is potentially significant and unavoidable, because the effects of changing the reservoir levels cannot be mitigated if water is made available for VAMP. (SJRGA 1999, p. 4-137.) Regardless, the hydropower impacts would not conflict with energy conservation plans, use non-renewable resources in a wasteful and inefficient manner, or result in the loss of available mineral resources. Although lost hydropower production could result in a shift to non-renewable energy sources, whether such a shift occurs and what the impacts of such a shift could be are determined by hydrologic conditions that cannot be determined at this time and therefore are speculative.

5.9. Hazards.

<table>
<thead>
<tr>
<th>Issues</th>
<th>Potentially Significant Impact</th>
<th>Potentially Significant Unless Mitigation Incorporated</th>
<th>Less-Than-Significant Impact</th>
<th>No Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. A risk of accidental explosion or release of hazardous substances (including, but not limited to: oil, pesticides, chemicals or radiation)?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>2. Possible interference with an emergency response plan or emergency evacuation plan?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>3. The creation of any health hazard or potential health hazard?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>4. Exposure of people to existing sources of potential health hazards?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>5. Increased fire hazards in areas with flammable brush, grass, or trees?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
</tbody>
</table>

The one-year SJRA Extension for 2011 involves the release of surface water for the VAMP. It does not involve construction or other activities that could cause or potentially cause new or increased noise levels, either in the long or short term. The SJRGA previously assessed the potential impact to such resources in the 1998 EA/IS and determined it was not significant. (SJRGA 1999, p. 4-1.) It remains so today and is not expected to change in 2011.
5.10. Noise.

<table>
<thead>
<tr>
<th>Issues</th>
<th>Potentially Significant Impact</th>
<th>Potentially Significant Unless Mitigation Incorporated</th>
<th>Less-Than-Significant Impact</th>
<th>No Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Would the proposal result in:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Increases in existing noise level?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-term</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
</tr>
<tr>
<td>Long-term</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
</tr>
<tr>
<td>2. Exposure of people to severe noise levels?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-term</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
</tr>
<tr>
<td>Long-term</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
</tr>
</tbody>
</table>

The 2011 SJRA Extension involves the acquisition of water for the VAMP. It does not involve construction or other activities that could cause or potentially cause new or increased noise levels, either in the long or short term. The SJRGA previously assessed the potential impact to such resources in the 1998 EA/IS and determined it was not significant. (SJRGA 1999, p. 4-1.) It remains so today and is not expected to change in 2011.

5.11. Public Services.

<table>
<thead>
<tr>
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<th>No Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Would the proposal have an effect upon, or result in a need for new or altered government services in any of the following areas:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Fire protection?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
</tr>
<tr>
<td>2. Police protection?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
</tr>
<tr>
<td>3. Schools?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
</tr>
<tr>
<td>4. Maintenance of public facilities, including roads?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
</tr>
<tr>
<td>5. Other governmental services?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
</tr>
</tbody>
</table>

The one-year SJRA Extension for 2011 involves the release of surface water for the VAMP. It does not involve the construction of new housing of other activities potentially increasing population and placing new or additional demand on police and/or fire protection, schools, maintenance of public facilities, or of other government services. The SJRGA previously assessed the potential impact to such resources in the 1998 EA/IS and determined it was not significant. (SJRGA 1999, p. 4-1.) It remains so today and is not expected to change in 2011.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Would the proposal result in a need for new systems or supplies, or substantial alternations to the following utilities:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Power or natural gas?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>✓</td>
</tr>
<tr>
<td>2. Communications systems?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>✓</td>
</tr>
<tr>
<td>3. Local of regional water treatment or distribution facilities?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>✓</td>
</tr>
<tr>
<td>4. Sewer or septic tanks?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>✓</td>
</tr>
<tr>
<td>5. Storm water drainage?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>✓</td>
</tr>
<tr>
<td>6. Solid waste disposal?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>✓</td>
</tr>
<tr>
<td>7. Local or regional water supplies?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>✓</td>
</tr>
</tbody>
</table>

The one-year SJRA Extension for 2011 involves the release of surface water for the VAMP. It does not involve construction, hazardous, flammable, or noxious chemicals, pesticides, or radioactive material. The SJRGA previously assessed the potential impact to such resources in the 1998 EA/IS and determined it was not significant. (SJRGA 1999, p. 4-1.) It remains so today and is not expected to change in 2011.


<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Would the proposal:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Affect a scenic vista or scenic highway?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>✓</td>
</tr>
<tr>
<td>2. Have a demonstrable negative aesthetic effect?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>✓</td>
</tr>
<tr>
<td>3. Create light or glare?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>✓</td>
</tr>
</tbody>
</table>

The one-year SJRA Extension for 2011 involves the release of surface water for the VAMP. It does not involve construction or other activities potentially affecting scenic vistas, having any demonstrable negative aesthetic effects, or creating any light or glare. The SJRGA previously assessed the potential impact to such resources in the 1998 EA/IS and determined it was not significant. (SJRGA 1999, p. 4-1.) It remains so today and is not expected to change in 2011.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Would the proposal:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Disturb paleontological resources?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>2. Disturb archeological resources?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>3. Affect historical resources?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>4. Have the potential to cause a physical change which would affect unique ethnic cultural values?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>5. Restrict existing religious or sacred uses within the potential impact area?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
</tbody>
</table>

The one-year SJRA Extension for 2011 involves the release of surface water for the VAMP. It does not involve construction or other infrastructure changes that could damage or destroy paleontological, archeological, or historical resources or otherwise affect unique ethnic cultural values or religious or sacred uses. The SJRGA previously assessed the potential impact to such resources in the 1998 EA/IS and determined it was not significant. (SJRGA 1999, p. 4-1.) It remains so today and is not expected to change in 2011.

5.15. Recreation.

<table>
<thead>
<tr>
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<th>Less-Than-Significant Impact</th>
<th>No Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Would the proposal:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Increase the demand for neighborhood or regional parks or other recreational facilities?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>2. Affect existing recreational opportunities?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
</tbody>
</table>

The one-year SJRA Extension for 2011 involves the release of surface water for the VAMP. It does not increase population or otherwise involve activities potentially generating increased demand for park services or recreational opportunities.

The SJRGA evaluated the potential for impacts on recreation in the 1999-2010 SJRA EIS/EIR and determined that any impacts would be beneficial. (SJRGA 1999, p. ES-14.) New Melones would have higher reservoir levels in September in Critical years. In addition, less than
critical flows would occur less frequently in the Merced River in Critical, Dry, and Below Normal years. (Id.) It remains so today and is not expected to change in 2011.

5.16. Mandatory Findings of Significance.

<table>
<thead>
<tr>
<th>Issues</th>
<th>Potentially Significant Impact</th>
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<th>No Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat for fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>2. Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>3. Does the project have impacts that are individuals limited, but cumulatively considerable? (“Cumulatively considerable” means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>4. Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly? Disturb paleontological resources?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
</tbody>
</table>
6. Determination

On the basis of this initial evaluation:

☑ I find that the Proposed Project COULD NOT have a significant impact on the environment, and a NEGATIVE DECLARATION will be prepared.

☐ I find that although the Proposed Project could have a significant effect on the environment, there WILL NOT be a significant effect in this case because project-specific mitigation measures have been added to the project. A MITIGATED NEGATIVE DECLARATION will be prepared.

☐ I find that the Proposed Project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

Signature

Dennis Westcot

Printed Name

San Joaquin River Group Authority

Date

February 11, 2011

For
7. Report Preparation

Kenneth Petruzzelli
O’Laughlin &Paris LLP
Attorneys for the San Joaquin River Group Authority

8. References

All these documents are available for review during normal business hours at the Modesto Irrigation Irrigation District office located at 1231 11th Street, Modesto, CA 95354 or available on the Internet.


EXECUTIVE SUMMARY

ES.1 BACKGROUND

The San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay/Delta Estuary) is a critically important part of California’s natural environment and economy. In recognition of the serious problems facing the region and the complex resource management decisions that must be made, the Federal government and the State of California are working together to stabilize, protect, and restore ecological health and improve water management for beneficial uses in and from the Bay/Delta Estuary. The San Joaquin River Group Authority (Authority or SJRGA) is working with the State and Federal governments to facilitate meeting these needs as related to the San Joaquin River: increased instream flows, the 1995 State Water Resources Control Board (SWRCB) Water Quality Control Plan (WQCP) flow objectives at Vernalis, and the Delta Smelt Biological Opinion.

As part of these ongoing efforts, the Draft San Joaquin River Agreement (SJRA)\(^1\) was developed as an alternative that provides a level of protection equivalent to the San Joaquin River flow objectives contained in the State Water Resources Control Board’s 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (1995 WQCP: SWRCB 1995). Discussion over the flow objectives led to a proactive problem-solving process to develop an adaptive fishery management plan and the water supplies (from willing sellers on the San Joaquin River system) to support that plan. The SJRA includes the Vernalis Adaptive Management Plan (VAMP).

The SJRA identifies where the water to support the VAMP study would be obtained, specifically from the San Joaquin River Group Authority whose members are making the water available\(^2\). It is a “performance agreement” (VAMP flows) and a water acquisition (other flows) wherein the U.S. Department of the Interior, Bureau of Reclamation (Reclamation) and the Department of Water

\(^1\) The SJRA proposes, among other things, a San Joaquin River flow and State Water Project/Central Valley Project export study during the April-May Pulse Flow Period and a mechanism by which the SWRCB can issue an order to implement the San Joaquin River portion of the 1995 Water Quality Control Plan for the Bay/Delta Estuary. Implement means to provide the flows and establish the pumping regimen called for in the SJRA which the parties to the SJRA intend will provide environmental benefits in the lower San Joaquin River and Delta at a level of protection equivalent to the San Joaquin River Portion of the 1995 WQCP.

\(^2\) Members of the San Joaquin River Group Authority (Authority) are: Modesto Irrigation District (MID), Turlock Irrigation District (TID), South San Joaquin Irrigation District (SSJID), San Joaquin River Exchange Contractors Water Authority (Exchange Contractors), Merced Irrigation District (Merced ID), Oakdale Irrigation District (OID), and the Friant Water Users Authority. Willing sellers for the proposed action are: MID, TID, SSJID, Exchange Contractors, Merced ID, and OID.
Resources (DWR) pay the Authority to ensure that water supplies are available for instream flows as needed up to prescribed limits.

There are two appendixes to the SJRA that relate to the proposed action. Appendix A is the VAMP, a conceptual framework for protection and experimental determination of juvenile chinook salmon survival within the lower San Joaquin River, the adaptive management study. Appendix B provides for planning and operation coordination for VAMP. The SJRA was completed in April 1998, and its implementation requires that the NEPA and CEQA documentation be completed by March 1, 1999. This Final Environmental Impact Statement / Environmental Impact Report (EIS/EIR) is prepared in compliance with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA).

The affected portions of the San Joaquin River and its tributaries (Stanislaus, Tuolumne, and Merced rivers) are located in the Central Valley of California. The rivers and related storage and conveyance facilities are located in the following counties: Fresno, Madera, Mariposa, Merced, San Joaquin, Stanislaus, Tuolumne, and Calaveras.

**ES.2 PROJECT PURPOSE AND NEED**

The purpose of the proposed project is to acquire water identified in the SJRA and use the water for:

- a pulse flow for a 31-day period at Vernalis during April and May, and
- other flows identified by the Central Valley Project Improvement Act (CVPIA) water acquisition plan, with concurrence by the Fish and Wildlife Service (Service), to facilitate migration and attraction of anadromous fish including fall attraction flows and other flows as needed by the adaptive management study, with concurrence by the Service, to support anadromous fish and environmental benefits in the project area.

This water is needed to support VAMP and to provide protective measures for fall-run chinook salmon in the San Joaquin River. The adaptive management study means that the flow requirement would change annually in response to hydrologic and biologic conditions. As a result, varying amounts of water would be needed. The additional water for other flows would be used for ramping around the pulse flow to assist in protection of salmon redds, to assist in control of water temperature, and to assist in improving water quality. Since the water released would increase instream flows in the lower San Joaquin River, it also improves compliance with the 1995 WQCP Vernalis objectives and with the San Joaquin River component of Delta Smelt Biological Opinion. (See Section ES.4 for additional information on the sources, amounts, and timing of the flows.)

Section 3406(b)(1) of the CVPIA requires the development of a program that will make all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991. As one element of the Draft Anadromous
Fish Restoration Program (AFRP), Reclamation has a need to obtain water on the Stanislaus, Tuolumne, Merced, and Lower San Joaquin rivers to provide additional flows at times that will facilitate migration, attraction, production, and survival of anadromous fish on these rivers in accordance with specific fish, wildlife, and habitat restoration purposes authorized by the CVPIA.

Reclamation proposes to contract for water on the San Joaquin River and its tributaries under P.L. 102-575, Title 34, Section 3406(b)(3) of the CVPIA. Water may be acquired by Reclamation to meet fish and wildlife needs within the San Joaquin Valley under the authority of Sections 3406(b)(3) of the CVPIA. The CVPIA amended the purposes of the Central Valley Project (CVP) to achieve a reasonable balance among competing demands for use of CVP water for fish and wildlife, agriculture, municipal and industrial, and power contractors.

The State Water Resources Control Board (SWRCB) approved the final Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary in May 1995. The 1995 WQCP includes objectives for Delta outflow, Sacramento and San Joaquin River flows, salinity, dissolved oxygen, and State Water Project (SWP) and Central Valley Project (CVP) operations. It presents a combination of Delta inflow and outflow objectives, water quality objectives, and project operation criteria. These requirements are specified temporally and vary depending on the hydrologic condition and the biological needs of various fish species.

The March 6, 1995 Biological Opinion (Opinion) for Threatened Delta Smelt, Delta Smelt critical habitat, and the proposed Threatened Sacramento Splittail approved Reclamation’s operations to provide flows and pursue acquisition of additional water (acquired flow) in order to provide San Joaquin River flows at Vernalis in excess of those exported by the CVP and SWP (USFWS 1995). Any such enhancement flows would be in excess of those attributable to CVP New Melones releases, unregulated accretions, or unstorable flows, and would not be exported at the Delta pumping facilities. As a result of this Opinion, Reclamation has a requirement to acquire water within the San Joaquin River Watershed to maximize the ability of the CVP to meet this commitment.

**ES.3 PUBLIC AND AGENCY INVOLVEMENT**

Reclamation and the Authority distributed a Notice of Preparation of a Joint EIS/EIR on supplying water to meet the flow objectives for the proposed VAMP on November 25, 1997 to about 160 agencies and individuals. The notice announced three public scoping meetings for January 6–8, 1998, and requested that comments on the content of this EIS/EIR be submitted by January 16, 1998. Issues raised at the meetings and in comment letters are discussed in each section of Chapter 4, Environmental Consequences and Mitigation Measures. Public review of the Draft EIS/EIR was conducted over the period September 25, 1998 to November 10, 1998. (See Appendix H, Responses to Comments.) Recirculation of the Draft EIS/EIR is not necessary, because all of the comments received resulted in minor modifications to the Draft EIS/EIR. This Final EIS/EIR has been sent to all agencies and individuals who commented on the Draft EIS/EIR.
Reclamation has also issued a newsletter covering topics related to the San Joaquin River Agreement. The first newsletter was published in May 1998, a second was distributed in September 1998 to 225 agencies and individuals, and a third newsletter was sent to 250 agencies and individuals in January 1999. Information on the proposed action is also available on Reclamation’s web page (www.mp.usbr.gov), and the detailed model results for the hydrologic analysis are available upon request.

The principal mechanism for agency involvement in the EIS/EIR is the San Joaquin River Agreement Joint Steering/Cooperating Agency Committee. Participating agencies are described in Chapter 5, Consultation and Coordination.

**ES.4 ALTERNATIVES CONSIDERED AND PREFERRED ALTERNATIVE**

The proposed action/proposed project is a 12-year, long-term water supply program, outlined in the San Joaquin River Agreement, for instream flows in the San Joaquin River system and has three components:

- **VAMP Flow:** Water from the Authority, for achieving the VAMP 31-day pulse flow (April-May), is provided by the Authority member agencies and is capped at 110,000 acre-feet in any year (Table 2.1-1 in Section 2.1). There is also the potential for additional water from willing sellers who are members of the Authority for VAMP implementation above the 110,000 acre-feet.

- **October Flow:** Additional water (12,500 acre-feet) from Merced Irrigation District (Merced ID) would be available for delivery during October of all years.

- **OID:** Additional water (15,000 acre-feet) from Oakdale Irrigation District (OID) would be available, plus the difference between water committed to the VAMP pulse flow by OID (11,000 acre-feet) and what is actually used. This water provided by OID would be used for various fish and wildlife benefits including additional instream flows on the Stanislaus during the months when fish are present, ramping of flow changes on the Stanislaus following high flow periods, implementing pre-VAMP and post-VAMP ramping objectives during the spring flow period, water for fall attraction flows, temperature control in the lower Stanislaus River during the summer and fall periods, and/or banked in New Melones Reservoir for the purpose of using the additional water to augment flows in subsequent dry years. The final decision for the use of this water for fish and wildlife purposes would be made by the Service annually, following consultation with other Federal and State agencies.
Executive Summary

The proposed project is for the Authority to make water available over the period 1999–2010 for release to the San Joaquin River and its tributaries. The quantity and precise timing of the proposed releases vary depending on hydrologic conditions.

In addition to the no action and proposed action, one other alternative was determined to meet the project’s purpose and need, the SWRCB Water Right Priority System Alternative. This alternative is assumed to be Flow Alternative 3 in the SWRCB’s Draft Environmental Impact Report for Implementation of the 1995 Bay/Delta Water Quality Control Plan (DEIR; SWRCB 1997). This alternative has the capabilities to meet the SWRCB’s 1995 Water Quality Control Plan Vernalis flow objectives assigned to water right holders based on a water right priority system. Under this alternative, up to 38 water right holders share responsibility to implement flow objectives. Junior appropriative water right holders are required to cease diversions before senior appropriative water right holders are affected (based on the “first-in-time, first-in-right” principle). This alternative would involve different water right holders than the proposed action and different quantities of water being released into the San Joaquin River system.

ES.5 SUMMARY OF SIGNIFICANT ENVIRONMENTAL EFFECTS AND MITIGATION

Table ES-1 provides a summary of all of the environmental effects and mitigation for both the proposed action and the alternative action. Impact statements are often abbreviated; see Chapter 4 for the complete statements of impact. The Mitigation Monitoring Program required by CEQA is described in Appendix G. Symbols used in the table are:

- S: Significant adverse impact
- SU: Significant unavoidable adverse impact
- PS: Potentially significant adverse impact
- PSU: Potentially significant unavoidable adverse impact
- LS: Less-than-significant adverse impact
- N: No adverse impact
- B: Beneficial impact
- na: Not applicable

### Table ES-1: SUMMARY COMPARISON OF ALTERNATIVE IMPACTS

<table>
<thead>
<tr>
<th>Impact</th>
<th>Proposed Action</th>
<th>Alternative Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without Mitigation</td>
<td>With Mitigation</td>
</tr>
<tr>
<td><strong>Surface Water</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Water Deliveries</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deliveries reduced to Merced Irrigation District during critically dry years and under below normal or dry hydrologic conditions under certain sequential hydrologic conditions; however, implementation of a conjunctive use program would augment surface water supplies.</td>
<td>PS</td>
<td>LS</td>
</tr>
<tr>
<td>Deliveries reduced to Oakdale Irrigation District during critically dry years; however, implementation of</td>
<td>PS</td>
<td>LS</td>
</tr>
</tbody>
</table>
Executive Summary

conjunctive use, reclamation, and increased efficiencies would augment surface water supplies.

Average annual deliveries reduced within the San Joaquin River Basin by 62,000 acre-feet; at times, complete curtailment of junior water rights appropriators. Mitigation unknown.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Proposed Action</th>
<th>Alternative Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without Mitigation</td>
<td>With Mitigation</td>
</tr>
<tr>
<td><strong>Water Storage</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carryover water storage improved for New Melones Reservoir.</td>
<td>B</td>
<td>na</td>
</tr>
<tr>
<td>Carryover water storage reduced for New Don Pedro Reservoir.</td>
<td>LS</td>
<td>na</td>
</tr>
<tr>
<td>Carryover water storage reduced for Lake McClure during below normal or dry hydrologic conditions.</td>
<td>PSU</td>
<td>na</td>
</tr>
<tr>
<td><strong>Water Quality</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exceedence of water quality standards reduced on San Joaquin River at Vernalis in October.</td>
<td>B</td>
<td>na</td>
</tr>
<tr>
<td>Exceedence of salinity standards reduced on San Joaquin River at Vernalis in June and July, and potentially in November or August.</td>
<td>B</td>
<td>na</td>
</tr>
<tr>
<td>Salinities reduced with April or May pulse flow.</td>
<td>B</td>
<td>na</td>
</tr>
<tr>
<td>Water quality would improve at Vernalis from November through March.</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Exceedence of salinity standards increased on San Joaquin River at Vernalis in June, July, and August. Mitigation would require additional releases from New Melones.</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td><strong>Groundwater</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No groundwater from the SSJID service area would be used to provide water for pulse flow; overdrafting would be unaffected.</td>
<td>N</td>
<td>na</td>
</tr>
<tr>
<td>A minor amount of groundwater from the OID service area</td>
<td>LS</td>
<td>na</td>
</tr>
</tbody>
</table>
(up to 15,000 acre-feet) would be used to provide water for instream flows, but the groundwater would be recharged by inflow from the Stanislaus River.

<table>
<thead>
<tr>
<th>Groundwater Source</th>
<th>Use for Pulse Flow</th>
<th>Water Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modesto Groundwater Basin</td>
<td>No</td>
<td>N na na na</td>
</tr>
<tr>
<td>Turlock Groundwater Basin</td>
<td>No</td>
<td>N na na na</td>
</tr>
<tr>
<td>Stanislaus River</td>
<td>Groundwater could indirectly be used to replace surface water used for the flows from the Merced ID (up to 67,500 acre-feet, 12% of the typical annual production); however, implementation of conjunctive use, reclamation, and increased efficiencies would augment groundwater supplies.</td>
<td>PS LS na na</td>
</tr>
<tr>
<td>Exchange Contractors service area</td>
<td>Groundwater may be used to supplement surface water deliveries in order to achieve the 1995 WQCP Vernalis flow objectives; however, implementation of conjunctive use, reclamation, and increased efficiencies would augment groundwater supplies.</td>
<td>na na PS LS</td>
</tr>
<tr>
<td>SSJID service area</td>
<td>No groundwater from the SSJID service area would be used to provide water for pulse flow; water levels would be unaffected.</td>
<td>N na na na</td>
</tr>
<tr>
<td>OID service area</td>
<td>Up to 15,000 acre-feet of groundwater from the OID service area would be used to provide water for instream flows, but the groundwater would be recharged by inflow from the Stanislaus River; the water levels would be unaffected.</td>
<td>N na na na</td>
</tr>
<tr>
<td>MID</td>
<td>No groundwater would be used to provide water for the pulse flow from MID; water levels in the Modesto Groundwater Basin would be unaffected.</td>
<td>N na na na</td>
</tr>
<tr>
<td>Turlock Groundwater Basin</td>
<td>No groundwater from the Turlock Groundwater Basin would be used to provide water for the pulse flow; water levels would be unaffected.</td>
<td>N na na na</td>
</tr>
<tr>
<td>Merced Groundwater Basin</td>
<td>Groundwater from the Merced Groundwater Basin could indirectly be used to replace surface water for the flows (up to 67,500 acre-feet, 12% of the typical annual production); implementation of conjunctive use, reclamation, and increased efficiencies would augment groundwater supplies.</td>
<td>PS LS na na</td>
</tr>
</tbody>
</table>
however, implementation of conjunctive use, reclamation, and increased efficiencies would augment groundwater supplies.

Groundwater from the Exchange Contractors service area could provide all of the water for the pulse flow (up to 11,000 acre-feet, 2.2% of the Delta Mendota Basin production rate).

Groundwater may be used to supplement surface water deliveries in order to achieve the 1995 WQCP Vernalis flow objectives; however, implementation of conjunctive use, reclamation, and increased efficiencies would mitigate use of groundwater.

Water Quality

No groundwater from the SSJID service area would be used to provide water for pulse flow; there would be no impact on water quality.

A minor amount of groundwater from the OID service area would be used to provide water for instream flows, but the groundwater would be recharged by inflow from the Stanislaus River; there would be no impact on water quality.

No groundwater from the Modesto Groundwater Basin would be used to provide water for the pulse flow; there would be no impact on water quality.

No groundwater from the Turlock Groundwater Basin would be used to provide water for pulse flow; there would be no impact on water quality.

Groundwater from the Merced Groundwater Basin could indirectly be used to replace surface water for the flows; TDS levels may increase slightly.

Groundwater could provide all of the water for the pulse flow from the Exchange Contractors service area; TDS levels may increase slightly.

Groundwater may be used to supplement surface water deliveries in order to achieve the 1995 WQCP Vernalis flow objectives; there could be an impact on water quality; however, limiting or restricting groundwater pumping in restricted areas, conjunctive use, and increased efficiencies could augment groundwater supplies.

Subsidence
No groundwater from the SSJID service area would be used to provide water for pulse flow; there would be no impact on subsidence.

Up to 15,000 acre-feet of groundwater from the OID service area would be used to provide water for instream flows, but the groundwater would be recharged by inflow from the Stanislaus River; there would be no impact on subsidence.

No groundwater from the Modesto Groundwater Basin would be used to provide water for the pulse flow; there would be no impact on subsidence.

No groundwater from the Turlock Groundwater Basin would be used to provide water for pulse flow; there would be no impact on subsidence.

Groundwater (up to 67,500 acre-feet) from the Merced Groundwater Basin could indirectly be used to replace surface water for the flows; there could be an impact on subsidence. However, limiting groundwater pumping in highly overdrafted areas, importing water, and developing or expanding recharge areas would reduce the impact.

Groundwater (up to 11,000 acre-feet) could provide all of the water for the pulse flow from the Exchange Contractors; the impact on subsidence is less than significant.

Approximately 62,000 acre-feet of groundwater may be used to supplement surface water deliveries in order to achieve the 1995 WQCP Vernalis flow objectives; there could be an impact on subsidence. However, limiting groundwater pumping in highly overdrafted areas, importing water, and developing or expanding recharge areas could reduce the impact to less than significant.

Agricultural Subsurface Drainage

The 31-day pulse flow and other flows would not have an impact on agricultural seepage.

Raised water levels in the San Joaquin River could affect seepage, but groundwater pumped to replace reductions in surface water deliveries would produce a less-than-significant effect on agricultural drainage.

Terrestrial Resources
**Riparian Vegetation**

May pulse flows interfere with Fremont cottonwood initiation; most likely operation would be for pulse flows to begin mid-April. Ramping flows to minimize flow changes are part of the proposed project.

<table>
<thead>
<tr>
<th></th>
<th>LS</th>
<th>na</th>
<th>LS</th>
<th>na</th>
</tr>
</thead>
</table>

Stable summer base flows would increase likelihood of invasion by narrowleaf willow, but FERC mandated flows in the Tuolumne would preclude such an impact.

<table>
<thead>
<tr>
<th></th>
<th>LS</th>
<th>na</th>
<th>LS</th>
<th>na</th>
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</thead>
</table>

No threatened or endangered plant species and no relic vegetation types would be affected.

<table>
<thead>
<tr>
<th></th>
<th>LS</th>
<th>na</th>
<th>LS</th>
<th>na</th>
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</thead>
</table>

**Wildlife**

Ramping rates and April pulse flows would reduce loss of wildlife habitat and decrease the potential for riparian corridor fragmentation.

<table>
<thead>
<tr>
<th></th>
<th>LS</th>
<th>na</th>
<th>LS</th>
<th>na</th>
</tr>
</thead>
</table>

The impacts to wildlife, especially TES species would be insignificant.

<table>
<thead>
<tr>
<th></th>
<th>LS</th>
<th>na</th>
<th>LS</th>
<th>na</th>
</tr>
</thead>
</table>

**Aquatic Resources**

**Factors Affecting Distribution and Abundance of Aquatic Resources**

Water quality improved; no adverse impacts on aquatic resources.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>na</th>
<th>N</th>
<th>na</th>
</tr>
</thead>
</table>

**Chinook Salmon**

Flow changes on all rivers would result in non-measurable or less-than-significant impacts to fall-run chinook salmon.

<table>
<thead>
<tr>
<th></th>
<th>N/LS</th>
<th>na</th>
<th>LS</th>
<th>na</th>
</tr>
</thead>
</table>

Flows increased in April/May and October on all rivers that benefit emigrating salmon smolts and immigrating adults.

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>na</th>
<th>na</th>
<th>na</th>
</tr>
</thead>
</table>

Rapid changes in flows in the spring and fall may affect juvenile salmon and salmon redds; however, ramping of flows would ensure the impacts would be less than significant.

<table>
<thead>
<tr>
<th></th>
<th>PS</th>
<th>LS</th>
<th>na</th>
<th>na</th>
</tr>
</thead>
</table>

Impacts to female fecundity in November from possibly high water temperature would have a low frequency of occurrence.

<table>
<thead>
<tr>
<th></th>
<th>LS</th>
<th>na</th>
<th>na</th>
<th>na</th>
</tr>
</thead>
</table>
### Executive Summary

<table>
<thead>
<tr>
<th>Species</th>
<th>Impact on Flows</th>
<th>Action Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minimal effects on water temperature in Merced River.</strong></td>
<td>LS na na na na</td>
<td></td>
</tr>
<tr>
<td>Decreasing seasonal air temperature dominates release temperatures.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced flows in February on the Merced River and in May on the Stanislaus River in critically dry periods would affect juvenile salmon. Mitigation could include increased smolt production.</td>
<td>na na PS LS</td>
<td></td>
</tr>
<tr>
<td><strong>Steelhead</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steelhead found only in the Stanislaus River. Flows increased during most months, in all water year types.</td>
<td>B na na na na</td>
<td></td>
</tr>
<tr>
<td>Reduced flows in May on the Stanislaus River during critically dry periods could affect juvenile steelhead. Mitigation could include increased smolt production.</td>
<td>na na PS LS</td>
<td></td>
</tr>
<tr>
<td>Occasional flow increases during summer months on the Stanislaus River would benefit over-summering juveniles.</td>
<td>na na B na</td>
<td></td>
</tr>
<tr>
<td><strong>Striped Bass</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flows increased during the spawning period, especially during dry and critically dry years.</td>
<td>B na na na na</td>
<td></td>
</tr>
<tr>
<td>Flows reduced in the Merced River during above normal and wet years with a potential reduction of available spawning.</td>
<td>LS na na na na</td>
<td></td>
</tr>
<tr>
<td>Flows increased during the spawning period in the Merced River.</td>
<td>na na B na</td>
<td></td>
</tr>
<tr>
<td>Flows reduced in the Stanislaus and Tuolumne rivers during the spawning period.</td>
<td>na na LS na</td>
<td></td>
</tr>
<tr>
<td>Increased flows in the summer months may benefit maturing striped bass fry in offsite locations (within the Delta).</td>
<td>na na B na</td>
<td></td>
</tr>
<tr>
<td><strong>Splittail</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flows increased during the spawning period, especially during dry and critically dry years.</td>
<td>B na na na na</td>
<td></td>
</tr>
<tr>
<td>Flows decreased on the Merced River during the spawning period during above normal and wet years.</td>
<td>LS na na na na</td>
<td></td>
</tr>
<tr>
<td>Flows increased during the spawning period in the Merced River.</td>
<td>na na B na</td>
<td></td>
</tr>
<tr>
<td>Flows reduced in the Stanislaus and Tuolumne rivers</td>
<td>na na LS na</td>
<td></td>
</tr>
</tbody>
</table>
**Executive Summary**

<table>
<thead>
<tr>
<th>Reservoir Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>No impacts to largemouth bass.</td>
</tr>
<tr>
<td>Habitat impacted at New Don Pedro Reservoir and Lake McClure.</td>
</tr>
<tr>
<td>Habitat impacted at New Melones Reservoir.</td>
</tr>
</tbody>
</table>

**Delta smelt and longfin smelt**

Flows provided by the proposed action would be in compliance with the 1995 Biological Opinion for the operation of the CVP and SWP. No significant impacts to delta or longfin smelt would occur during the spring or fall pulse flows or with the alternative action’s increased flows.

**Land Use**

<table>
<thead>
<tr>
<th>Population and Population Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>No adverse impacts on local populations or local population growth.</td>
</tr>
<tr>
<td>No impacts on municipal users, therefore no impact to population density.</td>
</tr>
<tr>
<td>Users with junior water rights who serve municipal water users would have deliveries curtailed 20 to 60% of the time in April-May. Groundwater could be used to replace surface water reductions.</td>
</tr>
<tr>
<td>Population densities under constrained growth would remain stable.</td>
</tr>
</tbody>
</table>

**Regional Economy and Employment**

| Short-term impacts on jobs from reduced farm production avoided by substituting groundwater for surface water supplies. | LS | na | na | na |
| Job losses less than significant, but output and income losses could be significant. Mitigation measures include groundwater substitution, conjunctive use, conservation, and tailwater recovery. | na | na | S | LS |
## Executive Summary

### Agricultural Land Use

Potential reduction of 104,500 acre-feet of Authority’s water to irrigation customers could adversely impact cropping patterns and productivity. However, most of this surface water would be replaced by groundwater including conjunctive use water or come from carryover storage.

Reduced deliveries by Merced ID could adversely affect agricultural production in the short term, but this decline in productivity would be mitigated through a conjunctive use project and by groundwater pumping by individual farmers.

Cropping patterns could change and crop production could be reduced. Mitigation measures include alternative sources of water.

<table>
<thead>
<tr>
<th>PS</th>
<th>LS</th>
<th>na</th>
<th>na</th>
</tr>
</thead>
</table>

### Cultural Resources

#### Reservoirs

Recreation use increased at New Melones during critically dry years; potential for cultural resource damage could increase.

<table>
<thead>
<tr>
<th>LS</th>
<th>na</th>
<th>LS</th>
<th>na</th>
</tr>
</thead>
</table>

Recreation use not affected at New Don Pedro Reservoir and Lake McClure, so no indirect impact.

Lower reservoir levels at New Don Pedro Reservoir may expose potential cultural resources to impact from recreationists.

<table>
<thead>
<tr>
<th>na</th>
<th>na</th>
<th>LS</th>
<th>na</th>
</tr>
</thead>
</table>

#### Rivers

No adverse impacts to cultural resources on San Joaquin, Stanislaus, or Tuolumne rivers.

<table>
<thead>
<tr>
<th>N</th>
<th>na</th>
<th>na</th>
<th>na</th>
</tr>
</thead>
</table>

Frequency of streamflows below critical flow decreased in critical, dry, and below normal years on Merced River; recreation use could increase and therefore could increase potential for cultural resource damage.

<table>
<thead>
<tr>
<th>LS</th>
<th>na</th>
<th>na</th>
<th>na</th>
</tr>
</thead>
</table>

Frequency of flows above the critical threshold increase on the San Joaquin River, but the short-term impact on cultural resources is less than significant.

<table>
<thead>
<tr>
<th>na</th>
<th>na</th>
<th>LS</th>
<th>na</th>
</tr>
</thead>
</table>

During critical water years, recreation use could increase or decrease on the San Joaquin River depending on the various critical thresholds or optimal ranges; the short-term impact on cultural resources is less than significant.

| na | na | LS | na |
Recreation use is beneficially impacted on the Stanislaus River and could, therefore, increase the potential for damage to cultural resources. Mitigation measures could include implementation of a protection plan.

### Recreation

<table>
<thead>
<tr>
<th>Reservoirs</th>
<th>na</th>
<th>na</th>
<th>PS</th>
<th>LS</th>
</tr>
</thead>
<tbody>
<tr>
<td>No adverse impact to recreationists at any of the reservoirs.</td>
<td>N</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Reservoir levels increased at New Melones in critical years in September.</td>
<td>B</td>
<td>na</td>
<td>B</td>
<td>na</td>
</tr>
<tr>
<td>Reservoir levels decreased at New Don Pedro Reservoir during critical water years.</td>
<td>na</td>
<td>na</td>
<td>LS</td>
<td>na</td>
</tr>
<tr>
<td>No impacts on reservoir levels at Lake McClure.</td>
<td>na</td>
<td>na</td>
<td>N</td>
<td>na</td>
</tr>
</tbody>
</table>

### Rivers

| Frequency of streamflows below critical flow decreased in critical, dry, and below normal years on Merced River. | B  | na | na | na |
| No adverse impacts to recreation on San Joaquin, Stanislaus, or Tuolumne rivers. | N  | na | na | na |
| Frequency of streamflows above critical flow increased in all years on San Joaquin River; however, the recreation opportunities above this threshold are unknown. | na | na | PSU| na |
| During critically dry years, San Joaquin River streamflows would provide both beneficial and adverse impacts to recreationists. | na | na | LS | na |
| Frequency of streamflows in optimal ranges for boating increased on the Stanislaus River. | na | na | B  | na |
| No adverse impacts to recreation on Tuolumne or Merced rivers. | na | na | N  | na |

### Energy Resources

<table>
<thead>
<tr>
<th>Reservoirs</th>
<th>na</th>
<th>na</th>
<th>B</th>
<th>na</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage increased at New Melones Reservoir during June, July, and August thus increasing potential for hydropower generation.</td>
<td>B</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Storage decreased at New Don Pedro Reservoir during peak power production months thus decreasing potential for hydropower generation.</td>
<td>LS</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
</tbody>
</table>
**Executive Summary**

<table>
<thead>
<tr>
<th>Storage decreased greater than 10% at Lake McClure in critical, dry, and below normal years during peak power production months thus decreasing potential for hydropower generation.</th>
<th>PSU</th>
<th>na</th>
<th>na</th>
<th>na</th>
</tr>
</thead>
<tbody>
<tr>
<td>There are less-than-significant impacts to potential hydropower production on any of the reservoirs.</td>
<td>na</td>
<td>na</td>
<td>LS</td>
<td>na</td>
</tr>
</tbody>
</table>

**Rivers**

<table>
<thead>
<tr>
<th>Releases increased on Stanislaus River could increase hydropower generation.</th>
<th>LS</th>
<th>na</th>
<th>na</th>
<th>na</th>
</tr>
</thead>
<tbody>
<tr>
<td>Releases increased on Tuolumne River could increase hydropower generation.</td>
<td>B</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Flows decreased more than 10% on Merced River in above normal years in June thus decreasing potential for hydropower generation.</td>
<td>PSU</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>There are less-than-significant impacts to potential hydropower production on the Stanislaus, Tuolumne, or Merced rivers.</td>
<td>na</td>
<td>na</td>
<td>LS</td>
<td>na</td>
</tr>
<tr>
<td>No hydropower generation is generated on the lower San Joaquin River so there are no impacts.</td>
<td>N</td>
<td>na</td>
<td>N</td>
<td>na</td>
</tr>
</tbody>
</table>

**Indian Trust Assets**

<table>
<thead>
<tr>
<th>Reservoirs</th>
<th>N</th>
<th>na</th>
<th>N</th>
<th>na</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indian Trust Assets are not located at any of the reservoirs.</td>
<td>N</td>
<td>na</td>
<td>N</td>
<td>na</td>
</tr>
<tr>
<td>Rivers</td>
<td>N</td>
<td>na</td>
<td>N</td>
<td>na</td>
</tr>
<tr>
<td>Indian Trust Assets do not occur along any of the rivers in the project area.</td>
<td>N</td>
<td>na</td>
<td>N</td>
<td>na</td>
</tr>
</tbody>
</table>

**Environmental Justice**

<table>
<thead>
<tr>
<th>Aquatic Resources</th>
<th>N</th>
<th>na</th>
<th>N</th>
<th>na</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beneficial impacts to fisheries would not affect environmental justice.</td>
<td>N</td>
<td>na</td>
<td>N</td>
<td>na</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recreation Resources</th>
<th>N</th>
<th>na</th>
<th>na</th>
<th>na</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beneficial impacts to recreation in rivers and reservoirs would not affect environmental justice.</td>
<td>N</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Less-than-significant adverse impacts to New Don Pedro Reservoir during critical water years would not impact environmental justice.</td>
<td>na</td>
<td>na</td>
<td>N</td>
<td>na</td>
</tr>
<tr>
<td>Impact Description</td>
<td>S</td>
<td>SU</td>
<td>PS</td>
<td>PSU</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------</td>
<td>---</td>
<td>----</td>
<td>----</td>
<td>-----</td>
</tr>
<tr>
<td>Potentially significant adverse or beneficial impacts to recreationists on the</td>
<td>na</td>
<td>na</td>
<td>N</td>
<td>na</td>
</tr>
<tr>
<td>San Joaquin River would not impact environmental justice.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are no impacts on either the Stanislaus, Tuolumne, or Merced rivers.</td>
<td>na</td>
<td>na</td>
<td>N</td>
<td>na</td>
</tr>
</tbody>
</table>

S: Significant adverse impact
SU: Significantly unavoidable adverse impact
PS: Potentially significant adverse impact
PSU: Potentially significant unavoidable adverse impact
LS: Less-than-significant adverse impact
N: No adverse impact
B: Beneficial impact
na: Not applicable
## Executive Summary

**EXECUTIVE SUMMARY**

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</tr>
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<tr>
<td>ES.3 PUBLIC AND AGENCY INVOLVEMENT</td>
<td>3</td>
</tr>
<tr>
<td>ES.4 ALTERNATIVES CONSIDERED AND PREFERRED ALTERNATIVE</td>
<td>4</td>
</tr>
<tr>
<td>ES.5 SUMMARY OF SIGNIFICANT ENVIRONMENTAL EFFECTS AND MITIGATION</td>
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</tr>
</tbody>
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1. PURPOSE OF AND NEED FOR ACTION

INTRODUCTION

The Bureau of Reclamation (Reclamation) and the San Joaquin River Group Authority (Authority) are jointly preparing this Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for meeting the flow objectives for the Draft San Joaquin River Agreement (SJRA or Agreement) over the 12-year period 1999-2010. It documents the environmental consequences of acquiring and using flows specified in the Agreement. This chapter describes the purpose of the proposed action or project, why it is needed, and what the project proposes to accomplish (objectives). Also it provides information on the history of the proposed project and the regulatory authority to conduct it.

The Agreement developed as an alternative that provides a level of protection equivalent to the San Joaquin River flow objectives contained in the State Water Resources Control Board’s 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (1995 WQCP: SWRCB 1995). Discussion over the flow objectives led to a proactive problem-solving process to develop an adaptive fishery management plan and the water supplies (from willing sellers on the San Joaquin River system) to support that plan. The SJRA includes the Vernalis Adaptive Management Plan (VAMP) and identifies where the water to support the fishery study would be obtained, specifically from the San Joaquin River Group Authority whose members are making the water available.¹ The Agreement is a “performance agreement” (VAMP flows) and a water acquisition program (other flows) wherein Reclamation and the Department of Water Resources pay the Authority to ensure that water supplies are available for instream flows as needed up to prescribed limits.

Reclamation proposes to contract for water on the San Joaquin River and its tributaries under P.L. 102-575, Title 34, Section 3406(b)(3) of the Central Valley Project Improvement Act (CVPIA).

1.1 HISTORY OF PROJECT

On December 15, 1994, the federal government, the State of California, and urban, agricultural and environmental interests reached the principles for agreement on a comprehensive, coordinated package of actions designed to provide interim protection to the San Francisco Bay and Sacramento-San Joaquin River Delta Estuary. That agreement is referred to as the 1994 Bay-Delta Accord (Accord), which was recently extended to December 15, 1998. Many of the coordinated package of actions agreed upon in the Accord were subsequently adopted by the State Water Resources Control Board (SWRCB) in their 1995 Water Quality Control Plan (1995 WQCP) (95-1 WR by SWRCB Resolution No. 95-24).

¹ Members of the San Joaquin River Group Authority (Authority) are: Modesto Irrigation District (MID), Turlock Irrigation District (TID), South San Joaquin Irrigation District (SSJID), San Joaquin River Exchange Contractors Water Authority (Exchange Contractors), Merced Irrigation District (Merced ID), Oakdale Irrigation District (OID), and Friant Water Users Authority. Willing sellers for the proposed action are: MID, TID, SSJID, Exchange Contractors, Merced ID, and OID.

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1. Purpose of and Need for Action

In June 1995, the San Joaquin Tributaries Association (SJTA) filed a lawsuit over the State Board’s adoption of the 1995 WQCP. SJTA’s complaint asserted that the 1995 WQCP was invalid for several reasons, chief among these was: (1) the lack of adequate scientific review and data necessary to design a flow objective for the San Joaquin River; (2) inadequate capability of the San Joaquin Basin water users to supply these flows without significant social and economic harm; and (3) the dispute over the State Board’s authority to require senior water rights holders to supply increased flows while the junior export projects were still allowed to pump significant quantities of San Joaquin flow (SJRTA 1996). In an effort to resolve the issues related to this legal dispute, the Authority proposed, in May 1996, an alternative that provides a level of protection equivalent to the San Joaquin River flow objectives in the 1995 WQCP. This proposed agreement was presented to the State and Federal governments in a document titled “Letter of Intent among Export Interests and San Joaquin River Interests to Resolve San Joaquin River Issues Related to Protection of Bay/Delta Environmental Resources” and became known as the Letter of Intent (LOI). The LOI resulted in an attempt to resolve the San Joaquin River flow objective dispute through a consensus building and problem-solving process.

A “Conceptual Framework for Protection and Experimental Determination of Juvenile Chinook Salmon Survival within the Lower San Joaquin River” (SJRA Appendix A) in response to river flow and State Water Project/Central Valley Project (SWP/CVP) exports was developed by Dr. Bruce Herbold and Dr. Chuck Hanson. From that study framework, a collaborative effort of scientists from state and federal agencies and stakeholder groups developed the VAMP to gather additional scientific fisheries information on the lower San Joaquin River. Based on the San Joaquin River flow and export targets identified in VAMP, a program was developed between the state and federal resource agencies, export interests, environmental community representatives, and San Joaquin River stakeholders. This process culminated in the development of the San Joaquin River Agreement. The VAMP study is joined with the other provisions of the Agreement to provide environmental benefits in the lower San Joaquin River and Delta, at a level of protection equivalent to the 1995 WQCP for the duration of the project.

In 1997, prior to completion of the Agreement, Reclamation initiated a one-year water acquisition on the San Joaquin River to help meet the VAMP target flows. In 1998, water acquisition contracts were completed with willing sellers to ensure that water would be available for the 1998 Spring Pulse Flow. Due to the wet hydrologic condition in April-May 1998, the supplemental water was not required.

1.2 PURPOSE OF AND NEED FOR ACTION

As required under the National Environmental Policy Act of 1969 as amended (NEPA), this section presents a concise statement of the proposed action’s purpose and need, followed by a more complete explanation.

1.2.1 Statement of Purpose and Need
1. Purpose of and Need for Action

The purpose of the proposed project is to acquire water identified in the SJRA and use the water for:

- a pulse flow for a 31-day period at Vernalis during April and May, and

- other flows identified by the CVPIA water acquisition plan, with concurrence by the Fish and Wildlife Service (Service), to facilitate migration and attraction of anadromous fish, including fall attraction flows and other flows as needed by the adaptive management study, with concurrence by the Service, to support anadromous fish and provide environmental benefits in the project area.

This water is needed to support the VAMP and to provide protective measures for fall-run chinook salmon in the San Joaquin River. The adaptive management study means that the flow requirement is to change annually in response to hydrologic and biologic conditions. As a result, varying amounts of water would be needed. The additional water for other flows would be used for ramping around the pulse flow, to assist in the protection of salmon redds, to assist in control of water temperature, and to assist in improving water quality. Since the water would increase instream flows in the lower San Joaquin River, it also improves compliance with the 1995 WQCP Vernalis objectives and with the Delta Smelt Biological Opinion.

1.2.2 Explanation of Need for Project

The San Francisco Bay/Sacramento-San Joaquin Delta Estuary is a critically important part of California’s natural environment and economy. In recognition of the serious environmental problems facing the region and the complex resource management decisions that must be made, the Federal government and the State of California are working together with stakeholders to stabilize, protect, and restore ecological health and improve water management for beneficial uses in and from the Bay/Delta Estuary. The proposed project is needed to help these environmental activities by providing necessary information on what flows are needed in the San Joaquin River system. The results of the adaptive management studies will be evaluated to help determine the appropriate Vernalis flow objective after 2010.

The Authority is working cooperatively with the State and Federal governments to assist in meeting the following needs as explained below: increased instream flows, the 1995 WQCP Vernalis objectives, and the Delta Smelt Biological Opinions (the 1995 Operations Criteria and Plan opinion and the April 26, 1996 opinion on temporary barriers).

Increased Instream Flows

Section 3406(b)(1) of the Central Valley Project Improvement Act (CVPIA) requires the development of a program that will “…make all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991….” As one element of the Draft Anadromous Fish Restoration Program (AFRP), Reclamation has a need to obtain water on the Stanislaus, Tuolumne, Merced, and Lower San Joaquin rivers to provide additional flows at times that will facilitate migration,
attraction, production, and survival of anadromous fish on these rivers in accordance with specific fish, wildlife, and habitat restoration purposes authorized by the CVPIA.

1995 WQCP Objectives

SWRCB approved the final *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* in May 1995. The 1995 WQCP includes objectives for Delta outflow, Sacramento and San Joaquin River flows, salinity, dissolved oxygen, and SWP and CVP operations. It presents a combination of Delta inflow and outflow objectives, water quality objectives, and project operation criteria. These requirements are specified temporally and vary depending on the hydrologic condition and the biological needs of various fish species. In accordance with the 1994 Principles for Agreement and the Delta Smelt and Winter-Run Chinook Salmon Biological Opinions, the CVP and SWP are meeting these 1995 WQCP objectives for the Delta. Specifically for the San Joaquin River objectives, the CVP attempts to meet the objectives to the extent possible and consistent with its other obligations.

The flow objectives for the San Joaquin River as measured at Vernalis have been debated in regards to the inadequacy of scientific information relating to salmon smolt survival. In an effort to clarify the scientific basis for the flow objective and resolve the uncertainty, the San Joaquin River and State/Federal export interests (federal and state agencies, irrigation districts, water authorities, and other water interests) collaborated to identify feasible voluntary actions to protect the San Joaquin River’s fish resources; help implement the State Board’s fishery objectives; and evaluate flow, export pumping, and salmon smolt survival relationships. This collaboration led to a scientifically-based adaptive fishery management plan known now as the VAMP. The Draft San Joaquin River Agreement to implement VAMP provides the basis for the project information here and in Chapter 2. The SJRA provides water to enhance instream flows for anadromous fish and a methodology for establishing flows.

Delta Smelt Biological Opinion

The March 6, 1995 Biological Opinion (Opinion) for Threatened Delta Smelt, Delta Smelt critical habitat, and the proposed Threatened Sacramento Splittail approved Reclamation’s operations to provide flows and pursue acquisition of additional water (acquired flow) in order to provide San Joaquin River flows at Vernalis in excess of those exported by the CVP and SWP (USFWS 1995). Any such enhancement flows would be in excess of those attributable to CVP New Melones releases, unregulated accretions, or unstorable flows, and would not be exported at the Delta pumping facilities. As a result of this Opinion, Reclamation has a requirement to acquire water within the San Joaquin River Watershed to maximize the ability of the CVP to meet this commitment.

1.3 PROJECT OBJECTIVES

The proposed project’s objective is to use water secured from willing sellers to provide additional instream flows for the San Joaquin River system. The additional instream flows include a 31-day pulse flow during April and May and other fishery-related flows (e.g., October flow) identified by the CVPIA water acquisition program (Section 3406 (b)(3)) and contained in
1. Purpose of and Need for Action

the SJRA. A description of the proposed stream flow enhancements, or underlying action with specific quantities by willing seller, is provided in Section 2.1, Proposed Action.

Flows for VAMP would be targeted to reach the Vernalis gaging station on the San Joaquin River. The specific objectives of VAMP are: (1) to implement protective measures for San Joaquin River fall-run chinook salmon within the framework of a carefully designed management and study program which is designed to achieve, in conjunction with other non-VAMP measures, a doubling of natural salmon production by improving smolt survival through the Delta; (2) to gather scientific information on the effects of flows in the lower San Joaquin River, CVP and SWP export pumping rates, and operation of a fish control structure at the head of Old River, on the survival and passage of salmon smolts through the Delta; and (3) to provide environmental benefits in the lower San Joaquin River and Delta at a level of protection equivalent to the San Joaquin River portion of the 1995 WQCP for the duration of the Agreement (1999-2010).

The VAMP is also intended to provide benefits through managed and unmanaged flow regimens (underlying action), reduced rates of export during the Spring Pulse Flow Period (related action), and installation of a fish control structure at the head of Old River (related action). All of these actions are expected to contribute to improved conditions aimed at assisting in achieving a doubling of natural production of chinook salmon consistent with the provisions of state and federal law. Some of these actions (exports and barrier operation) are not part of this document’s proposed action which is to provide the water to support VAMP and related flows.


- It obligates the Authority and its members to provide the amount of water needed to achieve the April–May Target Flow for VAMP or 110,000 acre-feet, whatever is less. Additional water, in excess of the 110,000 acre-feet required to be provided by the Authority members, may be purchased from willing sellers (if available) to meet the Target Flow for VAMP.

- The Agreement provides for Merced Irrigation District to sell 12,500 acre-feet above the existing flow for release to the Merced River during October of all years as attraction flow.

- The Agreement also provides for Oakdale Irrigation District (OID) to sell 15,000 acre-feet in every year of the Agreement plus the difference between the water made available by OID for VAMP pulse flow (11,000 acre-feet) and the amount actually used. The additional water from OID could be used for ramping around the Spring or October pulse flows or at other times to supplement spawning flows or control water temperature on the Stanislaus River. The final decision for the use of this water for fish and wildlife purposes would be made by the Service annually, following consultation with other Federal and State agencies.
1. Purpose of and Need for Action

The Agreement is a “performance agreement” for the VAMP flows in that Reclamation and the California Department of Water Resources will make annual payments to the Authority so long as Authority members perform under the terms of the Agreement. It is also a water acquisition program for the related flows. An important source of funding will be the CVPIA Restoration Fund. The funds paid to the Authority are intended to be used substantially to enhance efficient water management within the districts including, but not limited to, water reclamation, conservation, conjunctive use, and system improvements.

In addition to the total water available from the Agreement for VAMP (110,000 acre-feet), an additional amount of water would be purchased from Merced ID and OID for release at other times during the year to meet objectives of Public Law 102-575, Title 34, Section 3406(b)(3) of the CVPIA. This section requires that a program be developed and implemented in coordination with and in conformance to the AFRP. The U.S. Department of the Interior is developing a long-term program to address the acquisition of water to sustain long-term fish and wildlife supply needs for the entire Sacramento-San Joaquin Delta watershed. The objectives of the long-term program include securing long-term water supplies to supplement the available CVP yield that was dedicated for fish and wildlife purposed under Section 3406 (b)(2). The San Joaquin River Agreement will be included in the long-term program. Additional amounts of water not specified in the Agreement (and not evaluated here) that are to be included in the long-term program would undergo an independent analysis for NEPA/CEQA compliance.

1.4 AUTHORITY FOR PROJECT

The authority for the proposed project is derived principally from the CVPIA. The CVPIA amended the purposes of the CVP to achieve a reasonable balance among competing demands for use of CVP water for fish and wildlife, agriculture, municipal and industrial, and power contractors.

Section 3406(b)(1) requires the development and implementation of a program (AFRP) that will make all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable on a long-term basis, at levels that are at least twice the average levels attained during the period 1967-1991. Reclamation will attempt to meet these requirements through habitat and instream flow improvements in the Delta and the San Joaquin River Basin.

Water may be acquired by Reclamation to meet fish and wildlife needs within the San Joaquin Valley under the authority of Section 3406(b)(3) of the CVPIA. Section 3406(b)(3) provides for the acquisition of water from willing sellers on the streams for the following two specific purposes: “... to supplement the quantity of water dedicated to fish and wildlife purposes under Section 3406(b)(2)... and to fulfill the Secretary’s obligations under Section 3406(d)(2)...” Water obtained from willing sellers would be used to provide increased instream flows in specific months to improve habitat, in accordance with preliminary information developed by the AFRP. Acquiring water for the proposed action on the Stanislaus, Tuolumne, Merced, and San Joaquin rivers is authorized specifically under this section of the CVPIA.
1. Purpose of and Need for Action

In addition, the CVPIA “Final Administrative Proposal on the Management of Section 3406(b)(2) Water” (USBR 1997n) identifies supplemental instream flows including a 31-day pulse flow during April and May for VAMP.

1.5 RELATED PROJECTS

This EIS/EIR is one piece of a “puzzle” to manage resources in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay/Delta). Figure 1.5-1 illustrates that this EIS/EIR relates to other major projects and programs in the Bay/Delta region. This EIS/EIR covers a water management program for the San Joaquin River system, and this system is also affected by the other programs. The Agreement water under CVPIA Section 3406 (b)(3) influences the following actions:

- State Water Resources Control Board Bay/Delta Process (SWRCB 95-1) including water rights hearings
- Central Valley Project Improvement Act (especially Section 3406(b)(2))
- Interim South Delta Program (Reclamation and DWR)
- CALFED Bay-Delta Program

Each of these actions is described in Section 4.12, Cumulative Effects.
1. Purpose of and Need for Action

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2. ALTERNATIVES INCLUDING PROPOSED ACTION

This section describes the range of alternatives that were identified as potential options to the proposed action. In order to determine if each alternative was reasonable and practicable in meeting the project’s purpose and need, evaluation criteria were developed. A screening process, utilizing the evaluation criteria, was employed to select those alternatives which were determined to be reasonable and practicable thus warranting detailed impact analyses.

2.1 PROPOSED ACTION (PREFERRED ALTERNATIVE)

2.1.1 Description

The proposed action/proposed project is a 12-year, long-term water supply program, outlined in the San Joaquin River Agreement, for instream flows in the San Joaquin River system and has three components:

- Vernalis Adaptive Management Plan (VAMP) Flow: Water from the San Joaquin River Group Authority (Authority), for achieving the VAMP 31-day pulse flow (April-May), is guaranteed water from Authority member agencies and is capped at 110,000 acre-feet in any year (Table 2.1-1). There is also the potential for additional water from willing sellers who are members of the Authority for VAMP implementation above the 110,000 acre-feet required under the Agreement.

- October Flow: Additional water (12,500 acre-feet) from Merced Irrigation District (Merced ID) would be available for delivery during October of all years.

- OID: Additional water (15,000 acre-feet) from Oakdale Irrigation District (OID) would be available, plus the difference between water made available for the VAMP pulse flow by OID (11,000 acre-feet) and what is actually used. This water provided by OID would be used for various fish and wildlife benefits including supplemental instream flows on the Stanislaus during the months when fish are present, ramping of flow changes on the Stanislaus following high flow periods, implementing pre-VAMP and post-VAMP ramping objectives during the spring flow period, water for fall attraction flows, temperature control in the lower Stanislaus River during the summer and fall periods, and/or banked in New Melones Reservoir for the purpose of using the additional water to augment flows in subsequent dry years. The final decision for the use of this water for fish and wildlife purposes would be made by the Service annually, following consultation with other Federal and State agencies.

Each of these components is described in greater detail in Section 2.1.3. The proposed project is for the Authority to make water available over the period 1999–2010 for release to the San Joaquin River and its tributaries. The proposed releases vary both in total amount and in the tributaries as
shown in Table 2.1-1 and explained as a single- or double-step target flow in Section 2.1.3.1, depending on hydrologic conditions.

The Agreement obliges the Authority to provide water at Vernalis, and members of the Authority have flexibility under the Division Agreement (Table 2.1-1) on a year to year basis for who would provide the water.

Table 2.1-1: HIERARCHY FOR THE PROVISION OF THE PULSE FLOW (31-DAY PERIOD) FOR VERNALIS ADAPTIVE MANAGEMENT PLAN (110,000 AF)

<table>
<thead>
<tr>
<th>Entity (in order of providing flow)</th>
<th>First 50,000 AF</th>
<th>Next 23,000 AF</th>
<th>Next 17,000 AF</th>
<th>Next 20,000 AF</th>
<th>Totals 110,000 AF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merced</td>
<td>25,000</td>
<td>11,500</td>
<td>8,500</td>
<td>10,000</td>
<td>55,000</td>
</tr>
<tr>
<td>OID/SSIJD</td>
<td>10,000</td>
<td>4,600</td>
<td>3,400</td>
<td>4,000</td>
<td>22,000</td>
</tr>
<tr>
<td>Exchange Contractors</td>
<td>5,000</td>
<td>2,300</td>
<td>1,700</td>
<td>2,000</td>
<td>11,000</td>
</tr>
<tr>
<td>MID/TID</td>
<td>10,000</td>
<td>4,600</td>
<td>3,400</td>
<td>4,000</td>
<td>22,000</td>
</tr>
</tbody>
</table>

Note: Water is available in the amounts listed such that the water needed is distributed throughout the system. For purposes of this analysis, these are the flows that were used. The San Joaquin River Technical Committee (Operations Group) will determine best management of flow releases during the pulse flow period to achieve target flows.

2.1.2 Location

The affected portions of the San Joaquin River and its tributaries (Stanislaus, Tuolumne, and Merced Rivers) are located in the Central Valley of California (Figure 2.1-1). The rivers and related storage and conveyance facilities are located in the following counties: Fresno, Madera, Mariposa, Merced, Stanislaus, and Tuolumne. The project area is defined by river as follows:

- **San Joaquin River**: From Vernalis to point of release by the San Joaquin River Exchange Contractors Water Authority. The point of release is most often north of the town of Los Banos, but releases could be made as far upstream as the Mendota Pool.

- **Stanislaus River**: From its confluence with the San Joaquin River to and including New Melones Dam and Reservoir.

- **Tuolumne River**: From its confluence with the San Joaquin River to and including New Don Pedro Dam and Reservoir.

- **Merced River**: From its confluence with the San Joaquin River to and including New Exchequer Dam/Lake McClure.

These rivers are located between the communities of Stockton on the north and Mendota on the south. Figure 2.1-1 illustrates the project area and vicinity.

2.1.3 Characteristics

The specific characteristics of the proposed project (preferred alternative) consist of three flow components.
2. Alternatives Including Proposed Action

2.1.3.1 VAMP Flows

VAMP flows are guaranteed water supplies for the April-May pulse flow from the Authority of up to 110,000 acre-feet per year to support VAMP. The Authority proposes to cause to flow in the San Joaquin River at Vernalis during each April and May, a 31-day pulse flow period, the amount of water needed to achieve the Target Flow (described below) or up to 110,000 acre-feet, whichever is less. Additional water (in excess of the required water, possibly up to a total of 160,000 acre-feet) necessary to achieve VAMP Test Target Flow may be available on a “willing seller basis.”

- The Pulse Flow Period is defined as a period of 31 continuous days during the months of April and May. This is anticipated to be the period that most of the juvenile anadromous fish migrate out of the tributaries, through the Delta, and into the Pacific Ocean in order to complete their life cycle. It is expected to occur most often between mid-April and mid-May. The timing of the pulse flow is to coincide with the peak period of time when naturally spawned smolts are migrating out of the San Joaquin River Basin.

- The Target Flow is a specific flow regime between 2,000 and 7,000 cubic feet per second (cfs) for the Pulse Flow Period. It consists of the existing flow, plus either a single-step incremental increase in flow (over existing flow) or a double-step increase, depending on hydrologic conditions.

The 31-day out-migration Target Flow would be established as follows:

**Single-Step Target Flow.** Unless modified by the subsequently listed criteria, the annual 31-day out-migration Target Flow equals:

<table>
<thead>
<tr>
<th>Existing Flow (cfs)</th>
<th>Target Flow (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–1,999</td>
<td>2,000</td>
</tr>
<tr>
<td>2,000–3,199</td>
<td>3,200</td>
</tr>
<tr>
<td>3,200–4,449</td>
<td>4,450</td>
</tr>
<tr>
<td>4,450–5,699</td>
<td>5,700</td>
</tr>
<tr>
<td>5,700–6,999</td>
<td>7,000</td>
</tr>
<tr>
<td>7,000 or greater</td>
<td>Existing flow</td>
</tr>
</tbody>
</table>

When the existing flow exceeds 7,000 cfs, the Authority would use its best efforts to maintain a constant or stable flow rate during the Pulse Flow Period to the extent reasonably possible through cooperating in development of an operations plan and coordination of operations during the Spring Pulse Flow. During high flow events such as those occurring in Spring 1998 (20,000

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1 The need for “up to” 160,000 acre-feet derives from the mathematics of the double-step target flows and the 110,000 acre-feet cap as described in Appendix A, Hydrologic Analysis. In the maximum exposure case where the “existing flow” is 4,450 cfs and the double-step increment requires a target flow of 7,000 cfs, the required flow would amount to approximately 2,550 cfs to get to 7,000 cfs. This amounts to approximately 156,800 acre-feet for the 31-day period. The SIRA identifies that willing sellers could provide the 50,000 acre-feet over and above the 110,000 acre-feet cap when it is available. Additional NEPA/CEQA analysis would be required, as who would provide the water and on which river is not known at this time.
2. Alternatives Including Proposed Action

cfs), it may not be possible to maintain a constant flow rate at Vernalis during the 31-day pulse flow period.

**Double-Step Target Flow.** In any year when the sum of the current year’s 60-20-20 Indicator and previous year’s 60-20-20 Indicator is seven or greater, an annual 31-day out-migration flow target will be the Target Flow one level higher than that established by the single-step Target Flow. The 60-20-20 Indicator is the numeric adjunct to the State Water Resource Control Board’s (SWRCB’s) San Joaquin Valley Water Year Hydrologic Classification that is used to establish Target Flows and certain responsibilities of the parties to the Agreement. The San Joaquin Valley Water Year Hydrologic Classification was developed as an index of wetness and water supply availability within the San Joaquin River basin. The index is mathematically derived as the summation of 0.6 times the current year’s April–July San Joaquin Valley unimpaired runoff, plus 0.2 times the current year’s October–March unimpaired runoff, plus 0.2 times the lesser of 4.5 or the previous year’s index (thus the “60-20-20” reference). The streams used in the index are the Stanislaus, Tuolumne, Merced and the San Joaquin. The index defines five different year types: wet, above normal, below normal, dry and critical. Each of these year types has been designated a numeric indicator by the Agreement.

The 60-20-20 Indicator for VAMP is as follows:

<table>
<thead>
<tr>
<th>SJR Basin 60-20-20 Classification</th>
<th>60-20-20 Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet</td>
<td>5</td>
</tr>
<tr>
<td>Above Normal</td>
<td>4</td>
</tr>
<tr>
<td>Below Normal</td>
<td>3</td>
</tr>
<tr>
<td>Dry</td>
<td>2</td>
</tr>
<tr>
<td>Critical</td>
<td>1</td>
</tr>
</tbody>
</table>

For example, assuming a dry year followed by a wet year results in the sum of 7 (i.e., 2 + 5 = 7). Assuming the single-step Target Flow is 5,700 cfs, one step higher would be 7,000 cfs.

If achieving the double-step requires more than the 110,000 acre-feet of supplemental water, additional water from willing sellers on the San Joaquin, Stanislaus, Tuolumne, and Merced rivers (approximately 50,000 acre-feet) may be acquired by the Bureau of Reclamation (Reclamation) for the Pulse Flow Period, and it would require additional NEPA/CEQA analysis.

**Sequential Dry Year Relaxation.** During years when the sum of the current year’s 60-20-20 indicator and the previous two years’ 60-20-20 Indicator is four (4) or less, the Authority’s members will not be required to make water available above existing flow, except as may be provided by Merced and Oakdale Irrigation Districts or any of the districts under the willing sellers provision of the SJRA. Reclamation has continuing obligations to meet San Joaquin River flows pursuant to the March 6, 1995 Biological Opinion and may acquire water in excess of the amounts to be provided by Authority members under the Agreement.

**Operations Plan.** Reclamation and the California Department of Water Resources (DWR) will develop an operations plan in conjunction with tributary facilities operators (the San Joaquin River Technical Committee). By February 15 of each year 1999–2010, the initial version of this
2. Alternatives Including Proposed Action

plan will be described. The plan would be evaluated for NEPA/CEQA compliance, and related
actions not covered in this EIS/EIR or other NEPA/CEQA documentation would be evaluated at
that time for potential environmental impacts. Then in early April, flow and export targets
would be finalized and releases scheduled to meet the target flows at Vernalis. The operations
plan is to be updated periodically.

2.1.3.2 October Flow

Merced ID would provide 12,500 acre-feet of water to enhance flows in October to attract adult
salmon returning into the tributaries to spawn. It would be released from storage or provided as
re-operated flood control releases.

2.1.3.3 Oakdale Irrigation District

Contained within the Agreement is the provision that Reclamation would purchase up to 15,000
acre-feet of water from OID. In addition, Reclamation will purchase any remaining share from
OID after it has met its commitment (11,000 acre-feet) to support the target flows at Vernalis.
The Agreement states that this water may be used for any authorized purpose of the New
Melones Project. The water would be held in storage and subsequently reallocated to these
authorized uses in subsequent years.

If this water is purchased under the authority of Central Valley Project Improvement Act
(CVPIA) Section 3406 (b)(3), its use would be to “...supplement the quantity of water dedicated
to fish and wildlife purposes...” It could also be used to firm up other environmental purposes
of the New Melones Project and CVPIA. The environmental purposes of New Melones which
could benefit from the additional water provided by OID would include the following: instream
flows on the Stanislaus, ramping of flow changes on the Stanislaus, implementation of VAMP
and post-VAMP ramping objectives under CVPIA, releases of water to meet San Joaquin base
flows consistent with X2 requirements, releases of water to provide fall attraction flows, salinity
control at Vernalis, temperature control in the lower Stanislaus, and improved carryover storage
in New Melones for the purpose of reducing risk of future shortage. Full use of the acquired
OID water for environmental purposes may result in New Melones Project supplies being
available for other purposes. The specific allocation of the New Melones Project supplies will be
addressed in future interim operations plans and ultimately in the long-term operations plan for
New Melones Reservoir.

2.1.4 Sources of Water

The sources for the water provided to Reclamation under the San Joaquin River Agreement are:
re-regulation or surface water storage, groundwater, tailwater recovery, and conservation. The
amounts of water available by source per the Agreement (Table 2.1-2) represent a potential
range to reflect varying hydrologic conditions that could occur over the 12-year period of the
proposed project. The total amount of water for all three components described in Section 2.1.1
is up to 137,500 acre-feet.
Table 2.1-2 includes only the 110,000 acre-feet for the VAMP Target Flow. It does not include the 50,000 acre-feet above the 110,000 acre-feet cap that may be needed for the maximum exposure case (see Section 2.1.3.1).

A brief discussion of these types of sources follows.

**Regulation or Surface Water Storage.** Much of the water would come from changes in existing diversions or release patterns at non-Central Valley Project (CVP) facilities pursuant to the sellers’ applicable water rights. Water may also be provided from willing sellers that have water stored in New Melones Reservoir. The end of year storage could change, depending on the amount of water provided by re-regulation or within the year pattern of storage during the year.

**Groundwater.** Several districts pump groundwater to meet part of their water delivery needs. Although surface water storage is the principal source of water to meet instream flow objectives under the Agreement, some willing sellers may be able to rely on groundwater supplies directly or indirectly to replace surface water depending on hydrologic conditions.
2. Alternatives Including Proposed Action

Table 2.1-2: SOURCES OF AVAILABLE WATER FOR PROPOSED PROJECT (TAF)

<table>
<thead>
<tr>
<th>Source</th>
<th>Exchange Contractors</th>
<th>OID¹</th>
<th>SSJID</th>
<th>MID</th>
<th>TID</th>
<th>Merced ID²</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulation or Surface Water Storage</td>
<td>0</td>
<td>0-26</td>
<td>0-11</td>
<td>0-11</td>
<td>0-11</td>
<td>0-67.5</td>
<td>0-126.5</td>
</tr>
<tr>
<td>Groundwater</td>
<td>0-11</td>
<td>0-15</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0-26</td>
</tr>
<tr>
<td>Tailwater Recovery³</td>
<td>0-11</td>
<td>0-15</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0-5³</td>
<td>0-31</td>
</tr>
<tr>
<td>Conservation</td>
<td>0-11</td>
<td>0-20</td>
<td>0-5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0-47</td>
</tr>
</tbody>
</table>

Range of Available Water

0-11.0 0-26.0 0-11.0 0-11.0 0-11.0 0-67.5 0-137.5

Notes:
- Water includes 15,000 acre-feet for release at any time during the year.
- Water includes 12,500 acre-feet for delivery in October for fall attraction flow.
- No groundwater will be provided directly for meeting VAMP target flows. Groundwater would be pumped to help meet potential water supply impacts from increased releases from New Exchequer Reservoir (Lake McClure).
- Tailwater is not used as a direct release to canals/rivers for pulse flow. Rather it replaces other water released.
- Merced ID will attempt to recover greater quantities of tailwater; however, the current tailwater quantities are small and drain to areas that are not hydraulically connected to the San Joaquin River.
- Conservation projects will be undertaken on an “as needed” basis to improve operations and reduce unrecoverable losses. These projects may include improvements to canals and other projects.
- Total includes the 110,000 acre-feet for the Spring Pulse Flow plus the additional water in notes 1 and 2 above.

Tailwater Recovery. Reuse of tailwater flows is defined as the act or act(s) of reclaiming surface water from irrigated lands into a surface supply system. This can be achieved either by gravity or by low lift pumps. The recovered water would be reused within the political boundaries of the agency or agencies from which it originated.

Conservation. Water conservation measures are those that would result in water savings from increased water management efficiencies. Conserved water is water that has historically been used and is now available for use as a result of implementing specific conservation measures that create a water savings by reducing water uses or losses. These savings can be achieved by reducing losses to evaporation, transpiration, percolation, or surface outflows. For example, lining canals reduces water lost to percolation. Savings can also be achieved by implementation of different means of water distribution such as drip irrigation.

2.1.5 Scope of Project

The proposed project would occur on an annual basis over the period 1999 through 2010. The results of the experimental studies would be evaluated to help determine the appropriate Vernalis flow objective after 2010. The Agreement covers the 12-year period 1999-2010. Any project for the post-2010 period would be subject to additional NEPA and CEQA analyses.

This EIS/EIR addresses only the underlying action in the SJRA of providing for San Joaquin River water identified in the Agreement for VAMP and for other related flows in the San Joaquin River.
Non-flow aspects of VAMP and other aspects of CVPIA-related water operations are related actions that are not within the scope of this document and have independent applicability to NEPA or in some cases have no NEPA requirement. This document evaluates the impacts of the flows on the environment with a focus on potential impacts to the following resources and concerns: surface water, groundwater, biological resources (vegetation, wildlife, fisheries), land use (including agriculture), recreation, cultural resources, Indian Trust Assets, and environmental justice. This EIS/EIR focuses on potentially significant impacts and addresses non-significant issues at a reduced level of detail. Cumulative and other short- and long-term impacts are evaluated as well. What is being evaluated herein is the underlying action of providing water and its subsequent release for instream flow according to the amounts and schedule of the Agreement.

There are several related projects contained in the Agreement that are not part of the project being evaluated herein. DWR’s barrier at the head of Old River is part of the Interim South Delta Program (ISDP) and is addressed in separate NEPA/CEQA proceedings (DWR 1996). Finally, export targets and operations are outside of the scope of the water supply action and this document. Exports of water from the Delta include actions under the CVPIA and are included in the range of actions evaluated in the 1997 Draft PEIS. This range of actions includes both no export and export of acquired water for streams under Section 3406(b)(3). Also, see Figure 1.5-1, programs for the cumulative analysis.

The combined Central Valley Project/State Water Project (CVP/SWP) exports for the VAMP are set at 1,500, 2,250, or 3,000 cfs (as provided in the Agreement) during the April through May, 31-day Pulse Flow Period, or the exports are further constrained by other Delta criteria. These export targets (Table 2.1-3) are necessary to complete the salmon survival studies which constitute the monitoring and adaptive management component of VAMP. The combination of flow and export targets are consistent with the existing Biological Opinions. Export limits would be included in the operations plan described in Section 2.1.3.1. If the operations plan is unacceptable to any Party in the Agreement, then the export limits in Table 2.1-3 shall not apply during that calendar year. However, Reclamation and DWR shall not be constrained in the operation of their respective project.

<table>
<thead>
<tr>
<th>Exports</th>
<th>Vernalis Flow Rate - cfs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7,000</td>
</tr>
<tr>
<td>1,500 cfs</td>
<td>X</td>
</tr>
<tr>
<td>2,250 cfs</td>
<td></td>
</tr>
<tr>
<td>3,000 cfs</td>
<td>X</td>
</tr>
</tbody>
</table>
2. Alternatives Including Proposed Action

2.1.6 Required Approvals and Permits

No alterations of stream channels would occur under the proposed action. No permit is required from the U.S. Army Corps of Engineers to implement the flows. There are SWRCB permits required for the water purchases for release to the rivers. The SJRGA agencies have filed a petition for a change in place and purpose of use to preserve or enhance wetlands habitat, fish and wildlife resources, and recreation in or on the water pursuant to Water Code Section 1707. OID and SSJID are applying/filing petitions for a change in place and purpose of use for exchanges with Modesto Irrigation District (MID). A description of environmental commitments from Federal and State agencies is provided in Section 5.3.

2.2 OTHER REASONABLE ALTERNATIVE

In addition to the no action and proposed action, one other alternative was determined to meet the project’s purpose and need, the SWRCB Water Right Priority system. This alternative is assumed to be identical to Flow Alternative 3 in the SWRCB’s Draft Environmental Impact Report for Implementation of the 1995 Bay/Delta Water Quality Control Plan (1995 WQCP DEIR; SWRCB 1997). Detailed analyses of this alternative are included in Chapter 4. This alternative has the capabilities to meet the SWRCB’s 1995 Water Quality Control Plan Vernalis flow objectives assigned to water right holders based on a water right priority system. Under this alternative, water right holders share responsibility to implement flow objectives. Junior appropriative water right holders are required to cease diversions before senior appropriative water right holders are affected (based on the ‘first-in-time, first-in-right” principle).

Under this Water Right Priority Alternative, the SWRCB analysis assumes water right holders are assigned to groups based on their priority (see SWRCB 1997; Table II-5 and II-6). Groups of appropriators are directed to cease both diversions to storage and direct diversions when flow is inadequate to meet outflow objectives. The number of groups of water right holders receiving notification is based on the amount of water necessary to ensure that the SWP and CVP storage releases do not exceed their downstream inbasin and export delivery obligations (SWRCB 1997; pg. II-17) and the amount of water necessary to meet the flow objectives at Vernalis. A detailed description of the water right holders, their relative priority, and the calculations used to determine water availability under this alternative (and its subalternatives) is provided in the DEIR (SWRCB 1997; Chapter II and Chapter IV, Section F).

2.3 NO ACTION ALTERNATIVE

The No Action alternative represents existing conditions plus reasonably foreseeable future conditions that would exist without the proposed action. This No Action alternative is the benchmark for comparison of impacts of the other alternatives, and assumes the following conditions:

- Implementation, to the extent possible, of the SWRCB’s 1995 Water Quality Control Plan through operations of the CVP and SWP.
2. Alternatives Including Proposed Action

- Adherence by the CVP and SWP to the March 6, 1995 delta smelt and February 12, 1993 winter-run chinook salmon Biological Opinions.

- November 1997 Draft Anadromous Fish Restoration Program (AFRP) actions for instream flows in Clear Creek and below Keswick and Nimbus reservoirs, and a Trinity River maximum release of 340 TAF. No additional AFRP Delta actions other than the 1995 WQCP.

- New Melones is operated consistent with the Interim Plan of Operation, dated May 1, 1997.

- San Joaquin River tributary (Merced and Tuolumne rivers) minimum instream flows pursuant to existing agreements and regulatory requirements (for example, Davis-Grunsky and FERC). Operations of the tributaries are also governed by existing required flood control protocols.

- Current level of hydrology and operations in the San Joaquin Valley, including delivery of Level 4 refuge supplies.

The No Action alternative does not always meet the requirements for fishery flows contained in the 1987 Stanislaus Fishery Agreement between Reclamation and California Department of Fish and Game (DFG). The Interim Operations Plan (USBR 1997c) does not prescribe a specific allocation of fishery water in critical years. However, the Interim Operations Plan is adaptive; and while other releases not specifically allocated for the fishery assist in meeting the 1987 agreement, it is understood that critical fishery flows will need to be addressed on a case by case basis. The interim plan is to be revised and a long-term operation plan developed for New Melones Reservoir through the Stanislaus River Stakeholders process. Assumptions used in the hydrologic modeling for the SJRA flows contained in this EIS/EIR are not statements of Reclamation’s policy for the long-term operations plan.

2.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

A list of 26 alternatives was developed based on current knowledge of the basin, knowledge of other initiatives (e.g., 1995 WQCP DEIR, CVPIA PEIS, etc.), and information gained in the public scoping process. Three public meetings were held where concerns, input and suggestions from stakeholders were solicited, recorded, and considered in formulating the list of alternatives.

The alternatives were screened during a two step process. During the first step, all 26 alternatives were considered and screened using evaluation criteria that are based on the project’s purpose and need as explained in Chapter 1. This culminated in six alternatives which were considered in more detail. Comments were solicited from four resource agencies and members of the Authority regarding the concerns about potential impacts, which eliminated most of the remaining alternatives from further consideration. A final screening resulted in the final alternatives to receive a detailed impact analysis in this EIS/EIR.

2.4.1 Description of Each Alternative
Each of the 26 alternatives was assigned a number and an acronym to facilitate the screening process described in a subsequent section of this chapter.

1: NA No Action: See description in Section 2.3.

2: REC Recirculation: Responsibility for meeting Vernalis flow objectives for anadromous fish is with the CVP through releases from New Melones and releases into the San Joaquin River from the Delta-Mendota Canal (DMC) via the Newman Wasteway. Increased pumping of Tracy is required. Combined use of SWP/CVP points of diversion are allowed.

3: FR Friant Releases: Water would be made available from the CVP through releases into the San Joaquin River from Friant Dam.

4: CFR Combined Federal Releases: Water would be made available from the CVP through a combination of releases from: (a) the Stanislaus River (New Melones Reservoir), (b) Friant Dam, and (c) the Delta-Mendota Canal (via Newman Wasteway).

5: NM New Melones Reservoir: Responsibility for meeting Vernalis flow objectives would be solely the CVP through releases into the Stanislaus River from New Melones Reservoir.

6: HH Hetch Hetchy Reservoir: The City and County of San Francisco would re-operate Hetch Hetchy (and New Don Pedro Reservoir would be re-operated) with releases into the Tuolumne River.

7: EFS Ecological Fair-Share: Responsibility for meeting Vernalis flow objectives would be based on the unimpaired flow of all tributaries to the San Joaquin River (Stanislaus, Tuolumne, Merced, upper San Joaquin rivers). Water would come from willing sellers/willing buyers. This alternative is similar to the SWRCB Flow Alternative 5.

8: WCT Worst Case by Tributaries: This alternative would assign responsibility for meeting Vernalis flow objectives solely to each of the water right holders within the San Joaquin River Basin. This taking of water could be done through various administrative, legal, or legislative actions.

Alt 8a: Stanislaus River has all the responsibility
Alt 8b: Tuolumne River has all the responsibility.
Alt 8c: Merced River has all the responsibility.
Alt 8d: Upper San Joaquin River above the Merced confluence has all the responsibility.

9: RSL Re-operate San Luis Reservoir: The SWP and CVP would make water available through re-operation of San Luis Reservoir and releases into the San Joaquin River from the DMC via the Newman Wasteway similar to recirculation. However, increased pumping at Tracy is not required. Combined use of SWP/CVP points of diversion would be allowed.
2. Alternatives Including Proposed Action

10: CRR Conservation Plus Re-operation of Reservoirs: Responsibility for meeting Vernalis flow objectives is met equally on Stanislaus, Tuolumne and Merced rivers, and Upper San Joaquin River Basin (Friant Dam). Water would be obtained through conservation efforts within each basin and subsequent re-operation of reservoirs.

11: GW Groundwater: Responsibility for meeting Vernalis flow objectives is met equally on Stanislaus, Tuolumne and Merced rivers, and Upper San Joaquin River Basin (Friant Dam). Water would be obtained through groundwater pumping within each basin and possible re-operation of reservoirs.

12: ASF Additional Storage Facilities: Water would be made available by altering and re-operating existing facilities to accommodate more storage and provide more flow:

   Alternative 12a: Raise New Melones Reservoir on the Stanislaus River.
   Alternative 12b: Raise New Don Pedro Reservoir on the Tuolumne River.
   Alternative 12c: Raise Hetch Hetchy Reservoir and Cherry Lake on the Tuolumne River.
   Alternative 12d: Raise New Exchequer Dam/Lake McClure on the Merced River.
   Alternative 12e: Raise Friant Dam/Millerton Lake on the Upper San Joaquin River.

13: WRP SWRCB Water Right Priority System: See above (Section 2.2) for description.

14: ESP East Side Project: As once proposed by Reclamation, this project was to have been an extension of the Folsom Canal along the Sierra Foothills from Folsom Dam to the San Joaquin River, including new reservoirs.

15: CON Condemnation by Federal and/or State: Vernalis flow objectives would be met by condemnation of water rights associated with each project. Each scenario would start with junior appropriators and move to senior water rights holders until sufficient water was obtained to meet Vernalis flow objectives or until all the available water is condemned.

   Alternative 15a: Condemn Stanislaus River water rights and re-operate New Melones Reservoir.
   Alternative 15b: Condemn Tuolumne River water rights and re-operate New Don Pedro Reservoir.
   Alternative 15c: Condemn San Francisco’s water rights on the Tuolumne River and re-operate New Don Pedro Reservoir.
   Alternative 15d: Condemn Merced River water rights and re-operate Lake McClure.
   Alternative 15e: Condemn Upper San Joaquin River water rights and re-operate Friant Dam.
   Alternative 15f: Condemn San Joaquin River Exchange Contractors Water Authority water rights.
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Alternative 15g: Condemn San Joaquin River basin water rights based on water right priority system. See SWRCB’s DEIR, Flow Alternative 3.

16: MAQ Mountain aquifers used: Water would be obtained from pumping of perched aquifers located in the Sierras with possible re-operation of projects.

17: POB Purchases outside the SJR Basin with Delta re-operations: Water from outside the San Joaquin River Basin would be purchased or otherwise acquired. This alternative would include water transfers and possible Delta facility re-operation, and it may not make water available at Vernalis.

18: SJR Acquire water from the SJRGA (VAMP and other flows in the SJRA): This is the proposed project/preferred alternative (see Section 2.1 above for description).

19: URW Reclaimed wastewater from municipal and/or large industrial sewage treatment plants: Vernalis flow objectives would be met by using reclaimed wastewater within the San Joaquin River Basin. Treated effluent from municipal or industrial sites would need to be stored on-site and then conveyed into the San Joaquin River system in April–May and in October.

20: WMR Weather modification and re-operation: Vernalis flow objectives would be met by using weather modification processes to increase San Joaquin River Basin precipitation, increase storage/yield, and re-operate reservoirs.

21: ESL Eliminate seepage losses from San Joaquin River: In this alternative, seepage losses in the upper San Joaquin River (between the Mendota Pool and Friant Dam) would be eliminated to increase effective flow. Responsibility for meeting Vernalis flow objectives would fall solely on the CVP through subsequent re-operation of Friant Dam.

22: DDW Desalt drainage water: Vernalis flow objectives would be met by treatment and desalinization of agricultural drainage water providing increases in storage/yield, and possible re-operation of reservoirs.

23: PWD Purchase one or more water districts and their water rights: Vernalis flow objectives would be met by purchasing one or more of the water districts on the Stanislaus, Tuolumne, Merced, San Joaquin rivers (upper San Joaquin and Exchange Contractors) and using the acquired water rights to meet the VAMP water needs at Vernalis.

24: BFC Buy out Federal contracts: Vernalis flow objectives would be met by purchasing the CVP contracts serviced by New Melones Reservoir and Friant Dam (including the Exchange Contractors) and using the acquired contracts to meet the VAMP water needs at Vernalis.

25: SWP State Water Project re-operation (State would cease their project during pulse flows): Vernalis flow objectives would be met by re-operation of the State Water Project,
2. Alternatives Including Proposed Action

curtailment of exports, re-operation of San Luis Reservoir, and releases of water into the San Joaquin River via the Delta-Mendota Canal.
2. Alternatives Including Proposed Action

26: WSB Willing Sellers/Willing Buyers: Vernalis flow objectives would be achieved via water purchases (similar to the interim water acquisitions now occurring) based on willing sellers/willing buyers in all tributaries to the San Joaquin River (Stanislaus, Toulumne, Merced, upper San Joaquin River). This would be a market driven alternative in that the prices offered for water would determine which and how many buyers would be willing to provide water to meet the Vernalis fish flow objectives. Water availability, acquisition needs, water prices, and sellers would vary throughout the project lifetime.

2.4.2 Screening of Alternatives

Both NEPA and CEQA require that an EIS or EIR identify and analyze only reasonable alternatives. These reasonable alternatives are developed through a systematic evaluation of all alternatives based on a set of pre-defined screening criteria to evaluate their feasibility. A general definition of feasibility is: capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors. Alternatives may not be rejected merely because they are beyond an agency’s authority, would require new legislation, or would be too costly. For CEQA, reasonable alternatives are to be limited to only those that would avoid or substantially lessen at least one of the significant environmental effects of the proposed project. NEPA requirements to review and screen alternatives as options, prior to completing the impact analyses, were utilized. The results of the review are incorporated into this chapter. The CEQA requirement to select a short list of reasonable, practicable alternatives was also addressed during screening by taking into consideration the following areas of potential environmental concern or impact: surface water quality and quantity, groundwater, vegetation and wildlife, fisheries, land use including agriculture, recreation, and energy production.

The following screening criteria are comprised of objectives related to the Purpose and Need Statement (see Section 1.1) and other criteria.

2.4.2.1 Screening Criteria from Project Objectives

VAMP criteria: Is there sufficient water availability necessary to meet VAMP flow criteria for 31-day pulse flow in April/May (for downstream emigration of fall-run chinook salmon smolts in the San Joaquin Basin)? Increased water needs to be available to meet VAMP criteria under varying hydrological conditions.
2. Alternatives Including Proposed Action

Reliable water supplies: Are there reliable water supplies available for VAMP and related flows over the term of the Agreement and proposed action (1999–2010)? Water will be needed starting in April 1999, and reliance on a series of 1-year acquisitions is not acceptable over the long term.

Implement in Near Term: Is implementation possible in the near term, both physically and legally? Are the facilities to store and convey the water in place or can they be provided quickly (within a year)? Is the alternative likely to be subject to protracted litigation such that it cannot be implemented in the near term?

Fall Attraction Flows: Water must be available for fall attraction flows (October) for upstream migration of fall-run chinook salmon adults.

Water at Vernalis: Water from the alternative has to be made available as flow at Vernalis (at Airport Way Bridge) on the San Joaquin River. Vernalis is the point of entry into the Delta on the San Joaquin River where flow measurements are taken. The water must be available at Vernalis as required by the SWRCB.

2.4.2.2 Other Criteria

No new TES: Does the alternative have the potential to contribute to triggering of a threatened or endangered listing of any species? A reasonable outcome or positive effect is that the alternative would not lead to the listing of new species as threatened or endangered under the Endangered Species Act (ESA) or California Endangered Species Act (CESA) or cause a species to be of special concern under CESA.

Impacts to 3rd parties: Does the alternative have minimal or mitigable impacts to third parties (for example, economic, social, cultural, environmental justice), a type of indirect impact, due to flow releases? This would potentially include impacts to downstream water users.

Cost: Would the alternative have a reasonable cost for implementation? Major construction of new facilities is assumed to be costly. Cost alone cannot be used to exclude an alternative.

State Water Law: Is the alternative reasonable and implementable under California Water Law? Does the alternative comply with all state and federal laws?

Different from SJRA: Is the alternative a distinctly different approach from the preferred alternative of making water available for the SJRA including VAMP (No. 18)?

2.4.2.3 Initial Screening

The results of the initial screening (Table 2.4-1, alternative screening matrix) summarize the evaluation of all 26 alternatives, including the no action (1:NA), the preferred action (18:VAM), and the other reasonable alternative (13:WRP). The resultant selection of the reasonable, practicable alternatives (1:NA, 18:SJR, and 13:WRP) are analyzed in detail in the impacts
section of this EIS/EIR (Chapter 4). Each of the 26 alternatives have been examined against the criteria and scored as follows:

+ = a potentially positive effect or is reasonable relative to the criterion
_ = a neutral or no impact
- = a potentially negative effect or is unreasonable relative to the criterion
? = unknown effect or not enough information presently available
Y = yes
N = no

The greater the number of positive effects, and the fewer the negative effects, the more feasible (reasonable or practicable) the alternative becomes. “Reasonable (or “unreasonable”) relative to a criterion applies when a positive or negative effect is not applicable. For example, a reasonable response to scoring for cost means that a large financial investment is unlikely in relation to the cost of implementation or of new facilities. The cost criterion is not simply positive or negative but rather reasonable or unreasonable.

The alternatives screening matrix was developed based upon specific knowledge, published reports, and professional judgement and is presented in Table 2.4-1. In short, the set of 26 potential alternatives was reduced to six for further evaluation using this matrix.
## 2. Alternatives Including Proposed Action

### TABLE 2.4-1 INITIAL SCREENING OF ALTERNATIVES FOR

<table>
<thead>
<tr>
<th>Alternative</th>
<th>VAMP Criteria</th>
<th>Reliable Water Supplies</th>
<th>Implementable in Near Term</th>
<th>Fall Attrac. Flows</th>
<th>Water at Vernalis</th>
<th>No new TES</th>
<th>Impacts to 3rd Parties</th>
<th>Cost</th>
<th>State Water Law</th>
<th>Different from SJRA?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: NA</td>
<td>–</td>
<td>–</td>
<td>+</td>
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<td>–</td>
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<td>Y</td>
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<td>2: REC</td>
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<td>9: RSL</td>
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<td>11: GW</td>
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<td>12: ASF</td>
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<td>13: WRP</td>
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<td>20: WMR</td>
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<td>+</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>N?</td>
</tr>
</tbody>
</table>

+ Potentially positive effects or reasonable.
– Potentially neutral or no effect.
- Potentially negative effects or unreasonable.
?Unknown or not enough information presently available.
Y Yes.
N No.
2. Alternatives Including Proposed Action

2.4.2.4 Secondary Screening

In addition to the no-action and proposed-action alternatives, the following alternatives were examined by several agencies and districts (SJRA/Cooperating Agency Steering Committee) during secondary screening using the criteria (see Section 2.4.2.1): Recirculation, Willing Seller/Willing Buyer, Worst Case by Tributary, and SWRCB Water Right Priority System. The additional review led to the following conclusions:

Recirculation (2:REC)

This alternative could cause major adverse impacts to fisheries and endangered species. Preliminary modeling for this alternative has been completed by DWR and described in a draft report *(SJRIO Studies of San Joaquin River Recirculation and Reoperation of Wetland Discharge and Tile Drainage)* (DWR 1998). The modeling included determining the flows from the Tuolumne, Merced and Stanislaus rivers which are regulated in part by FERC agreements or FERC orders. The amount of additional water needed to meet the Vernalis spring pulse flows was determined. For modeling purposes, this additional water was supplied by releases from the DMC to the San Joaquin River via the Newman Wasteway, which was then recovered by re-exporting an equivalent volume of water from the Delta. This recirculation was superimposed on the flows and pumping that would occur in the absence of the supplemental water. Due to flow time delays, the system would be primed at the beginning of the pulse flow period with water from San Luis Reservoir (which would be re-filled during the end of the pulse flow). Tile drainage water, discharged through Salt and Mud sloughs, would be partially withheld (for example, 50 percent between March 1 and April 15) and released during the pulse flow between April 15 and May 15.

This alternative involved no reduction in export pumping, since it required maximum pumping all the time (to achieve the increase in flow during the pulse flow period). Therefore, this alternative was in direct conflict with the stated purpose and need for the project. Recirculation also had problems providing fall attraction flows for the same reasons (for example, increased flows at Vernalis were accompanied by increased exports, so gain in net systems flows were questionable). Consequently, this alternative was dropped from further consideration.

Willing Seller/Willing Buyer (26:WSB)

This alternative evolved from alternative 7, Ecological Fair Share, specifically the willing seller/willing buyer component. While this could be considered as the No Action alternative (for example, no sellers), this also could be considered to be the same as providing flows under the San Joaquin River Agreement for VAMP (where all the willing sellers in the basin were identified). The range of possibilities was considered by looking at the No Action and the Agreement. There are an infinite number of subtle options in between these two alternatives, and the impacts could vary greatly because the water would come from different places. The major difference between this alternative and the Agreement is that the sellers and the impacts may vary but in an unknown, and undefinable way. This entire alternative would be similar to the status quo in that a series of one year acquisitions would occur. It is not practically possible to get water out of Friant Dam. Therefore, this alternative involves subtle differences in
2. Alternatives Including Proposed Action

allocation of the other three tributaries. In essence, all willing sellers have identified themselves
(and have signed the statement of support for the San Joaquin River Agreement); other
combinations of willing sellers, therefore, are not reasonable. Under the interim acquisition
program, the only sellers that stepped forward are those included in the Agreement. As a result,
this alternative was not carried forward for detailed analysis.

Worst Case by Tributary (8:WCT)

This alternative represents an alternative scenario to the Willing Seller/Willing Buyer wherein
either the Stanislaus, Tuolumne, Merced, or Upper San Joaquin rivers (above Merced) would
provide all of the water. This alternative arose from the “Ecological Fair Share” concept based
on historical unimpaired flows put forward in the 1995 WQCP DEIR (SWRCB 1997; Flow
Alternative 5). Multiple parties could be responsible for meeting flow requirements on a
tributary. The Service is not necessarily in favor of the alternative as stated, but the Service
would consider a distribution of water across the tributaries based on unimpaired flows (Jewell
1998). There are significant legal, administrative, and technical feasibility problems with
implementing this alternative. It is not an achievable alternative, as there simply is not enough
water from any single tributary to meet the purpose and need of the project. As a result, this
alternative was not carried forward for detailed analysis, since it was neither reasonable nor
implementable.

Summary of Findings

After secondary screening, two reasonable practicable alternatives remained: the preferred
alternative (SJRA, Alternative 18) and the SWRCB Water Rights Order (Alternative 13). The
other alternatives were excluded because they either had several to many potentially significant
negative effects or were not significantly different from the SJRA or the SWRCB Water Rights
Priority System. Both of these reasonable, practicable alternatives had significant positive
effects in all or almost all of the screening criteria and were, therefore, considered for more
detailed environmental impact analysis in Chapter 4.

2.5 SUMMARY COMPARISON OF ALTERNATIVES

Table ES-1, contained in the Executive Summary, provides a summary comparison of
abbreviated impact statements for the proposed action and the alternative action.

Full impact statements are provided in Sections 4.2 through 4.11. Table 2.5-1 below is an
abbreviated comparison of characteristics of the No Action, SJRA, and Water Right Priority
System alternatives. In summary, the SJRA alternative (proposed action) is the environmentally
superior alternative because it has the fewest significant and potentially significant impacts on
the environment.
### Table 2.5-1: COMPARISON OF NO ACTION, PROPOSED ACTION AND ALTERNATIVE ACTION FOR MEETING FLOW OBJECTIVES FOR THE SAN JOAQUIN RIVER AGREEMENT

<table>
<thead>
<tr>
<th></th>
<th>No Action</th>
<th>SJRA Proposed Action</th>
<th>Water Right Priority System Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spring Pulse Flow</strong></td>
<td>0</td>
<td>VAMP Target</td>
<td>1995 WQCP</td>
</tr>
<tr>
<td><strong>October Flow</strong></td>
<td>0</td>
<td>12,500 AF</td>
<td>28,000 AF subject to conditions of 1995 WQCP</td>
</tr>
<tr>
<td><strong>Number of Potentially Affected Sellers</strong></td>
<td>Unknown</td>
<td>6 up to 38</td>
<td></td>
</tr>
<tr>
<td><strong>Type of Action</strong></td>
<td>Current regulatory action with willing sellers</td>
<td>Willing sellers</td>
<td>Regulatory</td>
</tr>
<tr>
<td><strong>Period of Action</strong></td>
<td>Annual, continues current practices</td>
<td>12 years</td>
<td>Permanent with 3 year review</td>
</tr>
<tr>
<td><strong>Consensus Driven</strong></td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Supports a Scientific Study</strong></td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
2. Alternatives Including Proposed Action

2. ALTERNATIVES INCLUDING PROPOSED ACTION 2-1
   2.1 PROPOSED ACTION (PREFERRED ALTERNATIVE) 2-1
       2.1.1 Description 2-1
       2.1.2 Location 2-2
       2.1.3 Characteristics 2-3
       2.1.4 Sources of Water 2-6
       2.1.5 Scope of Project 2-7
       2.1.6 Required Approvals and Permits 2-9
   2.2 OTHER REASONABLE ALTERNATIVE 2-9
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           2.4.2.4 Secondary Screening 2-19
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3. AFFECTED ENVIRONMENT

This chapter presents a general description of the physical environment of the project area and vicinity. The existing condition of resources sets the baseline against which the proposed action and alternative to the proposed action are evaluated subsequently in Chapter 4 to determine environmental effects.

3.1 GENERAL DESCRIPTION OF PROJECT AREA AND WILLING SELLERS

As described in Section 2.1.2, Alternatives Including Proposed Action, the immediate project area is comprised of portions of the Stanislaus, Tuolumne, and Merced rivers and the San Joaquin River from the Mendota Pool to Vernalis. These are the primary rivers that would be affected by the additional water. The points of release occur primarily at three reservoirs: New Melones Reservoir on the Stanislaus River, New Don Pedro Reservoir on the Tuolumne River, and Lake McClure on the Merced River. Additional releases would occur on the San Joaquin River, almost entirely near Los Banos from surface water conveyance facilities into Mud or Salt sloughs (which discharge into the San Joaquin River), or into Orestimba Creek, but also possibly upstream at the Mendota Pool.

3.1.1 Project Area and Vicinity

Inflows from the Merced, Tuolumne, and Stanislaus rivers historically contribute more than 60 percent of the flows in the San Joaquin River, as measured at Vernalis. The San Joaquin River enters the Delta at Vernalis which is widely used as a monitoring point for Delta inflows and standards. The U. S. Geological Survey (USGS) has operated a gaging station on the San Joaquin River near the community of Vernalis (Station 11303500) since 1922 (CALFED 1998).

The project area rivers are highly managed due to extensive water supply, hydroelectric, and flood control projects. As a result, the aquatic resources have undergone significant changes. Of concern is the protection and enhancement of economically important species such as chinook salmon and the adjacent riparian habitat which supports numerous plants and animals including some rare, threatened, and endangered species. Fall-run chinook salmon inhabit the three tributaries to the San Joaquin River during spawning and development stages of their life cycle. The ecological health of the project area rivers in the San Joaquin River Basin is important to the health of the Bay/Delta Estuary.

Land uses within the project area are primarily open space, agriculture, and recreation. Agricultural lands are often adjacent to the river corridors. There are three reservoirs in the project area that are used for a variety of purposes: water supply, regulation of river flows including flood control, hydroelectric power generation, and recreation. Recreation activities at project area reservoirs and rivers include boating, fishing, swimming, picnicking, camping, hunting, and wildlife observation.

The sections in this chapter on affected environment cover not only the immediate area of direct project impact but also the project area vicinity and adjacent areas that could potentially experience
3. Affected Environment

indirect impacts such as the larger San Joaquin River Basin and the Bay/Delta Estuary. Definition of the larger area, such as the San Joaquin River Region, varies depending on the source of information. Groundwater in the basin is used for municipal, industrial, and agricultural purposes. Cultural resources in the San Joaquin River Region have been documented from the excavation of reservoirs and other sites to reveal numerous prehistoric resource locations. Agriculture and mining activities characterize historic resources.

The water supply for Vernalis Adaptive Management Plan (VAMP) and related flows is to be provided by the San Joaquin River Group Authority as identified in the San Joaquin River Agreement and reported in Section 2.1.1. Members of the Authority who have agreed to sell water for release to the San Joaquin River system are the following: South San Joaquin Irrigation District (SSJID), Oakdale Irrigation District (OID), Modesto Irrigation District (MID), Turlock Irrigation District (TID), Merced Irrigation District (Merced ID), and the San Joaquin River Exchange Contractors Water Authority (Exchange Contractors). The Exchange Contractors have four members: San Luis Canal Company, Central California Irrigation District, Firebaugh Canal Water District, Columbia Canal Company. The service areas of these districts and agencies are shown on Figure 3.1-1. Annual surface water and groundwater use by the San Joaquin River Group’s willing sellers is shown in Table 3.1-1. Each willing seller is introduced in the following sections.

3.1.2 Willing Sellers on the San Joaquin River

3.1.2.1 San Joaquin River Exchange Contractors Water Authority

The Exchange Contractors include four separate entities located in the San Joaquin Valley (three on the west side of the San Joaquin River and one on the east): the Central California Irrigation District (CCID), San Luis Canal Company (SLCC), Firebaugh Canal Water District (FCWD), and Columbia Canal Company (CCC). The service area of 240,000 acres covers parts of Fresno, Madera, Merced, and Stanislaus Counties. The primary economy in this area is agriculture or agriculturally related businesses (NEA 1997).

Annual crops comprise 92 percent of the 225,562 acres of cropland in the Exchange Contractors service area. Cotton is the largest single crop grown in the area. Other annual crops grown include tomatoes, garlic, melons, and alfalfa hay (NEA 1997). Permanent crops grown in the area include walnuts and almonds.

The Exchange Contractors hold Miller and Lux water rights dating back to the 1880s. Because of this early water usage, the water rights of the Exchange Contractors are based on their riparian and pre-1914 diversions. The Exchange Contractors have an agreement with the Bureau of Reclamation (Reclamation) in which they agree not to exercise their San Joaquin River water rights in exchange for guaranteed deliveries of substitute Central Valley Project (CVP) water from the Delta-Mendota Canal.
### Table 3.1-1: SURFACE AND GROUNDWATER USE BY WILLING SELLERS (AF/Yr)

<table>
<thead>
<tr>
<th></th>
<th>Exchange Contractors</th>
<th>OID</th>
<th>SSJID</th>
<th>MID</th>
<th>TID</th>
<th>Merced ID</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surface Water:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Available (AF)</td>
<td>840,000</td>
<td>300,000</td>
<td>300,000</td>
<td>See Note 1</td>
<td>See Note 1</td>
<td>Not Available(^1)</td>
</tr>
<tr>
<td>Average Annual Diversion</td>
<td>840,000</td>
<td>300,000</td>
<td>242,000(^2)</td>
<td>320,000</td>
<td>541,000(^3)</td>
<td>Not Available</td>
</tr>
<tr>
<td>Avg Annual Use for Irrigation</td>
<td>840,000</td>
<td>300,000</td>
<td>242,000</td>
<td>193,000</td>
<td>498,000(^3)</td>
<td>522,000</td>
</tr>
<tr>
<td><strong>Groundwater(^4):</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Average Annual Use</td>
<td>144,000</td>
<td>9,668(^5)</td>
<td>11,200(^6)</td>
<td>23,500</td>
<td>120,000(^3)</td>
<td>25,000-30,000(^7)</td>
</tr>
<tr>
<td>Avg Annual Use for Irrigation</td>
<td>144,000</td>
<td>8,130</td>
<td>7,800</td>
<td>15,000</td>
<td>110,000(^3)</td>
<td>25,000-30,000</td>
</tr>
</tbody>
</table>

\(^1\)The operations of TID, MID and Merced ID are supported by a variety of water rights which include pre-1914 appropriations and riparian rights in addition to post-1914 licenses which have been issued by the SWRCB. Absent an adjudication, it is not possible to identify the maximum amount of water available. However, The MID/TID water diversion varies between 900,000 and 1,100,000 acre feet per year(AF/Yr).

\(^2\)This figure represents a 15-year average. SSJID’s historical use has ranged much higher and has exceeded 300,000 AF/Yr in some years. However, primarily as a result of conservation efforts, the district has diverted an average of approximately 242,000 AF/Yr over the last 15 years. The district sold to Interior 40,000 AF in 1997 and 25,000 AF in 1998. The district has contractual commitments to deliver up to 15,000 AF/Yr to the Stockton East Waster District beginning in October 1998 and 32,000 AF/Yr to a domestic water plant, beginning in approximately 2002.

\(^3\)TID usage based on 25 year average (1973-1997).

\(^4\)Groundwater use is by District


\(^6\)Based on the Groundwater Management Database Development report, Montgomery Watson, September 1993. This includes approximately 3,400 AF/Yr of shallow groundwater pumped and discharged by SSJID to lower saline groundwater from the crop root zone. This does not include other private pumping within the SSJID service area for agricultural use.

\(^7\)Range of water pumped is 10,000 AF – 167,000 AF. Most of this water is pumped in dry and critical years, and the 167,000 AF was pumped in 1977. Approximately 10,000 AF is pumped in all years.
3. Affected Environment

3.1.3 Willing Sellers on the Stanislaus River

3.1.3.1 South San Joaquin Irrigation District

Organized in 1909, SSJID is located on the east side of the San Joaquin Valley. The District encompasses approximately 72,000 acres of land that are predominantly agricultural with almonds and grapes as the primary crops. Total acres of irrigated agriculture are estimated at 62,000 acres since urban areas cover about 10,000 acres of the total area, including the cities of Manteca, Escalon, and Ripon, which provide water service separately from SSJID. Over the past 15 years, SSJID has experienced substantial urban development. By 2025, urban areas are projected to increase to over 35 percent of the land area. (MW 1993)

SSJID has a firm supply of surface water, based on its senior water rights in the Stanislaus River and its 1988 Agreement and Stipulation with Reclamation for up to 300,000 acre-feet of Stanislaus River water annually. This surface water supply has been used historically to meet agricultural water demands (MW 1993). SSJID is part-owner (with OID) of the Goodwin Dam and the SSJID/OID Joint Main Canal which is used to divert water to SSJID and OID (USBR 1997f).

3.1.3.2 Oakdale Irrigation District

Organized in 1909, OID is located in the eastern San Joaquin Valley and encompasses parts of San Joaquin and Stanislaus Counties. The District encompasses approximately 72,000 gross acres of land with cropping patterns that include irrigated pasture (clover), oats-corn, rice, fruit and nuts, and miscellaneous crops, such as berries, melons, onions, and home gardens and yards (OID 1995). OID has a firm supply of surface water, based on its senior water rights in the Stanislaus River and its 1988 Agreement and Stipulation with Reclamation for up to 300,000 acre-feet of Stanislaus River water annually. The District’s distribution system which is co-owned in large part with SSJID, includes the Tulloch Dam and Reservoir and the Goodwin Diversion Dam on the Stanislaus River below New Melones Dam. Water is diverted into the SSJID/OID Joint Main Canal and OID’s South canals (OID 1998). In addition, the District owns and operates deep well water reclamation pumps and two downstream river diversions. OID and SSJID jointly own and operate the Tri-Dam Project, an irrigation and hydroelectric project in the Stanislaus River that consists of three dams and associated appurtenant structures. OID’s service area is approximately 73,000 acres (USBR GIS 1998), and the city of Oakdale is the principal community.
3. Affected Environment

3.1.4 Willing Sellers on the Tuolumne River

3.1.4.1 Modesto Irrigation District

Organized in 1887, MID is located in Stanislaus County on the east side of the San Joaquin Valley. The District encompasses a 108,000-acre service area and supplies surface water, groundwater, and electrical service to agricultural (64,000 irrigated acres) and municipal users including the cities of Waterford, Empire, Modesto, and Salida. The primary economy in the District is agriculture or agriculturally related businesses, and the primary crops are trees (primarily almond), vines, grain, row, and pasture. The average farm size is 20 acres, and there are approximately 3,200 farms within MID (MID 1996). MID has pre-1914 and post-1914 water rights.

3.1.4.2 Turlock Irrigation District

Organized in 1887, TID is located on the east side of the San Joaquin Valley, and it encompasses portions of Stanislaus and Merced Counties. The District’s service area covers 272,000 acres and includes the cities of Turlock, Ceres, Hughson, part of Modesto, and the unincorporated communities of Keyes, Denair, Hickman, Delhi, and Hilmar (Goldman, Sachs & Company 1998). Over the past 25 years, TID has provided on average 608,000 acre-feet of water to irrigators for 149,000 acres (TID 1998, personal communication). The primary agricultural crops grown in the District include almonds, tomatoes, walnuts, peaches, grapes, and melons (Stanislaus County General Plan 1994). The District also generates hydroelectricity within its service area. TID has a firm supply of developed surface water and operates surface diversions from the Tuolumne River. TID jointly operates the New Don Pedro Reservoir with Modesto ID. Surface water accounts for about 81 percent of the total delivery for irrigation (TID 1997, 1998, personal communication).

3.1.5 Willing Sellers on the Merced River

3.1.5.1 Merced Irrigation District

Organized in 1919, the Merced ID is located on the east side of the San Joaquin Valley in Merced County. Merced has a firm supply of developed surface water and operates surface diversions from the Merced River. More than 140,000 acres are located within Merced ID’s boundaries, of which approximately 70 percent are irrigated with Merced ID water (Merced ID 1998). Merced ID uses surface and groundwater to supply approximately 552,000 acre-feet per year to irrigation customers. Surface water accounts for about 95 percent of the total delivery (MBK 1998, personal communication). Agricultural crops grown within the Merced ID service area include almonds (nearly 12,000 acres), corn (nearly 10,000 acres), alfalfa and cotton (nearly 8,000 acres each) (Merced ID 1998).
3. Affected Environment

3. AFFECTED ENVIRONMENT
.............................................................................................................. 1

3.1 GENERAL DESCRIPTION OF PROJECT AREA AND WILLING SELLERS
................................................................................................................................. 1

3.1.1 Project Area and Vicinity
................................................................................................................................. 1

3.1.2 Willing Sellers on the San Joaquin River
................................................................................................................................. 2

3.1.2.1 San Joaquin River Exchange Contractors Water Authority
................................................................................................................................. 2

3.1.3 Willing Sellers on the Stanislaus River 3.1.3.1 South San Joaquin Irrigation District
Organized in 1909, SSJID is located on the east side of the San Joaquin Valley. The District encompasses approximately 72,000 acres of land that are predominantly agricultural with almonds and grapes as the primary crops. Total acres of irrigated agriculture are estimated at 62,000 acres since urban areas cover about 10,000 acres of the total area, including the cities of Manteca, Escalon, and Ripon, which provide water service separately from SSJID. Over the past 15 years, SSJID has experienced substantial urban development. By 2025, urban areas are projected to increase to over 35 percent of the land area. (MW 1993) SSJID has a firm supply of surface water, based on its senior water rights in the Stanislaus River and its 1988 Agreement and Stipulation with Reclamation for up to 300,000 acre-feet of Stanislaus River water annually. This surface water supply has been used historically to meet agricultural water demands (MW 1993). SSJID is part-owner (with OID) of the Goodwin Dam and the SSJID/OID Joint Main Canal which is used to divert water to SSJID and OID (USBR 1997f). 3.1.3.2 Oakdale Irrigation District
Organized in 1909, OID is located in the eastern San Joaquin Valley and encompasses parts of San Joaquin and Stanislaus Counties. The District encompasses approximately 72,000 gross acres of land with cropping patterns that include irrigated pasture (clover), oats-corn, rice, fruit and nuts, and miscellaneous crops, such as berries, melons, onions, and home gardens and yards (OID 1995). OID has a firm supply of surface water, based on its senior water rights in the Stanislaus River and its 1988 Agreement and Stipulation with Reclamation for up to 300,000 acre-feet of Stanislaus River water annually. The District’s distribution system which is co-owned in large part with SSJID, includes the Tulloch Dam and Reservoir and the Goodwin Diversion Dam on the Stanislaus River below New Melones Dam. Water is diverted into the SSJID/OID Joint Main Canal and OID’s South canals (OID 1998). In addition, the District owns and operates deep well water reclamation pumps and two downstream river diversions. OID
and SSJID jointly own and operate the Tri-Dam Project, an irrigation and hydroelectric project in the Stanislaus River that consists of three dams and associated appurtenant structures. OID’s service area is approximately 73,000 acres (USBR GIS 1998), and the city of Oakdale is the principal community.

3.1.4 Willing Sellers on the Tuolumne River

3.1.4.1 Modesto Irrigation District

3.1.4.2 Turlock Irrigation District

3.1.5 Willing Sellers on the Merced River

3.1.5.1 Merced Irrigation District
3. Affected Environment

3.10 INDIAN TRUST ASSETS

Although there is no concise legal definition of Indian Trust Assets (ITA), the courts have traditionally interpreted them as being tied to real property. ITAs are property interests held in trust by the United States for the benefit of Indian tribes or individuals. Indian reservations, rancherias, and public domain allotments are common ITAs. The land associated with these ITAs, as well as the resources within the boundaries, such as trees, minerals, oil, and gas, are also considered trust assets. Other ITAs include traditional-use areas and fishery resources. Hunting and fishing rights may be ITAs, although under P.L. 280 fishing and hunting are regulated by the California Department of Fish and Game, both on and off reservations (CALFED 1998).

Types of actions which could affect ITAs include an interference with the exercise of a reserved water right, degradation of water quality where there is a water right, impacts to fish and wildlife where there is a hunting or fishing right, or noise near a land asset where it adversely impacts uses of the reserved land (USBR 1997d).

3.10.1 San Joaquin River Region

The San Joaquin River Region includes Fresno, Mariposa, San Joaquin, and Stanislaus counties, and parts of Calaveras, Merced, Madera, and Tuolumne counties. Approximately 11 reservations or rancherias are located in the counties that make up this region, although some of these reservations fall outside the region. There are also an unknown number of public domain allotments within the region. Each reservation, rancheria, or allotment represents an ITA unless they have been dropped from trust status.

The Monache, which are one of the native cultures in this region, have several places of mythical importance in the region. Table Mountain near Friant was thought to be visited by mythical beings. Burial or cremation sites may also exist within the San Joaquin River Region (CALFED 1998).

3.10.2 Sacramento-San Joaquin Delta

No reservations or rancherias are located in the Sacramento-San Joaquin Delta. It is unlikely that there are any public domain allotments located within this region. There are no traditional properties or sacred sites in the area; however, several burial and cremation sites have been discovered (CALFED 1998).
3. Affected Environment

3.10 INDIAN TRUST ASSETS

3.10.1 San Joaquin River Region

3.10.2 Sacramento-San Joaquin Delta
3. Affected Environment

3.11 ENVIRONMENTAL JUSTICE

Presidential Executive Orders constitute a form of high level federal regulation. Executive Orders have been utilized to address a number of environmental related problems such as wetlands. Executive Order 12898 requires each Federal agency to achieve environmental justice as part of its mission by identifying and addressing disproportionately high and adverse human health or environmental effects, including social or economic effects, of programs, policies, and activities on minority populations and low-income populations of the United States. EPA’s Office of Environmental Justice offers the following definition:

The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies (EPA 1997).

This section provides baseline demographic information used in the subsequent analyses of environmental justice impacts (Section 4.11).

3.11.1 Race and Ethnicity

The minority population in the San Joaquin River project area and vicinity is based on an analysis of race and ethnicity population data from the 1990 Census of Population and Housing for seven counties that approximate the area of potential impact from the proposed action and alternative action. Population data are summarized by five racial categories: White, Black, American Indian/Eskimo/Aleut, Asian and Pacific Islander, and Other (Table 3.11-1). These categories as used in the 1990 Census relied on self-identification by respondents to racial/ethnic categories. Persons of Hispanic origin may be of any race, so this ethnic category is summarized separately.

In comparison to the California state demographics, the San Joaquin River Area is proportionately higher in Hispanic population (28.1 percent). Racially, the area contains greater percentages of whites (71.1 percent) and other races (15.2 percent) than does the state (69.0 percent and 13.2 percent, respectively). The Hispanic population in the San Joaquin River area is concentrated in Fresno, Madera, and Merced counties (Table 3.11-1). Native Americans (American Indians) represent 1.1 percent of the area’s population, and are proportionately higher in Madera, Mariposa, and Tuolumne counties. Both the Black and Asian/Pacific Islander populations are under-represented in the San Joaquin River Area in comparison to the state.
Table 3.11-1: POPULATION BY RACE AND ETHNICITY, 1990

<table>
<thead>
<tr>
<th>County</th>
<th>Total Persons, April 1, 1990</th>
<th>White</th>
<th>Black</th>
<th>Amer. Indian, Eskimo, Aleut</th>
<th>Asian/Pacific Islander</th>
<th>Other</th>
<th>Percent Hispanic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresno</td>
<td>667,490</td>
<td>63.3</td>
<td>5.0</td>
<td>1.1</td>
<td>8.6</td>
<td>22.0</td>
<td>35.0</td>
</tr>
<tr>
<td>Madera</td>
<td>88,090</td>
<td>71.9</td>
<td>2.8</td>
<td>1.6</td>
<td>1.4</td>
<td>22.2</td>
<td>34.5</td>
</tr>
<tr>
<td>Mariposa</td>
<td>14,302</td>
<td>92.4</td>
<td>0.9</td>
<td>4.5</td>
<td>0.9</td>
<td>1.3</td>
<td>4.9</td>
</tr>
<tr>
<td>Merced</td>
<td>178,403</td>
<td>67.4</td>
<td>4.8</td>
<td>0.8</td>
<td>8.5</td>
<td>18.5</td>
<td>32.6</td>
</tr>
<tr>
<td>San Joaquin</td>
<td>480,628</td>
<td>73.5</td>
<td>5.6</td>
<td>1.1</td>
<td>12.4</td>
<td>7.4</td>
<td>23.4</td>
</tr>
<tr>
<td>Stanislaus</td>
<td>370,522</td>
<td>80.2</td>
<td>1.7</td>
<td>1.1</td>
<td>5.2</td>
<td>11.7</td>
<td>21.8</td>
</tr>
<tr>
<td>Tuolumne</td>
<td>48,456</td>
<td>90.4</td>
<td>3.2</td>
<td>2.0</td>
<td>0.8</td>
<td>3.6</td>
<td>7.7</td>
</tr>
<tr>
<td>San Joaquin River Area*</td>
<td>1,847,891</td>
<td>71.1</td>
<td>4.3</td>
<td>1.1</td>
<td>8.3</td>
<td>15.2</td>
<td>28.1</td>
</tr>
<tr>
<td>State</td>
<td>29,758,213</td>
<td>69.0</td>
<td>7.4</td>
<td>0.8</td>
<td>9.6</td>
<td>13.2</td>
<td>25.8</td>
</tr>
</tbody>
</table>

* Calculated from county percent distributions.

Source: Hall and Gaquin, 1997 County and City Extra, pp. 52, 66.

3.11.2 Low Income

Low income populations in the San Joaquin River Area are identified by several socioeconomic characteristics of the population residing in the area. As categorized by the 1990 Census (and updated by the U.S. Bureau of Census, 1995), specific characteristics used in this description of the existing environment are: per capita income, persons below the poverty level, families below the poverty level, substandard housing, and unemployment rates (Table 3.11-2).

Income and poverty, based on income in 1989 as reported in the 1990 Census, illustrates that the San Joaquin River area counties’ per capita and median household incomes are all lower than the averages for the state (Table 3.11-2). Merced County had the lowest per capita income, only $10,606; and Mariposa County had the lowest household income, only $25,272 (1989 dollars). Similar results are found for the percentages of persons and families living below the poverty level. Poverty status is based on the definition prescribed by the Federal Office of Management and Budget. Families and persons are below the poverty level if their total family income or unrelated individual income was less than the poverty threshold specified for the applicable family size, age of householder, and number of related children present under age 18 years. For persons not in families, poverty status is determined by their income in relation to the appropriate poverty threshold. For example, the 1989 poverty threshold for one person under age 65 was $6,451; for a family of four persons it was $12,674; and for a family of eight persons it was $21,328 (Hall and Gaquin 1997).
### Table 3.11-2. INCOME AND POVERTY, 1989

<table>
<thead>
<tr>
<th>County</th>
<th>Money Income 1989 $</th>
<th>Percent Below Poverty Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Per Capita</td>
<td>Median Household</td>
</tr>
<tr>
<td>Fresno</td>
<td>11,824</td>
<td>26,377</td>
</tr>
<tr>
<td>Madera</td>
<td>10,856</td>
<td>27,370</td>
</tr>
<tr>
<td>Mariposa</td>
<td>13,074</td>
<td>25,272</td>
</tr>
<tr>
<td>Merced</td>
<td>10,606</td>
<td>25,548</td>
</tr>
<tr>
<td>San Joaquin</td>
<td>12,705</td>
<td>30,635</td>
</tr>
<tr>
<td>Stanislaus</td>
<td>12,731</td>
<td>29,793</td>
</tr>
<tr>
<td>Tuolumne</td>
<td>13,224</td>
<td>27,030</td>
</tr>
<tr>
<td>San Joaquin River Area</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>State</td>
<td>16,409</td>
<td>35,798</td>
</tr>
</tbody>
</table>

NA=Not Available. Averages and percentages were given and are not additive.


Other measures of low income, such as substandard housing and unemployment, also characterize demographic data in relation to environmental justice (Table 3.11-3). Substandard housing units are occupied units which are overcrowded (1.01 persons or more per room) or lack complete plumbing facilities. The San Joaquin River Area counties of Fresno and Merced have higher percentages of substandard housing, 13.7 percent and 15.6 percent, than does the state. The civilian labor force is comprised of civilians 16 years old and older who were either “at work” or “with a job, but not at work” during the reference week. It includes those who worked 15 hours or more as unpaid workers in a family farm or business. The San Joaquin River Area’s unemployment rate in 1995 was 14.1 percent, significantly higher than the state unemployment rate of 10.8 percent. The highest unemployment rate was in Merced County (16.9 percent) followed by Stanislaus (15.3 percent) and Madera (15.1 percent) counties.
### 3. Affected Environment

#### Table 3.11-3: HOUSING, LABOR FORCE, AND EMPLOYMENT, 1990 AND 1995

<table>
<thead>
<tr>
<th>County</th>
<th>Housing Units 1990</th>
<th>Civilian Labor Force 1995</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Percent Substandard</td>
</tr>
<tr>
<td>Fresno</td>
<td>235,563</td>
<td>13.7</td>
</tr>
<tr>
<td>Madera</td>
<td>30,831</td>
<td>12.0</td>
</tr>
<tr>
<td>Mariposa</td>
<td>7,700</td>
<td>5.0</td>
</tr>
<tr>
<td>Merced</td>
<td>58,410</td>
<td>15.6</td>
</tr>
<tr>
<td>San Joaquin</td>
<td>166,274</td>
<td>12.4</td>
</tr>
<tr>
<td>Stanislaus</td>
<td>132,027</td>
<td>10.4</td>
</tr>
<tr>
<td>Tuolumne</td>
<td>25,175</td>
<td>4.5</td>
</tr>
<tr>
<td>San Joaquin River Area*</td>
<td>655,980</td>
<td>12.3</td>
</tr>
<tr>
<td>State</td>
<td>11,182,882</td>
<td>12.0</td>
</tr>
</tbody>
</table>

*Calculated from county percentage distributions.

3. Affected Environment

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3. Affected Environment

3.2 SURFACE WATER RESOURCES

This section of the EIR/EIS focuses on the surface waters of the San Joaquin River Basin and the resulting flows from the basin into the Delta as measured at the U.S. Geological Survey (USGS) gauging station at Vernalis. Most of the information for this section was taken directly from Reclamation’s Draft PEIS on the Central Valley Project Improvement Act (CVPIA) (Reclamation 1997d) with some information from the State Water Resources Control Board’s (SWRCB’s) Draft EIR on the 1995 Bay/Delta Water Quality Control Plan (SWRCB 1997).

The San Joaquin River Basin is contained within the southern portion of the vast Central Valley of California. The basin extends approximately 250 miles north-to-south, encompasses about 32,000 square miles, and is bounded by the Sierra Nevada mountains on the east and the Diablo Range on the west. The southern extent of the San Joaquin River Basin is formed by a relatively low hydrological divide separating it from the Tulare Lake Basin and the northern boundary is formed by the Sacramento-San Joaquin Delta. The Delta separates the San Joaquin River Basin from the Sacramento River Basin and ultimately drains all of the watersheds found within both basins.

Extensive water supply, hydroelectric, and flood control efforts during the past century have resulted in the construction of dams and reservoirs that now control the flow on nearly all major streams in the San Joaquin River Basin. Figure 3.2-1, Major features of the San Joaquin River Basin (Map) adapted from the Draft PEIS, shows major rivers and streams that drain the San Joaquin River Basin watersheds and major dams that affect stream flows.

Most of the following sections were taken directly from Reclamation’s Draft PEIS for the CVPIA (1997d), with minor edits.

3.2.1 Surface Water in the San Joaquin River Basin

The San Joaquin River Basin covers approximately 32,000 square miles in the northern part of the San Joaquin Valley, roughly from Fresno to Stockton. The climate of the San Joaquin River Basin is semiarid, characterized by hot, dry summers and mild winters, except at the highest altitudes, where distinct wet and dry seasons prevail. Most of the precipitation falls from November to April, with rain at the lower elevations and snow in the higher regions. On the valley floor, precipitation decreases from north to south, ranging from 14 inches in Stockton to eight inches at Mendota.

The primary sources of surface water to the basin are rivers that drain the western slope of the Sierra Nevada Range. Each of these rivers, the San Joaquin, Merced, Tuolumne, Stanislaus, Calaveras, Mokelumne, and Cosumnes, drain large areas of high elevation watershed that supply snowmelt runoff during the late spring and early summer months. Historically, peak flows occurred in May and June and flooding occurred in most years along all of the major rivers. When flood flows reached the valley floor, they spread out over the lowlands, creating several hundred thousand acres
of permanent tule marshes and more than 1.5 million acres of seasonally flooded wetlands. Construction and operation of the numerous water supply, hydroelectric, and flood control efforts during the 20th century have significantly modified the historic flows.

The three northernmost streams, the Calaveras, Mokelumne, and Cosumnes rivers, flow into the San Joaquin River (within the boundaries of the Delta) without affecting the flows at Vernalis and consequently are not considered in this document. Streams on the west side of the basin are intermittent, and their flows during high rainfall periods frequently reach the San Joaquin River. Natural runoff from westside sloughs is augmented with agricultural drainage.

### 3.2.2 Upper San Joaquin River and Tributaries

The San Joaquin River originates in the Sierra Nevada at an elevation over 10,000 feet and flows into the San Joaquin Valley at Friant. The river then flows to the center of the valley floor, where it turns sharply northward and flows through the San Joaquin Valley to the Delta. Along the valley floor, the San Joaquin River receives additional flow from the Merced, Tuolumne, and Stanislaus rivers. The upper San Joaquin River section, upstream of the confluence with the Merced River, was historically characterized by the runoff of the San Joaquin River.

Flows in the upper San Joaquin River are regulated by the CVP Friant Dam (Figure 3.2-1), which was completed in 1941 to store and divert water to the Madera and Friant-Kern canals for irrigation and municipal and industrial water supplies in the eastern portion of the San Joaquin Valley. In the reach between Friant Dam and the Gravelly Ford, flow is influenced by releases from Friant Dam, with minor contributions from agricultural and urban return flows. During the past 100 years, development in this area has resulted in groundwater overdraft conditions, and the river loses much of its flow through infiltration/percolation to the groundwater. Releases from Friant Dam are generally limited to those required to satisfy downstream water rights and instream flows. Millerton Lake, formed by Friant Dam, has a capacity of 520,000 acre-feet.

Above Friant Dam, the San Joaquin River drains an area of approximately 1,676 square miles and has an annual average unimpaired runoff of 1.7 million acre-feet. The median historical unimpaired runoff is 1.4 million acre-feet, with a range of 0.4 to 4.6 million acre-feet. Several reservoirs in the upper portion of the San Joaquin River watershed, including Edison, Florence, Huntington, Mammoth Pool, and Shaver Lake, are primarily used for hydroelectric power generation. The operation of these reservoirs affects the inflow to Millerton Lake.

### 3.2.3 Lower San Joaquin River and Tributaries

The lower San Joaquin River, from the confluence with the Merced River to the Delta, is characterized by the combination of flows from tributary streams, major rivers, groundwater accretions, and agricultural drainage water. The lower San Joaquin River is the section of river from
the confluence with the Merced River (below Fremont Ford) to Vernalis, which is generally considered the southern limit of the Delta. The drainage area of the San Joaquin River above Vernalis includes approximately 13,356 square miles, of which approximately 2,100 square miles are drained by Fresno Slough (James Bypass) as well as the much longer Kings River watershed. Little water is contributed from the upper San Joaquin River, except during flood events. Flow patterns in the lower San Joaquin River are therefore primarily governed by the tributary inflows from the Merced, Tuolumne, and Stanislaus rivers.

**Merced River.** The Merced River originates in the Sierra Nevada, drains an area of approximately 1,273 square miles east of the San Joaquin River, and produces an average unimpaired runoff of approximately 1.8 million acre-feet.

Agricultural development in the Merced River watershed began in the 1850s, and significant changes have been made to the hydrologic system since that time. The enlarged New Exchequer Dam, forming Lake McClure with a capacity of 1,024,000 acre-feet, was completed in 1967 and now regulates releases to the lower Merced River. New Exchequer Dam is owned and operated by the Merced Irrigation District for power production, irrigation, and flood control. Releases from Lake McClure pass through a series of powerplants and smaller diversions and are re-regulated at McSwain Reservoir. Below McSwain Dam, water is diverted to Merced Irrigation District at the Pacific Gas and Electric Company (PG&E) Merced Falls Dam and further downstream at the Crocker Huffman Dam.

**Tuolumne River.** The Tuolumne River originates in the Sierra Nevada Mountains, drains a watershed of approximately 1,540 square miles, and produces an average annual unimpaired runoff of approximately 1.8 million acre-feet.

Flows in the lower portion of the Tuolumne River are controlled primarily by the operation of New Don Pedro Dam, which was constructed in 1971 jointly by TID and MID with participation by the City and County of San Francisco. The 2.03-million-acre-foot reservoir stores water for irrigation, hydroelectric generation, fish and wildlife enhancement, recreation, and flood control purposes. The districts divert water to the Modesto Main Canal and the Turlock Main Canal a short distance downstream from New Don Pedro Dam at La Grange Dam. The existing dam at La Grange was completed in 1893.

The City and County of San Francisco (CCSF) operates several water supply and hydroelectric facilities within the Tuolumne River Basin upstream of New Don Pedro Reservoir. O’Shaughnessy Dam on the main stem of the Tuolumne River, completed in 1923, impounds approximately 0.36 million acre-feet of water in Hetch Hetchy Reservoir. Water from Hetch Hetchy is used primarily to meet the municipal and industrial water needs of the CCSF and to provide instream flows in the Tuolumne River below O’Shaughnessy Dam. Two other storage facilities upstream of New Don
Pedro Reservoir, Lake Eleanor and Cherry Lake, are also operated by CCSF for hydropower and water supply purposes. The combined capacity of these two reservoirs is about 0.3 million acre-feet.

**Stanislaus River.** The Stanislaus River originates in the Sierra Nevada Mountains, drains a watershed of approximately 900 square miles, and produces an average unimpaired runoff of approximately 1.056 million acre-feet. Snowmelt runoff contributes the largest portion of the flows in the Stanislaus River, with the highest monthly flows in May and June.

Flow control in the lower Stanislaus River is provided by the New Melones Reservoir, which has a capacity of 2.4 million acre-feet, and is operated by Reclamation as part of the CVP. Releases from New Melones Reservoir are re-regulated downstream by Tulloch Reservoir. Prior to the construction of New Melones Dam, average monthly flows in the Stanislaus River were generally uniform between January and June, with peak flows in May. As a result of limited storage capacity of facilities on the river, average monthly flows in August and September approached zero in many years downstream of Goodwin Dam. Following construction of New Melones Dam, average monthly flows included peak flows in March, with releases in all months.

The main water diversion point on the Stanislaus River is Goodwin Dam, which provides for delivery to OID and SSJID. Goodwin Dam is also used to divert water into the Goodwin Tunnel for deliveries to Central San Joaquin Water Conservation District and the Stockton East Water District.

**San Joaquin River at Vernalis.** Flows in the San Joaquin River at Vernalis are affected by the operation of upstream facilities on the San Joaquin, Merced, Tuolumne, and Stanislaus rivers, as well as by deliveries to the Mendota Pool from the Delta-Mendota Canal and overflows from the Kings River in the Tulare Lake Region. Prior to the construction of major dams on the San Joaquin River and its tributaries, average monthly flows peaked during May and June in response to snowmelt runoff. Unrestricted flows have not occurred since the construction of the original Exchequer and Don Pedro reservoirs in the 1920s. Between 1941 and 1978, flows were altered from natural conditions in response to the operations of Friant, New Exchequer, New Don Pedro, and New Melones dams. New Melones Dam, the most recently constructed dam in the San Joaquin River Basin, was completed in 1978. Since that time, average monthly flows in the San Joaquin River at Vernalis have been more uniform throughout the year, with maximum flows less than historical levels.

### 3.2.4 Surface Water Quality in the San Joaquin River Basin

Surface water quality in the San Joaquin River Basin is affected by several factors, including natural runoff, agricultural return flows, biostimulation, construction, logging, grazing, operations of flow regulating facilities, urbanization, and recreation. In addition, irrigated crops grown in the western portion of the San Joaquin Valley have accelerated the leaching of minerals from soils, altering water quality conditions in the San Joaquin River system.
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Water quality in the San Joaquin River varies considerably along the stream’s length. Above Millerton Lake and downstream towards Mendota Pool, water quality is generally excellent. The reach from Gravelly Ford to Mendota Pool (about 17 miles) is frequently dry except during flood control releases because all water released from Millerton Lake is diverted to satisfy contract agreements, or percolates to groundwater. During the irrigation season, most of the water released from the Mendota Pool to the San Joaquin River is imported from the Delta via the Delta-Mendota Canal, and has higher concentrations of total dissolved solids (TDS) than water in the upper reaches of the San Joaquin River. Most of the water released from the Mendota Pool to the San Joaquin River is diverted at or above Sack Dam for agricultural uses. Between Sack Dam and the confluence with Salt Slough, the San Joaquin River is often dry. From Salt Slough to Fremont Ford, most of the flow in the river is derived from irrigation returns carried by Salt and Mud sloughs. This reach typically has the poorest water quality of any reach of the river.

As the San Joaquin River progresses downstream from Fremont Ford, water quality generally improves at successive confluences, specifically at those with the Merced, Tuolumne, and Stanislaus rivers. In the relatively long reach between the Merced and Tuolumne rivers, however, mineral concentrations tend to increase due to agricultural drainage water return flows, other wastewaters, and effluent groundwater (DWR 1965 as cited in USBR 1997f). TDS in the San Joaquin River near Vernalis has historically ranged from 52 milligrams per liter (mg/l) (at high stages) to 1,220 mg/l during the 1951-1962 period (DWR 1965 as cited in USBR 1997f). While other contemporary periods (1976-1977 and 1986-1992) have had elevated mineral content (and reduced flows), the period of record from 1951-1962 is the most appropriate and inclusive of the greatest frequency of elevated TDS. During the mid to late 1960s, San Joaquin River water quality continued to decline. In 1972, the SWRCB included a provision in Decision 1422 (D-1422) that Reclamation maintain average monthly concentrations of TDS in the San Joaquin River at Vernalis of 500 mg/l as a condition of the operating permit for New Melones Reservoir on the Stanislaus River.

3.2.5 Water Facilities and Operations

3.2.5.1 CVP Facilities and Operations

The CVP is the largest surface water storage and delivery system in California, with a geographic scope covering 35 of the state’s 58 counties. The project includes 20 reservoirs, with a combined storage capacity of approximately 11 million acre feet; 8 powerplants and 2 pump-generating plants, with a combined generation capacity of approximately 2 million kilowatts; 2 pumping plants; and approximately 500 miles of major canals and aqueducts. The CVP supplies water to more than 250 long-term water contractors in the Central Valley, the Santa Clara Valley, and the San Francisco Bay Area.

Historically, approximately 90 percent of the CVP water has been delivered to agricultural users, including senior water right holders. Total annual contracts exceed 9 million acre-feet, including
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over 1 million acre-feet of Friant Division Class II supply, which is generally available only in wet years. At present, increasing quantities of water are being provided to municipal customers, including the cities of Redding, Sacramento, Folsom, Tracy, and Fresno; most of Santa Clara County; and the northeastern portion of Contra Costa County.

CVP operations are influenced by a myriad of general operating rules, regulatory requirements, and facility-specific concerns and requirements. This section summarizes the operations of the CVP, beginning with a description of factors that influence operations decisions, descriptions of regulatory requirements, and specific operating constraints at CVP facilities. It concludes with a discussion of CVP contract types, including water rights contracts, and criteria used to determine annual water delivery levels to those contractors.

General Criteria for the Operation of CVP Facilities

In the development of operations decisions, criteria related to reservoir operations, downstream conditions, and water rights in the Delta must be considered. This section describes how these issues generally influence CVP operational decisions.

Reservoir Operating Criteria. Inflow and release requirements are the principal elements influencing reservoir storage. Operational decisions must consider not only conditions at an individual reservoir, but also downstream conditions and conditions at other project reservoirs. The possibility of using multiple water sources for some requirements adds flexibility to project operations and complexity to operations decisions. Storage space south (upstream) of the Delta that can only be filled with water exported from the Delta is a major operational consideration involving the geographic distribution of water in storage. Other factors that influence the operation of CVP reservoirs include flood control requirements, carryover storage objectives, lake recreation, power production capabilities, cold water reserves, and pumping costs.

The U.S. Army Corps of Engineers (COE) is responsible for determining flood control operational requirements at most CVP reservoirs. If CVP reservoir storage exceeds COE requirements, water must be released at rates of flow defined in the COE's flood control manuals. These manuals require lower reservoir storage levels in the fall in anticipation of inflow from winter precipitation. To avoid excess releases at the end of the summer, releases in excess of minimum flow requirements are made over the course of the summer such that reservoir storage levels are at or below maximum flood control levels in the fall.

Streamflow Criteria. Streams below CVP dams support both resident and anadromous fisheries, recreation, and water diversions. While resident fisheries are slightly affected by release fluctuations, the anadromous fisheries (e.g., salmon and steelhead) are the most sensitive and are present year-round in several CVP streams. Maintaining water conditions favorable to spawning, incubation, rearing, and outmigration of the young anadromous fish is one of the main objectives.
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CVP operations are coordinated to anticipate and avoid streamflow fluctuations during spawning and incubation whenever possible.

In the management of releases prescribed by the COE for flood control, CVP operators have some latitude in controlling the magnitude and duration of the releases, based on criteria for downstream public safety and levee stability. Flood control releases are typically accomplished through a series of stepped increases defined by such factors as powerplant capability, minor flooding of adjacent lands, erosion, and channel capacity. Flood releases are established at the lowest step of the progression that will satisfy the requirements for evacuating storage, maximizing public safety, and minimizing the downstream effect of flood releases.

**Regulations and Agreements that Affect CVP Operations**

The operation of the CVP is, and has historically been, affected by the provisions of several regulatory requirements and agreements. Prior to the passage of CVPIA, the operation of the CVP was affected by SWRCB Decisions 1422 and 1485, and the Coordinated Operations Agreement (COA). Decisions 1422 and 1485 identify minimum water flow and water quality conditions at specified locations, which are to be maintained in part through the operation of the CVP. The COA specifies the responsibilities shared by the CVP and State Water Project (SWP) for meeting the requirements of D-1485.

Beginning in 1987, a series of actions by the SWRCB, U.S. Environmental Protection Agency (USEPA), the National Marine Fisheries Services (NMFS), and the U.S. Fish and Wildlife Service (Service) affected interim water flow and water quality standards in the Delta. However, at the time CVPIA was enacted (October, 1992), the water quality standard in the Delta remained D-1485, and the CVP and SWP were operated in accordance with the COA to maintain this requirement.

In 1993, the Service released a biological opinion and included restrictions on water management in and upstream of the Delta regarding delta smelt and associated habitat of operational actions by the CVP and SWP. This biological opinion was revised in 1994 and in 1995.

In December 1994, representatives of the state and federal governments and urban, agricultural and environmental interests agreed to the implementation of a Bay/Delta protection plan through the SWRCB, in order to provide ecosystem protection for the Bay/Delta Estuary. SWRCB WR Order 95-6 modified D-1485 and D-1422 to reflect the objectives of, and remove some inconsistencies with the Draft Bay/Delta Water Quality Plan, released May 1995. The coordinated operations of the CVP and SWP continue to be based on the COA.
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Operations of CVP Divisions and Facilities South of the Delta

The facilities included in CVP divisions north of the Delta are known collectively as the Northern CVP System. Facilities in CVP divisions south of the Delta include the Delta, West San Joaquin, and San Felipe divisions and are known collectively as the Southern CVP System. Both the Eastside and the Friant divisions are operated independently of the remainder of the CVP, due to the nature of their water supplies and service areas. The Northern and Southern CVP Systems are operated as an integrated system, and demands for water and power can be met by releases from any one of several facilities. Demands in the Delta and south (upstream) of the Delta can be met by the export of excess water in the Delta, which can result from releases from northern CVP reservoirs. As a result, operational decisions are based on a number of physical and hydrological factors that tend to change depending on conditions.

West San Joaquin Division. The West San Joaquin Division of the CVP consists of the San Luis Unit, and includes federal as well as joint federal and State of California water storage and conveyance facilities to provide for delivery of surplus water to CVP contractors in the San Joaquin Valley and in the San Felipe Division. Facilities in the West San Joaquin Division are San Luis Dam and Reservoir, O’Neill Dam and Forebay, the San Luis Canal, Coalinga Canal, Los Banos and Little Panoche Detention dams and reservoirs, and the San Luis Drain.

San Luis Dam and Reservoir are located on San Luis Creek near Los Banos (Figure 3.2-1). The reservoir, with a capacity of 2.0 million acre-feet, is a pumped-storage reservoir primarily used to store water exported from the Delta. It is a joint federal and State of California facility that stores CVP and SWP water. San Luis Reservoir waters are released for delivery to CVP and SWP contractors served by the San Luis Canal, through the Pacheco Tunnel to serve the San Felipe Unit of the CVP, and to the Delta-Mendota Canal to serve CVP water service and San Joaquin River Exchange Contractors on the west side of the San Joaquin Valley.

O’Neill Dam and Forebay are located on San Luis Creek downstream of San Luis Dam along the SWP California Aqueduct. The forebay is used as a hydraulic junction point for state and federal waters. CVP water is lifted from the Delta-Mendota Canal to the O’Neill Forebay by the O’Neill Pumping-Generating Plant. The San Luis Canal, a joint federal and state (CVP/SWP) facility, conveys water southeasterly from O’Neill Forebay along the west side of the San Joaquin Valley for delivery to CVP and SWP contractors.

The CVP operation of the San Luis Unit requires coordination with the SWP, since some of the facilities are joint state and federal facilities. Like the CVP, the SWP also has water demands it must meet with limited water supplies and facilities. Coordinating the operations of the two projects avoids inefficient situations such as one entity pumping water into San Luis Reservoir at the same time the other is releasing water.
3. Affected Environment

San Felipe Division. The San Felipe Division provides CVP water to Santa Clara and San Benito counties, through conveyance facilities from the San Luis Reservoir. Specific facilities include the Pacheco Tunnel and Conduit, the Hollister Conduit, San Justo Dam and Reservoir, and the Santa Clara Conduit. The Pajaro Valley, in southern Santa Cruz County, was originally authorized to receive irrigation water to reduce seawater intrusion caused by groundwater pumping. Although studies to reduce seawater intrusion and determine conveyance requirements have continued, no facilities have yet been constructed in the Pajaro Valley to receive the authorized water deliveries.

Eastside Division. The Eastside Division of the CVP includes water storage facilities on the Stanislaus River (New Melones Dam, Reservoir, and Powerplant), Chowchilla River (Buchanan Dam and Eastman Lake), and Fresno River (Hidden Dam and Hensley Lake). All of the dams and reservoirs in this division were constructed by the COE. Upon completion in 1978, the operation of New Melones was assigned to Reclamation to provide flood control, satisfy water rights obligations, provide instream flows, maintain water quality conditions in the Stanislaus River and in the San Joaquin River at Vernalis, and provide deliveries to CVP contractors.

The operating criteria for New Melones Reservoir are governed by water rights, instream fish and wildlife flow requirements, instream water quality, Delta water quality, CVP contracts, and flood control considerations. Flows in the lower Stanislaus River serve multiple purposes. These include providing water for instream water rights obligations, meeting instream fishery flow requirements, maintaining instream water conditions of dissolved oxygen, and maintaining water quality conditions in the San Joaquin River at Vernalis, in accordance with D-1422 and the SWRCB May 1995 Water Quality Plan (WQP). Water is also released from New Melones Reservoir to meet, to the extent available, the San Joaquin River flow requirements in the SWRCB May 1995 WQP. The operating criteria have been revised (May, 1997) and are currently being refined by stakeholders.

Friant Division. The Friant Division includes facilities to collect and convey water from the San Joaquin River in order to provide a supplemental water supply to areas along the east side of the southern San Joaquin River Basin and the Tulare Basin. The delivery of CVP water to this region augments groundwater and local surface water supplies in an area that has historically been subject to groundwater overdraft. The Friant Division is an integral part of the CVP, but is hydrologically independent and, therefore, operated separately from the other divisions of the CVP. The water supply to this division was made available through an agreement with San Joaquin River water right holders, who entered into an exchange contract and purchase agreement with Reclamation for delivery of water through the Delta-Mendota Canal. Major facilities of the Friant Division include Friant Dam and Millerton Lake, the Madera Canal, and the Friant-Kern Canal.

Flood control releases from Millerton Lake (Friant Dam) may be used to satisfy portions of deliveries to the Mendota Pool Contractors and the San Joaquin River Exchange Contractors on the San Joaquin River below Mendota Pool. Millerton Lake operations are coordinated with operations of the Delta-Mendota Canal in the Delta Division to use all available Millerton Lake flood control
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releases before additional water is delivered to Mendota Pool. During wet hydrologic periods, overflow from the Kings River may also enter the San Joaquin River Basin at the Mendota Pool through the Fresno Slough.

CVP Water Users South of the Delta

During development of the CVP, the United States entered into long-term contracts with many of the major water right holder in the Central Valley. In part, the CVP is operated to satisfy downstream water rights, meet the obligations of the water rights contracts, and deliver project water to CVP water service contractors.

Many of the CVP water rights originated from applications filed by the state in 1927 and 1938 to advance the California Water Plan. After the Federal Government authorized the construction of the CVP, those water rights were transferred to Reclamation, who made applications for the additional water rights needed for the CVP. In granting water rights, the SWRCB set certain conditions within the permits to protect prior water rights, fish and wildlife needs, and other prerequisites it deemed in the public interest.

San Joaquin River Exchange Contractors. San Joaquin River Exchange Contractors are water right holders who receive substitute CVP water from the Delta-Mendota Canal (DMC) at the Mendota Pool. Under the Exchange Contract, the parties agree to not exercise their San Joaquin River water rights in exchange for a substitute CVP water supply from the Delta. Under the water rights of the United States, these exchanges allow for water to be diverted from the San Joaquin River at Friant Dam and stored at Millerton Lake.

The purchase contract dealt with riparian and pre-1914 water rights. Under the Exchange Contract, the parties agree not to exercise their rights in exchange for a substitute water supply from the Delta. However, under the Exchange Contract, no transfer of water rights occurs, and Reclamation is responsible for delivering substitute water to these contractors in accordance with the Exchange Contract.

CVP Water Service Contractors. Before construction of the CVP, many irrigators on the west side of the Sacramento Valley, on the east and west sides of the San Joaquin Valley, and in the Santa Clara Valley relied primarily on groundwater. With the completion of CVP facilities in these areas, the irrigators signed contracts with Reclamation for the delivery of CVP water as a supplemental supply. Several cities also have similar contracts.

CVP water service contracts are between the United States and individual water users or districts and provide for an allocated supplemental supply of CVP water to be applied for beneficial use. In addition to CVP water service contracts, the Exchange Contract includes a supply of water that recognizes a previous water right. The purposes of a water service contract are to stipulate
provisions under which a water supply is provided, to produce revenues sufficient to recover an appropriate share of capital investment, and to pay the annual operations and maintenance costs of the project.

In the Friant Division, a two-class system of water service contracts is employed to support the conjunctive use of surface water and groundwater that has long been a practice in the San Joaquin River and Tulare Lake Basins. Class I contracts relate to “dependable supply,” typically assigned to users with limited access to good quality groundwater. Class II contracts are generally held by water users with access to good quality groundwater that can be used during periods of surface water deficiency. Groundwater recharge and recharge/exchange agreements are frequently employed in the management of Class II water supplies.

Criteria for Water Deliveries to CVP Contractors

Decision-making criteria are similar in most units and divisions of the CVP. The criteria applicable to CVP water service contractors served by the North System (Trinity, Shasta, Sacramento River, and American River divisions) and the South System (Delta, West San Joaquin, and San Felipe divisions) are similar. The decision-making criterion is unique for the Exchange Contractors because it is based solely on forecasted inflows to Shasta only. The criteria applied to establish water delivery deficiencies in the Friant Division are somewhat different, because this division is operated to provide water supplies for conjunctive use. In addition, the criteria for operations of New Melones Reservoir and contract deliveries on the Stanislaus River are affected by conditions unique to the Stanislaus River watershed as well as the May 1997 New Melones Interim Plan of operation (which is the subject of stakeholder refinement as of the writing of this document).

Criteria for Deliveries to CVP Contractors in the North and South Systems. Except in times of water shortages, the CVP makes available the amounts of water specified in the terms of its water rights and water service contracts in the CVP North and South systems. Water availability for delivery to CVP water service contractors during periods of insufficient water supply is determined based on a combination of operational objectives, hydrologic conditions, and reservoir storage conditions. Reclamation is required to allocate shortages among water service contractors within the same service area, as individual contracts and CVP operational capabilities permit.

Criteria for Deliveries to CVP Contractors in the Friant Division. The determination of annual water supply from the Friant Division is done independently of other CVP divisions. In February, Reclamation estimates the water supply for the coming contract year based on hydrologic conditions, storage in upstream reservoirs, and assumptions based on statistical analysis of historic records.

Criteria for Deliveries to CVP Contractors in the Eastside Division. Reclamation has had difficulty meeting all of the demands on New Melones Reservoir. This difficulty became apparent during the period of 1987-1992 when New Melones Reservoir was drawn down to approximately
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80,000 acre-feet by 1992. Numerous unanticipated operational factors influenced the drawdown of New Melones during this period. These include the severity of drought conditions from 1989 through 1992, the effect of return flow water quality in the San Joaquin River at Vernalis, and low flows on the Merced and Tuolumne rivers. During the drought period, many Stanislaus River stakeholder meetings were convened to coordinate management of limited water supplies. Consequently the May 1997 New Melones Interim Plan of Operation provides examples of operation under the 50 percent (most probable) and 90 percent probability of exceedance (90 percent chance of having increased flows) hydrologic conditions which include water years 1997 and 1998. This interim plan is currently the subject of stakeholder refinement as of the writing of this document.

3.2.5.2 SWP Facilities and Operations

SWP facilities consist of 22 dams and reservoirs that capture and store water on the Feather River, in order to deliver water to service areas in the Feather River Basin, the San Francisco Bay area, the San Joaquin Valley, the Tulare Basin, and Southern California. Lake Oroville, SWP’s largest reservoir, with a storage capacity of approximately 3.5 million acre-feet, regulates the Feather River for release to Sacramento River and the Delta. The water is diverted by various facilities of the SWP for delivery to contractors or salinity control. In addition, Lake Oroville provides flood control, fish and wildlife habitat, irrigation water, hydroelectric generation, and recreation (Water Education Foundation 1997).

The SWP operates two diversion facilities in the Delta. The North Bay Aqueduct diverts water from the north Delta near Cache Slough for agricultural and municipal uses in Napa and Solano counties.

In the southern portion of the Delta, the Banks Delta Pumping Plant lifts water into the California Aqueduct from the Clifton Court Forebay. The California Aqueduct is the state's largest and longest water conveyance system (444 miles), beginning at the Banks Pumping Plant and extending to Lake Perris south of Riverside, in Southern California. Water in the California Aqueduct flows to O’Neill Forebay, from which a portion of the flow may be lifted to the joint CVP/SWP San Luis Reservoir for storage. From O’Neill Forebay, the joint-use portion of the aqueduct, San Luis Canal, extends south to the southern end of the San Joaquin Valley. The SWP portion of the aqueduct continues over the Tehachapi Mountains to the South Coast Region. To cross the Tehachapis into southern California, water is elevated some 2,000 feet–more water pumped higher than anywhere else in the world.

SWP Water Users

About 30 percent of SWP water is used for irrigation, mostly in the San Joaquin Valley. Approximately 70 percent is used for residential, municipal, and industrial use, mainly in southern California. Currently, the SWP has contracted a total of 4.22 million acre-feet for delivery in San Joaquin River Region, the Central Coast Region, and the San Francisco and South Coast regions. Of this amount, about 2.5 million acre-feet is designated for the Southern California Transfer Area,
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nearly 1.36 million acre-feet to the San Joaquin Valley, and the remaining 0.37 million acre-feet to the San Francisco Bay area, the Central Coast Region, and the Feather River area.

Contracts executed in the early 1960s established the maximum annual water amount (entitlement) that each long-term contractor may request from the SWP. The annual quantities reflect each contractor’s projected annual water needs at the time the contracts were signed. SWP delivers water to agricultural and municipal and industrial water contractors based on the criteria established in the 1996 Monterey Agreement, which applies equal deficiency levels to all contractors.

3.2.5.3 San Joaquin River Group Authority Willing Sellers

San Joaquin River

San Joaquin River Exchange Contractors Water Authority. The operating scheme used by the CVP to service the Exchange Contractors is fairly straightforward. Shasta Reservoir, which has a capacity of 4,552,000 acre-feet, stores winter runoff from the upper Sacramento River. Some of this water is transferred to the southern delta CVP Tracy Pumping Plant via the Sacramento River, the Delta Cross-Channel, and interior central delta channels and is lifted into the Delta-Mendota Canal. This 117-mile-long canal carries water south by gravity flow to the Mendota Pool (which is located 30 miles west of Fresno). The water is used in the San Joaquin Valley to replace the San Joaquin River water that is diverted at Friant Dam near Fresno. Thus, Sacramento River water is brought down to replace the San Joaquin River water that is captured, stored in Millerton Lake, and diverted for use farther south through the Friant-Kern Canal and for use farther north through the Madera Canal (Littleworth and Garner 1995).

The Exchange Contractors have a total allotment of 840,000 acre-feet per year under a best-case wet year scenario. They are allowed a maximum of 719,000 acre-feet in a normal year to be diverted during the April-October period. In a critical drought year, the Exchange Contractors are limited to 529,000 acre-feet of CVP water during the same period.

Stanislaus River

Oakdale Irrigation District. The OID encompasses approximately 72,345 acres in Stanislaus and San Joaquin counties. Approximately 62,000 acres (or 86 percent) of land within the district is irrigated by OID through a gravity system of canals, tunnels, and pipelines. OID maintains more than 330 miles of laterals and pipelines and 40 miles of main canals and tunnels. The Stanislaus River runs throughout the central portion of the district.

OID has an adjudicated pre-1914 water right held jointly with SSJID to divert 1,816.6 cubic feet per second (cfs) of flow from the Stanislaus River. In addition to its pre-1914 rights, OID also has licenses and permits to direct divert and divert to storage waters of the Stanislaus River above its
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1,816.6 cfs pre-1914 right. Most of these rights are also held jointly with SSJID. When New Melones Reservoir was constructed, it flooded OID’s and SSJID’s Melones Reservoir. In settlement of that action and the Districts’ protests of Reclamation’s application to obtain a permit from the SWRCB, Reclamation, OID and SSJID entered into an Agreement and Stipulation in 1972. In 1988, the 1972 Agreement and Stipulation was amended. The Agreement entitles OID/SSJID to receive 600,000 acre-feet of water when the projected flow in the Stanislaus River is greater than 600,000 acre-feet. OID and SSJID have an internal agreement to equally divide the water available to them under the 1988 Agreement.

Historically, more than 95 percent of the water served by OID has been surface water diverted from the Stanislaus River at Goodwin Dam into the Joint Supply Canal and the South Main Canal. Water diversions historically have occurred from March 1 through October 30 of a calendar year. The bulk of the diversions occurred in May through August. OID still diverts the majority of its water for irrigation use in the months of May through August.

Surface water is supplemented by groundwater pumping, especially during dry periods when surface water supplies are limited, from 22 groundwater wells (approximately 200 feet deep) located throughout the district on both sides of the Stanislaus River. An approximate average of 8,130 acre-feet per year of water has been pumped from these wells directly into the surface conveyance system to balance flows for irrigation customers. OID also pumps a small quantity (average 1,358 acre-feet per year) from four shallow wells to control water table levels in certain portions of the district. Over the last fifteen years, OID has pumped an approximate average of 9,668 acre-feet per year of groundwater, or less than four percent of their total water usage (OID/SSJID 1997).

Other components of OID operations include river pumps and reclamation pumps that recover and re-distribute a portion of operational spills, operational fluctuations, and a portion of irrigation tailwater. Excess water in the surface system south of the Stanislaus River drains into the Modesto Irrigation Canal (MID), the Tuolumne River, and eventually into the Stanislaus River as surface water return flows. Surface water runoff on OID property north of the river drains into the SSJID main distribution canal and flows west into SSJID and Lone Tree Creek (not a tributary to the Stanislaus River). In addition to pumping for irrigation use, OID also owns and/or operates nine independent domestic water systems. Over the last ten years, these wells have produced an average of 1,100 acre-feet per year. An undetermined number of privately-owned agriculture and domestic wells are located within the OID but are not operated by OID. Production from these wells has been estimated at 30,000 acre-feet per year (OID/SSJID 1997).

South San Joaquin Irrigation District. The SSJID covers approximately 71,112 acres in San Joaquin County. The predominant land use in SSJID is agricultural with urban areas comprising approximately 10 percent of the total district area. Pursuant to the 1988 Agreement and Stipulation, SSJID is entitled to divert jointly with OID up to 600,000 acre-feet per year from the Stanislaus River. SSJID has rights to divert one-half of the total diversion, up to 300,000 acre-feet per year.
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Diverted Stanislaus River surface water flows into the SSJID/OID Joint Main Canal at the Goodwin Dam and is channeled into Woodward Reservoir. The District releases water from Woodward Reservoir into a conveyance system of canals to provide irrigation water for agricultural customers. Unused surface water drains north to the French Camp Outlet Canal. A small portion of irrigation runoff drains south as surface water return flows to the Stanislaus River. The return flows to the Stanislaus River have been monitored for the last two years and total approximately 3,124 acre-feet and 3,906 acre-feet for the 1996 and 1997 irrigation seasons, respectively (OID/SSJID 1997).

SSJID has made significant improvements to its irrigation delivery system over the last 15 years. As a result, SSJID is able to meet existing agricultural needs using less water and devote the conserved water to other uses, including additional conjunctive use projects which recharge the groundwater basin in wetter water years. SSJID is currently designing additional changes to its delivery system in some portions of the district to better meet the needs of existing agricultural customers and to enable farmers who currently use groundwater for sprinkler and drip irrigation to use surface water. SSJID has agreed to build a domestic water treatment plant to address the needs of four cities in the area which currently rely largely on groundwater. SSJID, along with OID, has agreed to make available up to 30,000 acre-feet of water annually to Stockton East Water District and the City of Stockton to reduce groundwater pumping.

SSJID has, in recent years, sold water that is temporarily surplus to the District’s needs as a result of water conservation. The District, along with OID, sold water to the Department of the Interior in 1994 and signed an agreement for a two year sale in 1997 and 1998. As part of the two year sale, SSJID sold 40,000 acre-feet in 1997 and 25,000 acre-feet in 1998 (OID/SSJID 1997).

After existing irrigation needs are met and after accounting for any sales of water, SSJID stores any additional water in the conservation account established by the 1988 Agreement and Stipulation with Reclamation. Water stored in the conservation account is reserved for SSJID’s use in years of very low inflow to New Melones. SSJID is entitled to store up to 100,000 acre-feet in the conservation account, which is half of the amount available by the 1988 Agreement and Stipulation. By the terms of an agreement with OID, OID is entitled to the remaining portion of the conservation account. Water stored in the conservation account is lost to the extent of flood control releases by Reclamation.

Tuolumne River

Modesto Irrigation District and Turlock Irrigation District. Tuolumne River water has been used for irrigation in the Central Valley since the late 1890s, when MID/TID (the Districts) constructed storage and conveyance facilities. The water resources of the upper basin were developed for water supply by the City and County of San Francisco during the early decades of the 20th century. This and later development modified the natural flow regime of the Tuolumne River; on average, more than 60 percent of the annual flow has been diverted for agricultural or municipal
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and industrial use. The three reservoirs in the Hetch Hetchy System (not including storage in CCSF’s Don Pedro Water Bank) can store up to 35 percent of the mean annual unimpaired flow of the river as measured below La Grange. New Don Pedro Reservoir, along with the two smaller district-specific storage reservoirs (Modesto Reservoir and Turlock Lake), can store up to 112 percent of the mean annual flow of the river (FERC 1996).

The New Don Pedro Project (NDPP) is owned and operated by the Districts and consists of the New Don Pedro Dam, Don Pedro Reservoir (New Don Pedro Lake), and the New Don Pedro Powerhouse. Diversions from the NDPP system as well as from La Grange Dam, the TID and MID diversion facilities at the La Grange Dam, the TID canal system, TID’s Turlock Lake, the MID canal system, and MID’s Modesto Reservoir currently supply water to agricultural users. TID has considered using diversion from the NDPP system to supply the city of Turlock for municipal and industrial supply purposes; MID recently began supplying Tuolumne River water to the city of Modesto in 1995. NDPP also provides flood control, hydropower production, reservoir-based recreation, and fish and wildlife conservation.

The New Don Pedro Dam is an earth and rockfill structure located at Tuolumne river mile 54.5. It has a crest length of 2,300 feet and a maximum height of 585 feet above the streambed. The dam was constructed in 1971 to replace the original Don Pedro Dam, which was located approximately 2 miles upstream. The New Don Pedro Reservoir has a gross capacity of 2,030,000 acre-feet and a net usable capacity for irrigation, flood control, and hydropower generation of 1,721,000 acre-feet (FERC 1996).

La Grange Dam is a diversion facility also owned and operated by the Districts and is located 2.3 miles downstream of New Don Pedro Dam. The dam is a 130-foot-high overflow structure built in 1893 and impounds approximately 500 acre-feet of water. The Turlock Main Canal and the Modesto Main Canal divert water from just above La Grange Dam into an extensive network of irrigation canals on both sides of the Tuolumne River, with TID’s canals on the south and MID’s on the north. Both irrigation districts have an intermediate storage reservoir at the upper end of their canal network to help regulate flows. Turlock Lake, on the south side of the Tuolumne River, has a capacity of 48,000 acre-feet. Modesto Reservoir, on the north side of the river, has a capacity of 28,000 acre-feet (FERC 1996).

The Hetch Hetchy System is owned and operated by City and County of San Francisco and is not part of the FERC licensed NDPP facilities. CCSF regulates the upper portion of the Tuolumne basin through the operation of its Hetch Hetchy System for municipal and industrial water supply and hydropower generation. Hetch Hetchy facilities include O’Shaughnessy Dam at the Hetch Hetchy Reservoir; the Hetch Hetchy Aqueduct; the Canyon Power Tunnel; the Kirkwood Powerhouse; the Early Intake Diversion Dam; and the Cherry Creek Power Development. Although CCSF has no authority over the operation of Don Pedro Reservoir, a portion of the storage in Don Pedro is
allocated to CCSF through a water bank arrangement (FERC 1996). CCSF is not a willing seller under the proposed project.

**Merced River**

**Merced Irrigation District.** Flows in the Merced River are regulated primarily by four major facilities: New Exchequer Dam (Lake McClure), McSwain Reservoir and Powerplant, Merced Falls Dam and Crocker-Huffman Dam. The largest reservoir, Lake McClure, has a capacity of 1,024,000 acre-feet and is created by New Exchequer Dam. Merced ID owns and operates the reservoir for power, irrigation, recreation and flood control purposes. Water released from Lake McClure passes through a series of powerplants and smaller diversions before reaching the main diversion point. McSwain Reservoir, a part of Merced ID’s Merced River Development Project, serves as an afterbay to New Exchequer Dam and Powerplant, re-regulating power generation releases to the Merced River. The capacity of McSwain Reservoir is 9,200 acre-feet (Merced ID 1977). Merced Falls Dam, from which diversions are made to Merced ID’s Northside Canal, is owned and operated by PG&E. Downstream of Merced Falls Dam is the Crocker-Huffman Dam, from which diversions are made to Merced ID’s Main Canal. On average, just over 50 percent of the annual streamflow in the Merced River below Merced Falls Dam is diverted to Merced ID’s Main Canal (500,900 acre-feet per year between 1955 and 1980) (Merced ID 1997).
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3.3 GROUNDWATER RESOURCES

This section identifies the existing groundwater resources that could be affected by implementation of flow objectives of the San Joaquin River Agreement (Agreement). It presents general information on the regional groundwater resources within the San Joaquin Groundwater Basin. Area-specific information on the groundwater basins underlying the service areas of the willing sellers is described in Appendix B. Section 4.3, subsequently, describes the impacts to groundwater within the local groundwater basins.

3.3.1 Introduction

The discussion of groundwater conditions in this section is for the San Joaquin River Region. Included in the discussion are hydrogeology, groundwater storage and production, groundwater levels, land subsidence, groundwater quality, agricultural subsurface drainage, and seepage-induced waterlogging of farm lands. It covers the following basins and service areas:

- Turlock Groundwater Basin
- Modesto Basin
- Merced Groundwater Basin
- Eastern San Joaquin County Basin
- San Joaquin River Exchange Contractors Service Area

3.3.2 Historical Perspective and Recent Conditions

Groundwater resources of the San Joaquin Valley are described with regard to regional hydrogeology, groundwater storage and production, groundwater levels, and groundwater quality. The discussion of groundwater quality covers those constituents of concern that affect agricultural productivity and others that are noted to be in high concentrations and known to affect human health and wildlife, including: TDS, boron, nitrates, arsenic, selenium, and dibromochloropropane (DBCP).

In addition, three other issues are related to groundwater conditions: agricultural drainage associated with shallow groundwater, seepage-induced waterlogging of farm lands, and land subsidence caused by groundwater level declines. Agricultural subsurface drainage has historically been affected by the presence of perched shallow groundwater conditions in parts of the San Joaquin Valley. Seepage-induced waterlogging of farm land has historically occurred due to the movement of water from streams into adjacent shallow groundwater aquifers. Land subsidence may be caused by one or a combination of the following mechanisms: compaction of aquifer sediments, resulting from groundwater overdrafting and lowering of the hydraulic head in the aquifer system; compaction of sediments in petroleum reservoir rocks caused by oil and gas exploration and extraction; hydrocompaction (the compaction of moisture-deficient sediments following the first application of
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Historically, the greatest occurrence of land subsidence in the San Joaquin Valley has resulted from groundwater overdraft and lowering of the hydraulic head, and is the only type of land subsidence discussed in this section.

3.3.3 Overview of the Central Valley Regional Aquifer System

The Central Valley regional aquifer system of California is a 400-mile long, northwest-trending asymmetric trough averaging 50 miles in width. The location and geologic boundary of this aquifer system is shown in Figure 3.3-1.

The significant water-producing geologic units throughout the valley trough are the unconsolidated to semi-consolidated non-marine sediments that range from the Oligocene and Miocene ages (13 million to 25 million years old) to recent. The west side of the trough is bounded by pre-Tertiary and Tertiary semi-consolidated to consolidated marine sedimentary rocks of the Coast Ranges. These faulted and folded sediments extend eastward beneath most of the Central Valley; any water contained in the sediments is usually saline. The east side of the valley is underlain by pre-Tertiary igneous and metamorphic rocks of the Sierra Nevada. Only small quantities of water are extracted from the joints and cracks of these basement rocks.

3.3.4 Groundwater Resources of the San Joaquin River Region

The southern two-thirds of the Central Valley regional aquifer system extends from just south of the Delta to just south of Bakersfield, and is referred to as the San Joaquin Valley Basin (DWR 1975), covering over 13,500 square-miles. The Department of Water Resources (DWR) further divides this basin into subbasins. Subbasins in the northern half of the San Joaquin Valley basin, lying within the San Joaquin River Region, include the Tracy, Eastern San Joaquin County, Modesto, Turlock, Merced, Chowchilla, Madera, and Delta-Mendota subbasins (DWR 1994).

3.3.4.1 Hydrogeology of the San Joaquin River Region

The San Joaquin Valley Basin has accumulated up to 6 vertical miles of unconsolidated continental and marine sediment in the structural trough. The top 2,000 feet of these sediments consist of continental deposits that generally contain freshwater (Page 1986). As these sediments accumulated over the last 24 million years, large lakes periodically filled and drained, resulting in deposition of laterally extensive clay layers that formed significant barriers to the vertical movement of groundwater in the basin (USBR 1997d.). The most extensive of these is the Corcoran Clay (a member of the Tulare Formation which was deposited about 600,000 years ago), consisting of a clay layer zero to 160 feet thick, found at depths of 100 to 400 feet below the land surface in the San
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Joaquin River Region. These hydrogeologic features are displayed in Figure 3.3-2, showing a generalized cross-sections for the San Joaquin River Region. Figure 3.3-2 shows the approximate distribution of the Corcoran Clay in the San Joaquin River Region and the location of the generalized cross section. Other clay layers are present above and below the Corcoran Clay and may have local impacts on groundwater conditions.

The Corcoran Clay divides the groundwater system into two major aquifers: a confined aquifer below the clay layer and a semi-confined aquifer above the layer (Williamson et al. 1989). Water recharge of the semi-confined upper aquifer generally occurs from stream seepage, deep percolation of rainfall, and subsurface inflow along basin boundaries. As agricultural practices expanded in the region, recharge was augmented with deep percolation of applied agricultural water and seepage from the distribution systems used to convey this water. Recharge of the lower confined aquifer consists of subsurface inflow from the valley floor and foothill areas to the east of the eastern boundary of the Corcoran Clay Member. Present information indicates that the clay layers, including the Corcoran Clay, are not continuous in some areas, and some seepage from the semi-confined aquifer above does occur through the confining layer.

Historically, the interaction of groundwater and surface water resulted in net gains to the streams. This condition existed on a regional basis through about the mid 1950s. Since that time groundwater level declines have resulted in some stream reaches losing flow through seepage to the groundwater systems below.

During pre-development conditions, groundwater in the San Joaquin River Region flowed from the valley flanks to the axis, then north toward the Delta. Large-scale groundwater development since the 1940s, combined with the introduction of imported surface water supplies, have modified the natural groundwater flow pattern. The groundwater pumping and recharge from imported irrigation water has resulted in a change in regional flow patterns. Flow largely occurs from areas of recharge towards areas of lower groundwater levels due to groundwater pumping (Bertoldi et al. 1991). The vertical movement of water in the aquifer has been altered in this region as a result of thousands of wells constructed with perforation above and below the confining unit (Corcoran Clay Member, where present), providing a direct hydraulic connection (Bertoldi et al. 1991). This may have been partially offset by a decrease in vertical flow resulting from the inelastic compaction of fine-grained materials within the aquifer system.

3.3.4.2 Groundwater Storage and Production

In DWR’s Bulletin 160-93, usable storage capacity for the San Joaquin River Region was estimated to be approximately 24 million acre-feet (DWR 1994). The change in groundwater storage from 1970 to 1992 for the San Joaquin River and Tulare Lake Regions combined is shown in Figure 3.3-3. Relative to 1970, groundwater storage in the San Joaquin Valley Basin during the 1970s reached a low point in 1978, a result of the 1976 to 1977 drought period. By the early 1980s, groundwater
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Groundwater pumping ranged from 1.6 million acre-feet in 1922 to 4.7 million acre-feet in 1977. Groundwater pumping has increased through the 1970s, and has varied greatly from year to year depending on hydrologic conditions and water user needs. Immediately following the 1976-1977 drought, hydrologic conditions for the years 1978, 1979, and 1980, characterized as wet, above normal, and wet, respectively, were largely responsible for the reduced pumping following the drought period.

There have been numerous attempts to estimate the safe yield of the San Joaquin River Region. The most recent estimate, made by DWR, is approximately 3.3 million acre-feet of perennial yield (DWR 1994). DWR estimated recent groundwater pumping for 1990 conditions (normalized) in the San Joaquin River Region to be 3.5 million acre-feet. This exceeds the estimated perennial yield by approximately 200 thousand acre-feet. All of the subbasins within the San Joaquin River Region experienced some overdraft (DWR 1994).

3.3.4.3 Groundwater Levels in the San Joaquin River Region

Expansion of agricultural practices between 1920 and 1950 caused declines in groundwater levels in many areas of the San Joaquin River Region. Along the east side of the region, declines have ranged between 40 and 80 feet since redevelopment conditions (1860) (Williamson et al. 1989).

With the exception of perched water tables, declines began occurring in the 1940s along the west side of the San Joaquin River Region, dropping more than 30 feet by 1960. By spring 1970, groundwater levels (reported by DWR) in this same area were recorded as ranging from 200 feet to 100 feet below sea level, a drop of as much as 100 feet. Groundwater levels in central San Joaquin County reached 50 feet below sea level by spring 1970, causing saline groundwater intrusion problems for the city of Stockton. By spring 1980, confined aquifer groundwater levels (reported by DWR) along northwestern Fresno County and western Merced County increased up to 100 feet. Groundwater levels in the semi-confined aquifer between spring 1970 and spring 1980 declined in response to 1976-1977 drought conditions and recovered to near pre-drought levels by 1980. The 1987-1992 drought resulted in substantial deficiencies in surface water deliveries and corresponding increases in groundwater pumping. Water levels declined by 20 to 30 feet throughout most of the central and eastern parts of the San Joaquin Valley (Westlands Water District 1995). Recent groundwater conditions, observed for spring 1993 following the drought, are shown in Figure 3.3-4.

Depression areas resulting from groundwater withdrawals are indicated along the east side of the San Joaquin River Region in Merced and Madera counties and are less than 50 feet above sea level. These groundwater levels are indicative of depleted conditions due to regional groundwater withdrawals resulting from the 1987-1992 drought period. This is consistent with observed storage
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recovery time which may span several years. For example, recovery to pre-drought storage conditions took more than five years following the 1976-1977 drought.

3.3.4.4 Groundwater Quality in the San Joaquin River Region

Groundwater quality conditions in the San Joaquin River Region vary throughout the area. Groundwater quality parameters are discussed below for the San Joaquin River Region, and sources and reasons for concerns associated with these parameters are listed. The discussion is limited to parameters that are associated with regional problems.

Total Dissolved Solids

TDS concentrations vary considerably in the San Joaquin River and Tulare Lake Regions, depending upon the groundwater zone. TDS concentrations in groundwater along the east side of the San Joaquin Valley are lower in comparison to concentrations in the west side of the San Joaquin River Region. This distribution reflects the low concentrations of dissolved solids in recharge water that originates in the Sierra Nevada and the predominant regional groundwater flow pattern. In the center and on the east side, TDS concentrations generally do not exceed 500 mg/l. On the west side, TDS concentrations are generally greater than 500 mg/l, and are in excess of 2,000 mg/l along portions of the western margin of the valley (Bertoldi et al. 1991). The concentrations in excess of 2,000 mg/l commonly occur above the Corcoran Clay layer. Impaired municipal use of groundwater for drinking water supply due to elevated TDS concentrations occurs at several locations throughout the San Joaquin River Region (SWRCB 1991).

Boron

High boron concentrations occur in the groundwater in the northwestern part of the San Joaquin River Region from the northernmost edge of the region to the southernmost edge of the region (Bertoldi et al. 1991). Agricultural use of groundwater is impaired due to elevated boron concentrations in western Stanislaus and Merced counties (SWRCB 1991) due to boron’s excessive phytotoxicity.

Nitrates

In the San Joaquin River Region, a large area within the northern San Joaquin County (between Lodi and Stockton) contains NO$_3$-N concentrations in groundwater exceeding 5 mg/l (Bertoldi et al. 1991). Municipal use of groundwater as a drinking water supply is also impaired due to elevated nitrate concentrations in the Tracy, Modesto-Turlock, Merced, and Madera areas (SWRCB 1991).
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**Arsenic**

In the San Joaquin River Region, municipal use of groundwater as a drinking water supply is impaired due to elevated arsenic concentrations in Stanislaus and Merced counties and western San Joaquin County (SWRCB 1991).

**Selenium**

High selenium concentrations occur naturally in soils and groundwater on the west side of the San Joaquin River Region. These concentrations have raised considerable concern because of their potential to leach from the soil by subsurface irrigation return flow into the groundwater and into receiving surface waters. Selenium concentrations in shallow groundwater have been highest in the central and southern area south of Los Banos and Mendota (median concentrations of 10,000 to 11,000 µg/l) (Bertoldi et al. 1991). Although selenium is currently regulated by federal primary drinking water standards at an MCL of 50 µg/l, USEPA recently established chronic and acute toxicity criteria of 5 and 20 µg/l, respectively, for the protection of wildlife and aquatic organisms. The SWRCB, Central Valley Region, has established monthly mean and daily maximum selenium objectives of 5 and 12 µg/l, respectively, for the San Joaquin River from the mouth of the Merced River to Vernalis and 10 and 26 µg/l from Sack Dam to the mouth of the Merced River (SWRCB Central Valley Region 1992).

**Dibromochloropropane**

DBCP has been detected in many groundwater wells in the San Joaquin River Region. Municipal use of groundwater as drinking water supply is impaired due to elevated DBCP concentrations in groundwater near several cities within the San Joaquin River Region, including Chowchilla, Madera, Merced, and the Modesto-Turlock area (SWRCB 1991).

**3.3.4.5 Land Subsidence in the San Joaquin River Region**

Beginning in the 1920s, the use of San Joaquin Valley groundwater for crop irrigation began to increase rapidly until the mid-1960s. As a result of this heavy pumping, groundwater level declines have caused land subsidence on areas of the valley. Land subsidence is a significant problem in the San Joaquin River and Tulare Lake Regions. From 1920 to 1970, almost 5,200 square miles of irrigated land in the San Joaquin River and Tulare Lake regions registered at least 1 foot of land subsidence (Ireland 1986). By the mid 1970s, the use of imported surface water in the western and southern portions of San Joaquin Valley essentially eliminated new land subsidence. During the 1976 to 1977 drought, land subsidence was again observed in areas previously affected due to renewed high groundwater pumping rates. After nearly two decades of little or no land subsidence, significant land subsidence has been recently detected in the San Joaquin Valley due to increased groundwater pumping during the 1987-1992 drought. Land subsidence occurring between 1984 and
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1996 was reported along the Delta-Mendota Canal. Two locations of note are: (1) near Mendota Pool where 1.3 feet of land subsidence was measured, and (2) approximately 25 miles northeast of Mendota Pool where 2.0 feet of land subsidence was measured (Central California Irrigation District 1996). Measured land subsidence by DWR between 1990 and 1995 of up to 2.0 feet was reported along the California Aqueduct in Westlands Water District (Dudley 1995).

Land subsidence in the San Joaquin Valley has occurred mostly in areas that are confined by the Corcoran Clay, where pressure changes caused by groundwater pumping promote greater compressive stress than in the unconfined zone (DWR 1977). The maximum land subsidence levels recorded in the Central Valley occurred in the 2,600 square-mile Los Banos-Kettleman City area. Because of the slow drainage of the fine-grained deposits, subsidence at a particular time is more closely related to past water-level change than to current change. For example, in the San Joaquin Valley, groundwater withdrawals increased greatly until large imports of surface water through various canals occurred; but even though water levels in the area started to rise, the rate of subsidence began to decrease three years later.

3.3.4.6 Agricultural Subsurface Drainage in the San Joaquin River Region

Inadequate drainage and accumulating salts have been persistent problems for irrigated agriculture along the west side and in parts of the east side of the San Joaquin River Region for more than a century. The most extensive drainage problems exist on the west side of the San Joaquin River and Tulare Lake Regions.

The soils on the west side of the region are derived from marine sediments and are naturally high in salts and trace elements. Irrigation of these soils has mobilized these compounds and facilitated their movement into the shallow groundwater. Since the early 1950s, much of this irrigation has been with imported water, resulting in rising groundwater and increasing soil salinity. Where agricultural drains have been installed to control rising water tables, drainage water frequently contains high concentrations of salts and trace elements (SJVDP 1990). The area of subsurface drainage problems extends along the western side of the San Joaquin River and Tulare Lake Regions from the Delta on the north to the Tehachapi Mountains south of Bakersfield. In some portions, groundwater levels often encroach on the root zone of agricultural crops, and natural subsurface drainage must be supplemented by constructed drainage facilities for irrigation agriculture to be sustained.

Toxic and potentially toxic trace elements in some soil and shallow groundwater on the western side of the San Joaquin River and Tulare Lake Regions are also of concern. These trace elements greatly complicate the disposal of subsurface drainage waters. Elements of primary concern are selenium, boron, molybdenum, and arsenic. Selenium is of greatest concern due to the wide distribution and known toxicity of selenium to aquatic animals and waterfowl.
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3.3.4.7 Seepage and Waterlogging in the San Joaquin River Region

In the lower reaches of the San Joaquin River and in the vicinity of its confluence with major tributaries, high periodic streamflows and local flooding combined with high groundwater levels have resulted in seepage-induced waterlogging damage to low-lying farm land. In the western portion of the Stanislaus River watershed, groundwater pumping has historically been used for control of high groundwater levels and seepage-induced waterlogging conditions. Along the San Joaquin River from the confluence with the Tuolumne River through the South Delta, flood control operation requirements have recently contributed to some seepage-induced waterlogging damage to low-lying farm land, a result of streamflow seepage into adjacent shallow groundwater aquifers (USBR 1997f). The seepage-induced waterlogging places neighboring crops and farm land at risk and prevents cultivation of the land until the summer months, placing the annual crop production at risk. Concern has been raised that San Joaquin River flows in excess of 16,000 cfs at Vernalis can result in seepage-induced waterlogging damage of adjacent low-lying farm land in the south Sacramento-San Joaquin Delta area (Hildebrand 1996).

3.3.5 Summary of Groundwater Conditions

Each of the basins and service areas within the San Joaquin River Region are summarized in Table 3.3-1. The areas include:

- Turlock Groundwater Basin
- Modesto Basin
- Merced Groundwater Basin
- Eastern San Joaquin County Basin
- San Joaquin River Exchange Contractors Service Area

The Oakdale Irrigation District Service Area is contained in parts of both the Modesto Basin and the Eastern San Joaquin County Basin, and the groundwater conditions are not separated out for purposes of this summary. A detailed description of the groundwater resources in each of the districts is contained in Appendix B.
Table 3.3-1. SUMMARY OF GROUNDWATER CONDITIONS IN THE SAN JOAQUIN RIVER REGION

<table>
<thead>
<tr>
<th>Groundwater Conditions</th>
<th>Turlock Groundwater Basin</th>
<th>Modesto Basin/Oakdale Irrigation District Service Area</th>
<th>Merced Groundwater Basin</th>
<th>Eastern San Joaquin County Basin</th>
<th>San Joaquin River Exchange Contractors Service Area</th>
</tr>
</thead>
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<tr>
<td>Elevation/Levels</td>
<td>Depth to groundwater ranges from 6 to over 100 feet bgs.</td>
<td>Depth to groundwater ranges from less than 5 feet to over 100 feet bgs. Water table declined 15' for period 1970-90.</td>
<td>Depth to groundwater ranges from less than 1 foot to over 100 feet bgs. Water table declined up to 40' for period 1980-92.</td>
<td>Water table declined 20' to 30' since 1964.</td>
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</tr>
<tr>
<td>Water Quality</td>
<td>Water table declined approximately 5 feet. Water hardness moderate to very hard</td>
<td>Generally acceptable</td>
<td>Numerous constituents detected</td>
<td>Increasing levels of contaminants</td>
<td>Localized poor groundwater quality</td>
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<tr>
<td>• TDS</td>
<td>High TDS in wells deeper than 350 feet</td>
<td>Relatively low</td>
<td>High TDS in wells deeper than 350 feet</td>
<td>No data available</td>
<td>No data available</td>
</tr>
<tr>
<td>• Nitrates</td>
<td>Localized and some levels above MCL</td>
<td>Localized and some levels above MCL</td>
<td>Below current MCL</td>
<td>Localized levels above MCL - wells closed or replaced</td>
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</tr>
<tr>
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<td>Below current MCL</td>
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</tr>
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<td>• Iron and Manganese</td>
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<td>Elevated naturally occurring concentrations</td>
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<td>Elevated concentrations</td>
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</tbody>
</table>
### Table 3.3-1. SUMMARY OF GROUNDWATER CONDITIONS IN THE SAN JOAQUIN RIVER REGION (CONT.)

<table>
<thead>
<tr>
<th>Groundwater Conditions</th>
<th>Turlock Groundwater Basin</th>
<th>Modesto Basin/Oakdale Irrigation District Service Area</th>
<th>Merced Groundwater Basin</th>
<th>Eastern San Joaquin County Basin</th>
<th>San Joaquin River Exchange Contractors Service Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radionuclides</td>
<td>High naturally occurring uranium</td>
<td>High naturally occurring uranium</td>
<td>No data available</td>
<td>No data available</td>
<td>No data available</td>
</tr>
<tr>
<td>Pesticides</td>
<td>Localized and some levels above MCL.</td>
<td>Localized and some levels above MCL.</td>
<td>Levels detected at or below MCL.</td>
<td>Levels detected below MCL</td>
<td>No data available</td>
</tr>
<tr>
<td>Trace Organics/Organics</td>
<td>Isolated occurrences principally the result of leaking USTs - none in public water supply</td>
<td>Isolated occurrences principally the result of leaking USTs- some in public water supply</td>
<td>Localized and some levels above MCLs</td>
<td>No data available</td>
<td>No data available</td>
</tr>
<tr>
<td>Subsidence</td>
<td>Not a problem</td>
<td>Not a problem</td>
<td>Not a problem</td>
<td>Not a problem</td>
<td>Significant in western San Joaquin Valley</td>
</tr>
<tr>
<td>Agricultural Subsurface Drainage</td>
<td>Drainage pumping</td>
<td>Drainage pumping</td>
<td>Drainage pumping</td>
<td>Not a problem</td>
<td>Many subsurface drainage systems</td>
</tr>
</tbody>
</table>
3. Affected Environment

3.3 GROUNDWATER RESOURCES

3.3.1 Introduction

3.3.2 Historical Perspective and Recent Conditions

3.3.3 Overview of the Central Valley Regional Aquifer System

3.3.4 Groundwater Resources of the San Joaquin River Region

3.3.4.1 Hydrogeology of the San Joaquin River Region

3.3.4.2 Groundwater Storage and Production

3.3.4.3 Groundwater Levels in the San Joaquin River Region

3.3.4.4 Groundwater Quality in the San Joaquin River Region

3.3.4.6 Agricultural Subsurface Drainage in the San Joaquin River Region

3.3.4.7 Seepage and Waterlogging in the San Joaquin River Region

3.3.5 Summary of Groundwater Conditions

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### 3. Affected Environment

#### 3.4 TERRESTRIAL RESOURCES

This section discusses existing vegetation and wildlife resources in the San Joaquin Valley with emphasis on biological communities where implementation of the instream flows for SJRA will have the greatest effect. Sensitive features, such as wetlands, and rare, threatened, endangered, and sensitive (RTES) species are specifically addressed. Information for this section was primarily derived from existing data. Site visits were conducted to assess vegetation resources.

##### 3.4.1 Vegetation

This description of vegetation growing within the boundaries of the riparian corridors of the project area is based on the ecological relationships between vegetation, soils, and hydrology (which the fluvial system creates). This section, along with Appendix C, describes the current status of vegetation growing within the riparian corridor along the Stanislaus, Tuolumne, Merced, and San Joaquin rivers (the project area). This vegetation description is based on the ecological relationship between vegetation growing within the project area’s riparian corridors and the fluvial system. Appendix C contains a description of vegetation resources in the San Joaquin River and the East San Joaquin Basin Ecological Zones.

##### 3.4.1.1 Background

The term riparian describes a unique physical environment and associated plant vegetation that occurs along banks of freshwater bodies, watercourses, estuaries, and surface-emergent aquifers and adjacent areas. The groundwater in these areas provides soil moisture sufficiently in excess of that available through local precipitation, and is capable of supporting vegetation requiring moderate amounts of water (Warner et al. 1984). The extent of groundwater influence defines the riparian corridor width and the plant assemblages that grow there.

A riparian plant’s life has four stages: initiation, establishment, maturity, and senescence (Figure 3.4-1). Initiation starts after a seed lands on exposed, moist substrate and germinates; this stage continues through the first growing season. The establishment stage begins after the first growing season and continues until the plant has enough resources to begin sexual reproduction. When a plant flowers and produces seed, maturity starts. Eventually seed production and reproductive capacity decline, and the mature plant enters senescence. Within the project area, riparian stands growing on what are now terraces (floodplains prior to flow regulation) are predominantly senescent with no younger age classes to replace them. Historically, large floods created gaps in the riparian vegetation where new sediments could be deposited, and younger age classes could regenerate. Because the magnitude and frequency of these floods have been virtually eliminated, remaining mature stands are in decline because there are no younger age classes to replace trees when they die.
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Vegetation growing within the riparian corridor forms a mosaic of patches; individual patches are called stands. The list of plant species comprising the stand defines the composition of a particular plant series. Plant series are the latest classification term used to describe riparian vegetation (Sawyer and Keeler-Wolf 1995). Plant series consist of uniform patches of vegetation, usually comprised of multiple species, but always having one or two species that dominate. Series are stratified into a canopy, shrub and ground layer, with the series name determined by the species of greatest relative abundance within the highest strata (Sawyer and Keeler-Wolf 1995).

The types of riparian vegetation that would be affected by the project alternatives are divided into three groups: aquatic vegetation, emergent marshes, and terrestrial vegetation with plant series endemic to each group. Aquatic vegetation is commonly referred to as a lacustrine wetland because it grows in open, still water. Section 3.5 contains a more detailed discussion of aquatic resources. Cowardin et. al. (1979) referred to terrestrial and emergent vegetation within the riparian corridor as forested palustrine and palustrine wetlands. Holland (1986) classified riparian vegetation in further detail however his classification was never published for public use, and the scale of his descriptions are geographically broad (e.g., Valley, foothill, grasslands). The plant series classification remains as providing the greatest detail geographically and is generally consistent in species composition. The series classification is compared to Holland’s system (see Table 3.4-1 on the following pages).

The proposed project would release different magnitudes of water into rivers within the project area. These releases would only affect vegetation within the immediate area of the rivers, and are not expected to have any significant effects on vegetation growing outside of the riparian corridor. Because the proposed project and alternative would only affect vegetation growing within the riparian corridor, a boundary limiting the evaluation scope was defined. Since it is difficult to detect the groundwater limits within the riparian corridor, another more practical boundary was used. The bankfull channel is well defined along each river, is the immediate area that may be potentially impacted by the pulse flows, and was established as the limit for evaluating project effects.

Vegetation patterns within each river’s riparian corridor result from the interactions of fluvial geomorphology, hydrology, and a particular plant species’ physiologic tolerances. Important hydrologic processes include magnitude and timing of flow inundation, and groundwater table fluctuation. Important fluvial geomorphic processes include channel migration and avulsion, fine sediment deposition on floodplains and terraces, point bar scour, and woody debris transport. Fluvial geomorphic processes are a product of variable discharges, which create and maintain an alternate bar morphology. The alternate bar morphology is a geomorphic template that structures the basic riparian vegetation patterns (Figure 3.4-2). The alternate bar morphology is divided into geomorphic units: riffles, pools, runs, point bars, floodplains, terraces, sloughs/oxbows, and backwaters. The channel region below the floodplain is called the bankfull channel.
### 3. Affected Environment

<table>
<thead>
<tr>
<th>VEGETATION SERIES</th>
<th>NDDB/HOLLAND TYPE SYNONOMIES</th>
<th>NATURE CONSERVANCY STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arroyo willow series (RpScr)</td>
<td>Southern cottonwood-willow riparian forest (61330 in part)</td>
<td>G3 S3</td>
</tr>
<tr>
<td></td>
<td>Great Valley cottonwood riparian forest (61410 in part)</td>
<td>G3 S2.1</td>
</tr>
<tr>
<td></td>
<td>Great Valley mixed riparian forest (61420 in part)</td>
<td>G2 S2.1</td>
</tr>
<tr>
<td></td>
<td>Southern willow scrub (63320 in part)</td>
<td>G3 S3.2</td>
</tr>
<tr>
<td>Black willow series (RpScr; RpWld)</td>
<td>Southern cottonwood-willow riparian forest (61330 in part)</td>
<td>G3 S3</td>
</tr>
<tr>
<td></td>
<td>Great Valley cottonwood riparian forest (61410 in part)</td>
<td>G3 S2.1</td>
</tr>
<tr>
<td></td>
<td>Great Valley mixed riparian forest (61420 in part)</td>
<td>G2 S2.1</td>
</tr>
<tr>
<td></td>
<td>Southern willow scrub (63320 in part)</td>
<td>G3 S3.2</td>
</tr>
<tr>
<td>Blue elderberry series (RpScr;RpWld;VFGr)</td>
<td>Elderberry savanna (63430)</td>
<td>G2 S2.1</td>
</tr>
<tr>
<td></td>
<td>Mexican elderberry series</td>
<td></td>
</tr>
<tr>
<td>Box elder series (RpScr; RpWld)</td>
<td>Southern cottonwood-willow riparian forest (61330 in part)</td>
<td>G3 S3</td>
</tr>
<tr>
<td></td>
<td>Great Valley cottonwood riparian forest (61410 in part)</td>
<td>G3 S2.1</td>
</tr>
<tr>
<td></td>
<td>Great Valley mixed riparian forest (61420 in part)</td>
<td>G2 S2.1</td>
</tr>
<tr>
<td></td>
<td>Southern willow scrub (63320 in part)</td>
<td>G3 S3.2</td>
</tr>
<tr>
<td>Bulrush series (MshSw)</td>
<td>Coast and Valley freshwater marsh (52410 in part)</td>
<td>G3 S2.1</td>
</tr>
<tr>
<td>Bulrush- cattail series (MshSw)</td>
<td>Coast and Valley freshwater marsh (52410 in part)</td>
<td>G3 S2.1</td>
</tr>
<tr>
<td>Buttonbush series (MshSw; RpScr)</td>
<td>Buttonbush scrub (63430)</td>
<td>G1 S1.1</td>
</tr>
<tr>
<td>California walnut series (CmWld; RpWld)</td>
<td>California walnut woodland (71210)</td>
<td>G2 S2.1</td>
</tr>
<tr>
<td></td>
<td>Walnut forest (81600)</td>
<td>G1 S1.1</td>
</tr>
<tr>
<td>Cattail series (MshSw)</td>
<td>Coast and Valley freshwater marsh (52410 in part)</td>
<td>G3 S2.1</td>
</tr>
<tr>
<td>Common reed series (MshSw)</td>
<td></td>
<td>n/a</td>
</tr>
</tbody>
</table>
### 3. Affected Environment

<table>
<thead>
<tr>
<th>VEGETATION SERIES</th>
<th>NDDB/HOLLAND TYPE SYNONOMIES</th>
<th>NATURE CONSERVANCY STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ditch-grass series (MshSw)</td>
<td>Coastal brackish marsh <em>(52200 in part)</em></td>
<td>G2 S2.1</td>
</tr>
<tr>
<td></td>
<td>Cismontane alkali marsh <em>(52310 in part)</em></td>
<td>G1 S1.1</td>
</tr>
<tr>
<td></td>
<td>Alkali seep <em>(45320 in part)</em></td>
<td>G3 S2.1</td>
</tr>
<tr>
<td>Duckweed series (MshSw)</td>
<td>Coast and Valley freshwater marsh <em>(52410 in part)</em></td>
<td>G3 S2.1</td>
</tr>
<tr>
<td>Dusky willow series (MshSw)</td>
<td>Great Valley cottonwood riparian forest <em>(61410 in part)</em></td>
<td>G3 S2.1</td>
</tr>
<tr>
<td></td>
<td>Great Valley mixed riparian forest <em>(61420 in part)</em></td>
<td>G2 S2.1</td>
</tr>
<tr>
<td></td>
<td>Great Valley willow scrub <em>(63410 in part)</em></td>
<td>G3 S3.2</td>
</tr>
<tr>
<td></td>
<td>Southern willow scrub <em>(63320 in part)</em></td>
<td>G3 S3.2</td>
</tr>
<tr>
<td>Eucalyptus series</td>
<td>EXOTIC</td>
<td>n/a</td>
</tr>
<tr>
<td>Edible fig series</td>
<td>EXOTIC</td>
<td>n/a</td>
</tr>
<tr>
<td>Fremont cottonwood series (RpWld)</td>
<td>Great Valley cottonwood riparian forest <em>(61410 in part)</em></td>
<td>G3 S2.1</td>
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<tr>
<td></td>
<td>Great Valley mixed riparian forest <em>(61420 in part)</em></td>
<td>G2 S2.1</td>
</tr>
<tr>
<td>Hind’s Walnut stands (RpWld; CmWld)</td>
<td>Hinds walnut woodland <em>(71220)</em></td>
<td>G1 S1.2</td>
</tr>
<tr>
<td>Kentucky bluegrass series (VFG)</td>
<td>Valley and foothill grasslands <em>(42000)</em></td>
<td>n/a</td>
</tr>
<tr>
<td>Mixed willow series (RpScr; RpWld)</td>
<td>Freshwater swamp <em>(52600 in part)</em></td>
<td>G1 S1.2</td>
</tr>
<tr>
<td></td>
<td>Great Valley cottonwood riparian forest <em>(61410 in part)</em></td>
<td>G3 S2.1</td>
</tr>
<tr>
<td></td>
<td>Great Valley mixed riparian forest <em>(61420 in part)</em></td>
<td>G2 S2.1</td>
</tr>
<tr>
<td></td>
<td>Great Valley willow scrub <em>(63410 in part)</em></td>
<td>G3 S3.2</td>
</tr>
<tr>
<td></td>
<td>Southern willow scrub <em>(63320 in part)</em></td>
<td>G3 S3.2</td>
</tr>
<tr>
<td>Mosquito fern series (MshSw)</td>
<td>Coast and Valley freshwater marsh <em>(52410 in part)</em></td>
<td>G3 S2.2</td>
</tr>
<tr>
<td>Narrowleaf willow series (RpScr)</td>
<td>Southern cottonwood-willow riparian forest <em>(61330 in part)</em></td>
<td>G3 S3</td>
</tr>
<tr>
<td></td>
<td>Great Valley cottonwood riparian forest <em>(61410 in part)</em></td>
<td>G3 S2.1</td>
</tr>
<tr>
<td></td>
<td>Great Valley willow scrub <em>(63410 in part)</em></td>
<td>G3 S3.2</td>
</tr>
<tr>
<td>Nodding needlegrass series (VFG)</td>
<td>Valley needlegrass grassland <em>(42110 in part)</em></td>
<td>G3 S3.1</td>
</tr>
<tr>
<td>Northern claypan vernal pools (VnPl)</td>
<td>Northern claypan vernal pool <em>(44120)</em></td>
<td>G1 S1.2</td>
</tr>
</tbody>
</table>
### 3. Affected Environment

<table>
<thead>
<tr>
<th>Nature Conservancy Heritage Program Status Ranks</th>
<th>Element</th>
<th>Global ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3. Affected Environment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northern hardpan vernal pools (VnPl)</td>
<td>Northern hardpan vernal pool (44110)</td>
<td>G3 S4</td>
</tr>
<tr>
<td><strong>Oregon ash series (RpScr; RpWld)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southern cottonwood-willow riparian forest (61330 in part)</td>
<td>G3 S4</td>
<td></td>
</tr>
<tr>
<td>Great Valley mixed riparian forest (61420 in part)</td>
<td>G2 S2.1</td>
<td></td>
</tr>
<tr>
<td>Great Valley cottonwood riparian forest (61410 in part)</td>
<td>G3 S2.1</td>
<td></td>
</tr>
<tr>
<td>Great Valley willow scrub (63410 in part)</td>
<td>G3 S3.2</td>
<td></td>
</tr>
<tr>
<td><strong>Purple needlegrass series (VFGr)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valley needlegrass grassland (42110 in part)</td>
<td>G3 S3.1</td>
<td></td>
</tr>
<tr>
<td><strong>Shining willow series (RpScr; RpWld)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshwater swamp (52600 in part)</td>
<td>G1 S1.2</td>
<td></td>
</tr>
<tr>
<td>Southern cottonwood-willow riparian forest (61330 in part)</td>
<td>G3 S3</td>
<td></td>
</tr>
<tr>
<td>Great Valley mixed riparian forest (61420 in part)</td>
<td>G2 S2.1</td>
<td></td>
</tr>
<tr>
<td>Great Valley cottonwood riparian forest (61410 in part)</td>
<td>G3 S2.1</td>
<td></td>
</tr>
<tr>
<td>Great Valley willow scrub (63410 in part)</td>
<td>G3 S3.2</td>
<td></td>
</tr>
<tr>
<td><strong>Shining willow series (RpScr; RpWld)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Great Valley willow scrub (63410 in part)</td>
<td>G3 S3.2</td>
<td></td>
</tr>
<tr>
<td>Pacific willow series</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pondweeds with floating leaves series</strong> (MshSw)</td>
<td>Coast and Valley freshwater marsh (52410 in part)</td>
<td>G3 S2.2</td>
</tr>
<tr>
<td><strong>Pondweeds with submerged leaves series (MshSw)</strong></td>
<td>Coast and Valley freshwater marsh (52410 in part)</td>
<td>G3 S2.3</td>
</tr>
<tr>
<td><strong>Quillwort series (MshSw)</strong></td>
<td>Freshwater marsh (52400 in part)</td>
<td>G4 S4</td>
</tr>
<tr>
<td><strong>Tree of heaven series EXOTIC</strong></td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td><strong>Valley oak series (RpWld)</strong></td>
<td>Great Valley valley oak riparian forest (61430)</td>
<td>G1 S1.2</td>
</tr>
<tr>
<td></td>
<td>Valley oak woodland (71130)</td>
<td>G2 S2.1</td>
</tr>
</tbody>
</table>

**Table 3.4-1:** POTENTIALLY OCCURRING PLANT SERIES ALONG THE SAN JOAQUIN RIVER AND TRIBUTARIES (CONT.)
3. Affected Environment

G1 = Fewer than 6 viable occurrences worldwide and/or 2000 acres
G2 = 6-20 viable occurrences worldwide and/or 2,000-10,000 acres
G3 = 21-100 viable occurrences worldwide and/or 10,000-50,000 acres
G4 = Greater than 100 viable occurrences worldwide and/or greater than 50,000 acres
G5 = vegetation type is demonstrably secure due to worldwide abundance

State ranks
S1 = Fewer than 6 viable occurrences statewide and/or 2000 acres
S2 = 6-20 viable occurrences statewide and/or 2,000-10,000 acres
S3 = 21-100 viable occurrences statewide and/or 10,000-50,000 acres
S4 = Greater than 100 viable occurrences statewide and/or greater than 50,000 acres
S5 = vegetation type is demonstrably secure statewide

Threat Ranks
0.1 = Very threatened
0.2 = Threatened
0.3 = No current threats known

References:
University of California Press, Berkeley.

California Native Plant Society.
3. Affected Environment

Annual hydraulic regimes are often illustrated with an annual hydrograph (Figure 3.4-3). The annual hydrograph is broken into components to illustrate certain trends in timing, magnitude and duration of discharge during portion of the water year. Individual hydrograph components affect riparian vegetation growing on geomorphic units differently, and the cumulative effects are summarized in Table 3.4-2 on the following pages.

Historically, spring snowmelt floods rose and fell gradually; and after the peak, river water levels declined gradually through summer months (Figure 3.4-3). This annual trend in discharge affected initiating and establishing vegetation, creating observable patterns in established vegetation. Some plant species evolved rapidly growing roots, which “follow” dwindling sub-surface soil moisture created by flow recession (Segelquist et al. 1993). Falling groundwater tables during summer months created soil moisture gradients, which placed strong selective pressures on vegetation. Plants whose roots could not keep up with the groundwater drawdown died. These gradients, combined with local soil differences, caused distinctive “zonation” patterns in riparian vegetation. In many locations, plants germinated but were later unable to survive because of insufficient soil moisture. Desiccation mortality may prevent a plant’s transition into the establishment stage for many successive years, causing distinct age classes between successful cohorts. Before flow regulation, inundation discouraged seed germination in the bankfull channel. Spring snowmelt floods would inundate substrate on which seeds could potentially land and germinate. Riparian hardwoods disperse most of their annual seeds during the spring snowmelt, resulting in a sparsely vegetated bankfull channel.

Each woody riparian species (and life stage) responds differently to hydrologic and fluvial processes. Particular plant life stages are more vulnerable to the effects of flow variation and fluvial processes. Initiating and early establishing plants are especially susceptible to mortality created by inadequate substrate and water availability. If initiating plants survive the summer, they are still susceptible to inundation or scour-induced mortality during winter and spring flood events. Once plants escape a two- to four-year window and develop deeper and more extensive root systems, the risk of scour induced mortality decreases. Ultimately, mortality of maturing plants depends on channel migration, being pushed over by flood debris, or disease. These periodic and spatially variable disturbance patterns and mortality agents perpetuated the plant series diversity that was once found along the rivers within the project area.

Prior to human intervention, the riparian corridor was several miles wide in places where the rivers lacked confinement, creating true riparian “forests”. The dynamic interaction between initiation and maturation on one hand, and mortality on the other, maintained riparian stand species and structural diversity. The struggle between plants’ physiological tolerances and fluvial and hydrologic processes resulted in noticeable patterns in species location on specific geomorphic surfaces. Riparian plants initiate and establish after floods of specific recurrence intervals (Auble et al 1994, Bradley and Smith 1984, Osterkamp and Hupp 1984). A study by McBain and Trush (1998) suggests that these
### Table 3.4-2: THE COMBINED INTERACTIVE EFFECTS OF INDIVIDUAL HYDROGRAPH COMPONENTS AND FLUVIAL GEOMORPHOLOGY ON RIPARIAN VEGETATION

<table>
<thead>
<tr>
<th>Hydrograph Component</th>
<th>Point Bar</th>
<th>Floodplains</th>
<th>Geomorphic Feature</th>
<th>Terraces</th>
<th>Outside of Meander Bends</th>
<th>Oxbows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter/Spring baseflow</td>
<td>Promote inundation mortality of seedlings</td>
<td>Recharges ground water promoting late fall/early winter growth and maximum growth after plants break dormancy</td>
<td>Recharges ground water in excess of precipitation facilitating maximum growth in establishing mature and senescent vegetation</td>
<td>Sustains ground water promoting late fall/early winter season growth</td>
<td>Recharges and maintains ground water tables sustaining off-channel wetlands</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prevent germination by inundating the active channel margins</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winter floods</td>
<td>Significantly mobilize channel bed scouring previous years seedlings</td>
<td>Builds and fertilizes floodplain by fine sediment and detrital deposition</td>
<td>Deposits seeds, establishing a short term seed bank waiting for suitable germination conditions</td>
<td>Channel migrates against the outside of the bend, causing limited mortality to mature and senescent vegetation, introducing large woody debris</td>
<td>Over bank flow can refill sloughs and oxbows potentially introducing more plant species</td>
<td></td>
</tr>
<tr>
<td>Extreme winter floods</td>
<td>Move and reorganize inchannel woody debris</td>
<td>Significantly scour around mature, and senescent vegetation, creating new seed beds</td>
<td>Build and fertilizes terrace through fine sediment and detrital deposition</td>
<td>Channel migrates against the outside of the bend, causing limited mortality to mature and senescent vegetation, introducing large woody debris</td>
<td>Oxbow may be recaptured by the channel and the wetland reoccupied by the main channel</td>
<td></td>
</tr>
<tr>
<td>(during normal or above normal water years)</td>
<td>Realign channel by jumping channel or cutting off sharp meander bends creating wetlands</td>
<td>Mobilize woody debris jams; locally removing or pushing over establishing, mature, and senescent vegetation</td>
<td>Promotes inundation mortality in physiologically sensitive plant species</td>
<td>Fine sediment deposition promotes root suffocation</td>
<td>Fine sediment and detrital deposition creates greater topographic variation and increases nutrient availability</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fine sediment deposition promotes root suffocation</td>
<td></td>
<td></td>
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</tbody>
</table>
### 3. Affected Environment

#### Table 3.4-2: THE COMBINED INTERACTIVE EFFECTS OF INDIVIDUAL HYDROGRAPH COMPONENTS AND FLUVIAL GEOMORPHOLOGY ON RIPARIAN VEGETATION (CONT.)

<table>
<thead>
<tr>
<th>Hydrograph Component</th>
<th>Point Bar</th>
<th>Floodplains</th>
<th>Terraces</th>
<th>Outside of Meander Bends</th>
<th>Oxbows</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Snowmelt peak</strong></td>
<td>Prevents germination by inundation of point bar</td>
<td>Encourages seed germination by providing high soil moisture</td>
<td>Encourages seed germination by providing high soil moisture</td>
<td>Channel migrates against the outside of the bend, causing limited mortality to mature and senescent vegetation, introducing large woody debris</td>
<td>Surface and ground water recharges creating the specialized environmental conditions required by ephemeral herbaceous plant species</td>
</tr>
<tr>
<td></td>
<td>Scour establishing seedlings</td>
<td>Discourages germination near the active channel by inundation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Promote inundation related mortality</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Snowmelt recession</strong></td>
<td>Prevent plant germination by inundation</td>
<td>Facilitates seed germination over a wide elevation range</td>
<td>Drops in river stage causes desiccation mortality to plants that had germinated</td>
<td>Recharges ground water promoting maximum growth after breaking dormancy</td>
<td>Water table draw down causes desiccation related mortality</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drops in river stage causes desiccation mortality to plants that had germinated earlier in the spring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Summer baseflows</strong></td>
<td>Plant germination on point bar occurs too late in the growing season to permit survival through next year’s flow regime</td>
<td>Desiccate seedling germinated through the late winter and spring</td>
<td>Low water tables create drought stress among plants leading to desiccation related mortality</td>
<td>Desiccate seedlings that germinated through the late winter and spring</td>
<td>In below normal water years, some portions could dry up causing widespread mortality to aquatic and emergent vegetation</td>
</tr>
<tr>
<td></td>
<td>Sustains herbaceous perennials surviving along the summer baseflow water surface elevation</td>
<td></td>
<td>Sustains herbaceous perennials surviving among the summer baseflow water surface elevation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
relationships historically existed on the Tuolumne River and presumably existed along the other rivers in the project area as well (Table 3.4-3).


<table>
<thead>
<tr>
<th>Plant Series</th>
<th>Recurrence Interval Range</th>
<th>Pre-NDPP Magnitudes (cfs)</th>
<th>Post-NDPP Magnitudes (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrow-leaf willow</td>
<td>summer baseflow to 1.5 year flood</td>
<td>150 to 8,500</td>
<td>150 to 3,020</td>
</tr>
<tr>
<td>White alder/Box elder</td>
<td>1.5 to 5 year flood</td>
<td>8,500 to 25,000</td>
<td>3,020 to 7,500</td>
</tr>
<tr>
<td>Fremont Cottonwood</td>
<td>5 year to 20 year flood</td>
<td>25,000 to 51,000</td>
<td>7,500 to 12,800</td>
</tr>
<tr>
<td>Valley oak</td>
<td>20 year to the 100 year flood</td>
<td>51,000 to 89,000</td>
<td>12,800 to 18,000</td>
</tr>
</tbody>
</table>


Over the years intensive land management has reduced riparian vegetation in the San Joaquin Valley to less than two percent of its historic coverage (CALFED 1998). Where riparian stands have persisted, older senescent Fremont cottonwood and valley oaks stands have been infiltrated by exotic plants and younger willow, alder and box elder stands are encroaching into the bankfull channel. Flow regulation, combined with human disturbance, has simplified channel morphology and eliminated the extent and diversity of historic riparian vegetation. Senescent stands are relics of pre-flow regulation flow regime vegetation, while in most locations the once extensive native riparian forests have been reduced to a narrow band often no more than one tree wide along the river’s bankfull channel.

Relic stands have canopy parasites (e.g., mistletoe) and liana (vine) development between the ground and canopy. Parasite loads in the canopy increase with age, and liana development is indicative of a low frequency disturbance regime. If a stand has a no liana development, but a large parasite load in the canopy, it is an old stand with a high frequency of disturbance. Where relic stands are present in the project area there is often visible mistletoe, but lianas have been removed by humans or are not well developed. This is because the old trees are valued for esthetic and shade value but not the habitat complex that they create. Intensive land management by mowing or clearing has kept the older trees, but removed all the vegetation on the ground and shrub layers around them; the canopy remains, but the other habitat created by the associated liana and shrubs is removed.

The combination of contemporary hydrologic and geomorphic processes, human disturbance, and each riparian plant’s specific physiologic tolerances interactions has resulted in a narrow riparian corridor with low species diversity. Periodic and spatially variable disturbance patterns perpetuated the plant diversity that was once found along the rivers within the project area. Human induced
changes to hydrology and fluvial geomorphology have resulted in some plant species to increase cover and dominate the riparian corridor (narrowleaf willow) and others to decrease in cover and eventually disappear (western sycamore, Fremont cottonwood and valley oak).

3.4.1.2 Current Conditions

Common, Exotic, and Rare Plant Stands

Both native and exotic plants comprise riparian vegetation growing on terraces, floodplains, and within the active channel. General riparian vegetation types within the project area consists of riparian woodland, riparian scrub, vernal pools, valley/foothill grasslands, marches/swamps, wet meadows, and cismontane woodland. These general vegetation types are further subdivided into individual stands composed of a plant series. Table 3.4-4 on the following pages lists the plant series that are potentially found within riparian corridors in the project area, other common habitat type synonymies, and the relative abundance of each series in the Central Valley. Along all of the rivers in the study area, the riparian scrub type vegetation series are the most prevalent, and often grow within the active channel.

Human impacts have reduced the riparian vegetation in the Central Valley to a fraction of its previous extent; however, it is difficult to say that this vegetation type is threatened when plants that comprise it are common. The Nature Conservancy has characterized California’s general vegetation types in terms of relative abundance. Where there is only between 2,000 and 10,000 acres of the specific vegetation type left in the state, the vegetation type has been identified as “threatened”. Using their classification, all native terrestrial vegetation within the riparian corridor is very threatened to threatened (Table 3.4-4). Some aquatic and emergent vegetation is very threatened (e.g., ditch grass series), while others are common with no threat of extinction (e.g., pondweeds with floating leaves series).
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No plant series is unique to a specific river. Fremont cottonwood, valley oak and black willow series are the most impacted by human disturbance because they grow on terraces and floodplains. Terraces and floodplains typically have Class 1 soils, making them extremely productive and economically valuable. Agricultural development has reduced riparian vegetation in many locations to one tree width along the river as a buffer. This one tree width buffer is not connected with or contiguous with any other trees or shrubs along the channel, causing further fragmentation of the remaining vegetation and migration corridors.

Exotic plant series are proliferating throughout the riparian corridor, displacing native plants and preventing native plant regeneration. Exotic plants are effective interspecific competitors, and often grow in pure stands that exclude other plant species from growing. Four exotic plant species represent 67 percent of all mapped exotic plants in the Tuolumne River riparian corridor: Eucalyptus, edible fig, common reed, and tree of heaven. These species form large stands and interfere with native hardwood recruitment and regeneration.

Most remaining large tracts of relic riparian vegetation are associated with state, federal or county parks. Large relic stands (>5 acres) preserved by parks are subjected to different types of human activities, which often conflict with riparian vegetation use by wildlife. Roads and campgrounds create openings and clear the dense understory. The presence of dogs, trails, and noise also impacts relic stands. Dogs are prey-driven animals, and most will readily pursue anything that flees. Non-burrowing wildlife species may be driven out of the riparian vegetation within parks where there is no refuge from dogs. Planned and un-planned trails sub-divide habitat, and small animals may find this a barrier. The management of these relic stands prohibits their temporal evolution and disturbance by the river; this strategy prevents a change to the relic stand’s current condition. Although the parks represent most of the largest tracts of relic riparian vegetation, they are riparian vegetation museums where stand evolution is incompatible with long term park management activities.

Vernal pools and great valley grass lands both fall within the project area (the San Joaquin River north of Bear Slough and including the confluence areas with backwater effects). However, they do not rely solely on the fluvial system for survival. Vernal pools are not subject to the changes in groundwater created by the rising and falling of the river stage, and rely solely on rainfall for the moisture to sustain them. Great valley grasslands and vernal pools have the highest number of rare, threatened or endangered plants of any vegetation type within the project area; however, the pulse flows of various project alternatives are not anticipated to affect them (see Section 4.4.1).
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Common, Exotic, Rare, Threatened, or Endangered Plant Species

Common riparian plant species make up the majority of canopy structure and understory; there are no endangered plants associated with it. Valley grasslands and vernal pools have a very high species diversity and several endangered plants; however, they are not further evaluated because the proposed project alternatives will not affect them. See Appendix D for a complete listing of threatened and endangered plant species evaluated for the proposed and alternative actions. Fremont cottonwood, white alder, box elder, valley oak, black willow, and narrowleaf willow are the primary riparian vegetation constituents throughout the project area’s riparian corridors.

Exotic plants are widespread throughout the project area and are affecting native plant regeneration, and canopy and understory structure. Aquatic exotic plants brought from tropical countries have been favored by higher water temperature created by flow regulation and low gradient river reaches. Eucalyptus, edible fig, common reed (Arundo donax), and tree of heaven already form large stands and are interfering with native hardwood recruitment and regeneration. White mulberry, yellow flag iris, and weeping willow are just beginning to proliferate and will soon out-compete indigenous riparian plant species.

Aspects of Common Species Annual Life History

Riparian plants have adapted to survive within the fluvial environment by timing different stages of their annual life history to coincide with changes in discharge associated with different hydrograph components. Dormancy and seed dispersal are the two annual life history stages that are most likely to occur during the different fall and spring pulse flow alternatives associated with this project. These will affect each species differently because of the timing of individual seed dispersal periods (Figure 3.4-4).

Plant dormancy along the San Joaquin River and its tributaries is correlated with the onset of late fall and early winter storms. These storms are colder and cause a rise in river stage, and also coincide with a shorter photoperiod. Drought stress, a change in temperature, or flooding can induce plant dormancy. Plants are the most vulnerable to mortality agents during the growing season, and dormancy is a way for the plant to protect its resources from environmental stresses created during drought, in-climate temperatures, or flooding. Plant physiologic processes such as respiration and photosynthesis are reduced during dormancy, and their need for oxygen and mineral nutrients is negligible. Many riparian plants will only go dormant if exposed to environmental stress, such as a storm or flood. Otherwise, they maximize their photosynthetic potential each year by continuing growth as long as possible. If fall pulse flows occur before dormancy, it is conceivable, however improbable, that inundation could cause stress and mortality.

Spring pulse flow timing, magnitude, and duration may provide the conditions necessary for hardwood regeneration in certain locations along the San Joaquin River and its tributaries. Historically, the timing of seed dispersal for the dominant species on the floodplain coincided with
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each river’s snowmelt peak and the subsequent receding line. For example, Fremont cottonwood drops its seeds during the first two weeks of May, and narrowleaf willow drops its seeds during late May and early June; their seeds have a short life span of seven to ten days (Young and Young 1992). In contrast, box elder and white alder drop their seeds in the late summer and fall, and the seeds are viable for a minimum of a year (Young and Young 1992).

Different seed dispersal strategies lead to unique germination and establishment patterns along the bankfull channel, floodplains, and terraces. For example, because white alder and box elder disperse seeds in the fall, the pattern of alder and box elder stand establishment is a function of flows that raft seeds to a place where they can germinate and establish. Fremont cottonwood seed dispersal takes place in the late spring when floodplain soils are moist; the soil moisture being fed subsurface by high ground water tables recharged by the snowmelt peak, and sustained by the slow flow recession into the summer. Spring pulse flows could potentially affect the quantities, size, distribution, and species composition of regenerating riparian vegetation.

3.4.2 Wildlife

In the context of the proposed actions of this project, wildlife in the San Joaquin Valley are a less important feature than the aquatic resources (discussed in Section 3.5). This is because the proposed project involves the potential redistribution of water in the San Joaquin River Basin. Since none of the proposed project alternatives involve transport of water away from existing upland areas, this section addresses wildlife in the context of habitats that depend upon water to support wildlife.

The diversity and types of wildlife within the San Joaquin River Basin are related to the quality and areal extent of terrestrial habitat. Many of the wildlife species that formerly dominated the landscape (elk, bison, and other large mammals) required extensive desert scrub, large seasonal wetlands, extensive grasslands, and broad riparian corridors. Mountain meadows typically had less than 20 percent shrub canopy, with trees widely scattered around the perimeter. Wet meadows supported rushes, grasses, and perennial sedges. The soil remained wet late into the summer while in some places it remained permanently wet. The dry meadows were dominated by perennial grasses and forbs with some sedges. The riparian deciduous corridors were located along streams or ponds. These areas provided a narrow band of deciduous trees and shrubs along the margins.

Consequently, in the proposed project, the chief habitat used by wildlife species is riparian. Based on the interaction of a unique physical environment and the associated vegetation that occurs along the banks of the San Joaquin River tributaries, riparian corridors include surface and groundwater (sufficiently in excess of local precipitation) capable of supporting vegetation requiring moderate amounts of water. Plants in these areas undergo ecological succession from: 1) initiation (when the seeds fall on exposed, moist substrate and starts germination); to 2) establishment (from the end of the first growing season until the plant begins sexual reproduction); to 3) maturation (the active production of flowers and seeds); to 4) senescence (from when seed/flower production declines until plant death).
Historically, large floods (during wet years) created gaps in the riparian vegetation. Due to excessive erosion associated with flooding, open areas were created where new sediments associated with the flood events could be deposited. During normal years riparian vegetation was established, and seral stages of ecological succession followed. With the occurrence of dry years, seed production was limited, no new areas were opened for deposition, no sediments were transported, and no new plants could start their life cycle.

The plants growing in the riparian corridor formed a patchwork distribution responding to the availability of adequate water. The patterning of vegetation within the riparian corridor resulted from not only plant specific physiologic tolerances but also interactions of fluvial geomorphology, and hydrology. As a result of naturally occurring spring snowmelt floods, water levels rose and fell gradually. Following peak water levels, there was a gradual decline during summer months which created patterns in the vegetation along the waterway’s riparian corridor. Each riparian plant species (and each life stage) respond differently to hydrologic and fluvial processes. Initiation and establishing stage plants were susceptible to mortality due to inadequate substrate and water availability. Establishing plants were susceptible to inundation or scour-induced mortality from subsequent year flooding. The longevity of maturation plants depends on channel migration and damage from debris from major floods as well as disease. The dynamic interactions between the four life stages and mortality results in structural diversity of riparian habitat. The interactions of contemporary hydrologic and geomorphic processes, anthropogenic management of water resources, and each riparian plant’s specific physiologic tolerances resulted in a “narrow window” for survival of the riparian plants.

With development in the Valley, the natural processes of ecological succession (time, human activities, and natural changes) all resulted in changes in the structure and composition of the plant community. Superimposed on these changes are the ecological successional patterns from a grass forb stage, to a shrub/seedling/sapling stage, to a pole/medium tree stage, to a mature large tree stage (all with associated changes in the soils). As a result of the natural ecological succession and the anthropogenic influences of development, vegetation and wildlife now associated with natural terrestrial, agricultural, urban, riparian, and wetlands habitats exists.

As a result of habitat disruption or elimination, common wildlife species today include foxes, coyote, badgers, skunks, and opossums (an introduced species) which feed on insects, reptiles, rabbits and rodents. Their utilization of the habitat is inextricably linked to three major life history activities of the wildlife: breeding, feeding, and resting.

While the CALFED (1997) ecological zone classification system (fully described in Section 3.5.1) has been used to subdivide the project area, the wide distribution of wildlife does not facilitate such description within the same zones. Consequently, this section highlights common wildlife species of the San Joaquin Valley, and draws particular attention to wildlife species associated with riparian habitat. Representative avifauna include waterfowl (associated with the Pacific Flyway) which
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overwinter in valley wetlands. In addition, upland game birds (doves, pheasant, quail, and chukar) and shorebirds (terns, plovers, sandpipers, egrets, and gulls) inhabit the study area. Raptors (bald eagles, prairie falcons, and owls) feed in the riparian and wetlands habitats of the valley. Passerines, including warblers, blackbirds, sparrows, flycatchers, and swallows, utilize the diverse habitats of the San Joaquin River Basin for nesting and overwintering.

Riparian habitat includes areas in or adjacent to drainage ways and flood plains which are characterized by species and/or life forms significantly different from those of the surrounding non-riparian habitats. Nutrients, water, and detrital materials are transported into riparian areas from surrounding upland areas. The importance of riparian habitat is demonstrated in that some of the highest densities of breeding birds are found in riparian habitats, and more than 60 percent of all vertebrates spend some portion of their life cycle in riparian habitat (Ohmart and Anderson 1982). Some of the riparian habitat has a lush canopy with associated shade and cover which provides habitat for a myriad of insects. Rough, ever-sloughing bark of common riparian trees attracts wood-boring larvae and provides forage for bark-gleaning and trunk-scaling birds. Woodpeckers, warblers, flycatchers, and owls are common inhabitants of this habitat. The tall trees also attract wintering and breeding raptors.

In addition to birds, riparian habitat is important to large mammals because it affords food, water, and cover. Herpatofauna (turtles, snakes, and amphibians such as salamanders) are dependent on riparian habitat for at least some stages of their life cycle. Many of these species are aquatic or semi-aquatic and lay open eggs (nonshelled) in water or very moist areas. Many also prefer rotting logs or dense ground cover (provided by leaf litter from the riparian vegetation). Many of these species are insectivorous or carnivorous. Herptiles also depend on this habitat for dispersal and genetic continuity between populations.

A number of mammals make use of the diverse habitats afforded by the San Joaquin River Basin (Table 3.4-5). Many of these are transients between the upland and riparian habitats. The San Joaquin pocket mouse prefers dry, open grasslands or scrub areas of fine textured soils. Feeding on seeds and some green vegetation and insects, this nocturnal mouse digs burrows for cover and may become torpid during extreme heat or cold. Heermann’s kangaroo rat is found in the foothills and valley. It is common to the grasslands, scrub, mixed and montane chaparral, and early successional stages of valley hardwood and hardwood-conifer habitats. Feeding mostly on grains but also eating some forbs and green grass, this rat prefers food from red brome, foxtail, fescue, mouse barley, wild oats, lupine, lotus, and clover. It burrows in fine, deep, well drained soils. Muskrats are abundant in riparian areas, especially in fresh emergent wetlands as well as valley foothill and montane riparian habitats, aspen, and lacustrine riverine habitats. Muskrats are mainly herbivorous and prefer roots and basal stems of plants but also consume crayfish, molluscs, turtles, and fish
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Table 3.4-5: MAMMALS COMMONLY OCCURRING IN THE SAN JOAQUIN VALLEY

<table>
<thead>
<tr>
<th>COMMON NAME</th>
<th>NATIVE</th>
<th>INTRODUCED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virginia Opossum</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Ornate Shrew</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Broad-footed mole</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Yuma myotis</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Western pipistrelle</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Big brown bat</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Red bat</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Hoary bat</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Townsend’s big-eared bat</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Pallid bat</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Brazilian free-tailed bat</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Desert cottontail</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Black-tailed hare</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>California ground squirrel</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Botta’s pocket gopher</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>San Joaquin pocket mouse</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Heermann’s kangaroo rat</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Beaver</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Western harvest mouse</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Deer mouse</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>California vole</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Muskrat</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Black rat</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Norway rat</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>House mouse</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Coyote</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Gray fox</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Ringtail</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Raccoon</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Long-tailed weasel</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Badger</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Western spotted skunk</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Striped skunk</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Bobcat</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Mule deer</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

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opportunistically. Coyote are common in brush, scrub, shrub, and herbaceous habitats. They also frequent younger stands of deciduous and conifer forests with low to intermediate canopy. An omnivorous opportunist, coyote eat primarily rats, mice, ground squirrels, gophers, and carrion.

A number of anthropogenic activities including livestock grazing, mining, intensive recreational activities, impoundment construction, logging (and associated road construction) have had dramatic impacts on the diversity of wildlife found in these riparian habitats. Although extensive efforts have been taken to slow habitat alteration, a number of species have declined in abundance, some to near extinction (Table 3.4-6). Species included in this list are those associated with habitat types that may potentially be affected by project alternatives. Species that were considered for this list are contained in Appendix D.

Table 3.4-6: STATE AND FEDERAL THREATENED, ENDANGERED, PROPOSED, AND CANDIDATE WILDLIFE SPECIES THAT MAY OCCUR IN THE PROJECT AREA.

<table>
<thead>
<tr>
<th>Species</th>
<th>Status^</th>
<th>Federal/State</th>
<th>Habits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservancy fairy shrimp * Branchinecta conservatio</td>
<td>E/--</td>
<td></td>
<td>Large, deep vernal pools in annual grasslands</td>
</tr>
<tr>
<td>Longhorn fairy shrimp * Branchinecta longiantenna</td>
<td>E/--</td>
<td></td>
<td>Small, clear pools in sandstone rock outcrops of clear to moderately turbid clay- or grass-bottomed pools</td>
</tr>
<tr>
<td>Valley elderberry longhorn beetle * Desmocerus californicus dimorphus</td>
<td>T/--</td>
<td></td>
<td>Riparian and oak savanna habitats with elderberry shrubs; below 2,000 feet elevation</td>
</tr>
<tr>
<td>Vernal pool fairy shrimp * Branchinecta lynchi</td>
<td>T/--</td>
<td></td>
<td>Vernal pools; sandstone rock outcrop pools</td>
</tr>
<tr>
<td>Vernal pool tadpole shrimp * Lepidurus packardi</td>
<td>E/--</td>
<td></td>
<td>Vernal pools; ephemeral stock ponds</td>
</tr>
</tbody>
</table>

**Invertebrates**

California tiger salamander \* Ambystoma tigrinum californiense | C1/SSC |               | Small ponds, lakes, or vernal pools in grasslands and oak woodlands for larvae; rodent burrows, rock crevices, or fallen logs for cover for adults and for summer dormancy |

California red-legged frog \* Rana aurora draytonii | T/SSC |               | Permanent and semipermanent aquatic habitats such as creeks and coldwater ponds with emergent and submerged vegetation and riparian species along the edges; may estivate in rodent burrows or cracks during dry periods |

Table 3.4-6: STATE AND FEDERAL THREATENED, ENDANGERED, PROPOSED, AND CANDIDATE WILDLIFE SPECIES THAT MAY OCCUR IN THE PROJECT AREA (CONT.)

<table>
<thead>
<tr>
<th>Status^</th>
</tr>
</thead>
</table>

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### Table 3.4-6: STATE AND FEDERAL THREATENED, ENDANGERED, PROPOSED, AND CANDIDATE WILDLIFE SPECIES THAT MAY OCCUR IN THE PROJECT AREA (CONT.)

<table>
<thead>
<tr>
<th>Species</th>
<th>Federal/State</th>
<th>Habitats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giant garter snake <em>Thamnophis couchi gigas</em></td>
<td>T/T</td>
<td>Sloughs, canals, and other small waterways, where there is a prey base of small fish and amphibians; requires grassy banks and emergent vegetation for basking, and areas of high ground protected from flooding during winter</td>
</tr>
<tr>
<td>Western pond turtle <em>Clemmys marmorata</em></td>
<td>--/SSC</td>
<td>Permanent ponds, lakes, streams, and irrigation ditches; basking sites, such as logs, rocks, mud banks, or mats of floating vegetation required; nests constructed in sandy banks or on hillsides up to 325 feet from water</td>
</tr>
</tbody>
</table>

#### Birds

<table>
<thead>
<tr>
<th>Species</th>
<th>Federal/State</th>
<th>Habitats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aleutian Canada goose <em>Branta canadensis leucopareia</em></td>
<td>T/--</td>
<td>Winters in the San Joaquin Valley; forage on pastures, harvested fields, and wetlands; roost on flooded fields and ponds at night</td>
</tr>
<tr>
<td>Bald eagle <em>Haliaeetus leucocephalus</em></td>
<td>T/E</td>
<td>Requires large, old-growth trees or snags in mixed stands near large bodies of water or free-flowing rivers with abundant fish. Roosts communally in winter in dense, sheltered, remote conifer stands in proximity to feeding areas.</td>
</tr>
<tr>
<td>American peregrine falcon <em>Falco peregrinus anatum</em></td>
<td>E/E</td>
<td>Nests and roosts on protected ledges of high cliffs, usually adjacent to lakes, rivers, or marshes that support large populations of other bird species</td>
</tr>
<tr>
<td>Bank swallow <em>Riparia riparia</em></td>
<td>--/T</td>
<td>Nests in bluffs or banks adjacent to water where the soil consists of sand or sandy loam to allow digging; the state’s largest breeding populations are along the Sacramento River, and along the Feather and Lower American Rivers, in the Owens Valley</td>
</tr>
<tr>
<td>California yellow warbler <em>Dendroica petechia brewsteri</em></td>
<td>--/SSC</td>
<td>Nests and feeds in riparian deciduous habitats; preferred species include cottonwoods, willows, and alders</td>
</tr>
<tr>
<td>Cooper’s hawk <em>Accipiter cooperii</em></td>
<td>--/SSC</td>
<td>Dense stands of live oak, riparian deciduous, or other forest habitats near water used most frequently</td>
</tr>
<tr>
<td>Greater sandhill crane <em>Grus canadensis tabida</em></td>
<td>--/T</td>
<td>Summers in open terrain near shallow lakes or freshwater marshes; winters in plains and valleys near bodies of fresh water</td>
</tr>
<tr>
<td>Loggerhead shrike <em>Lanius ludovicianus</em></td>
<td>--/SSC</td>
<td>Found in a wide variety of lowland habitats including valley foothill hardwood, hardwood-conifer, valley foothill riparian, and pinyon-juniper</td>
</tr>
<tr>
<td>Long-billed curlew <em>Numenius americanus</em></td>
<td>--/SSC</td>
<td>Breeds on grazed, mixed-grass and short grass prairies, and wetlands; feeds in a variety of wetlands, and flooded or wet fields</td>
</tr>
<tr>
<td>Mountain plover <em>Charadrius montanus</em></td>
<td>C/SSC</td>
<td>Frequents open plains below 3,200 feet elevation with low herbaceous or scattered shrub vegetation; plowed fields with little vegetation; avoids high and dense cover</td>
</tr>
</tbody>
</table>

---

* Final EIS/EIR
* TX3_4.WPD
* January 28, 1999
## 3. Affected Environment

<table>
<thead>
<tr>
<th>Species</th>
<th>Status</th>
<th>Habitats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern harrier <em>Circus cyaneus</em></td>
<td>--/SSC</td>
<td>Frequent meadows, grasslands, open rangelands, and wetlands; nests in emergent wetland or along rivers or lakes; less frequently nests in grasslands and grain fields</td>
</tr>
<tr>
<td>Prairie falcon <em>Falco mexicanus</em></td>
<td>--/SSC</td>
<td>Associated primarily with perennial grasslands, savannas, rangelands, and some agricultural fields; uses open terrain for foraging and nests in adjacent canyons, cliffs, or rock outcrops</td>
</tr>
<tr>
<td>Sharp-shinned hawk <em>Accipiter striatus</em></td>
<td>--/SSC</td>
<td>Prefers, but not restricted to, riparian habitats; forages in openings at edges of woodlands, brushy pastures, and shorelines where there is an abundance of migrating birds</td>
</tr>
<tr>
<td>Short-eared owl <em>Aego flammeus</em></td>
<td>--/SSC</td>
<td>Winters in the Central Valley; usually found in open areas with few trees, such as grasslands, prairies, irrigated lands meadows, and wetlands</td>
</tr>
<tr>
<td>Swainson's hawk <em>Buteo swainsoni</em></td>
<td>--/T</td>
<td>Nests in oaks or cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, and grain fields</td>
</tr>
<tr>
<td>Western least bittern <em>Ixobrychus exilis hesperis</em></td>
<td>--/SSC</td>
<td>Nests in fresh emergent wetlands in the Central Valley; rests, roosts, and hides in dense emergent vegetation; often feeds along the edge of emergent vegetation on the open-water side</td>
</tr>
<tr>
<td>White-tailed kite <em>Elanus leucurus</em></td>
<td>--/P</td>
<td>Forages in agricultural areas and grasslands; uses trees with dense canopies for cover; nests in dense oak, willow, or other tree stand</td>
</tr>
<tr>
<td>Willow flycatcher <em>Empidonax traillii brewsteri</em></td>
<td>--/E</td>
<td>Riparian areas and large, wet meadows with abundant willows for breeding; usually occurs in riparian habitats during migration</td>
</tr>
</tbody>
</table>

### Mammals

<table>
<thead>
<tr>
<th>Species</th>
<th>Status</th>
<th>Habitats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giant kangaroo rat <em>Dipodomys ingens</em></td>
<td>E/E</td>
<td>Restricted to flat, sparsely vegetated areas with native annual grassland and shrubland habitats; requires uncultivated soils consisting of dry, fine, sandy loams for burrowing</td>
</tr>
<tr>
<td>Tipton kangaroo rat <em>Dipodomys nitratoides nitratoides</em></td>
<td>E/E</td>
<td>Construct burrows in alkali marshes and on plains. Unable to use cultivated lands. Prefer areas with scattered woody shrubs such as saltbush, and a sparse covering of grasses and forbs. A critical element of their habitat is slightly elevated terrain where they can build burrows above the winter and spring floods.</td>
</tr>
<tr>
<td>Fresno kangaroo rat <em>Dipodomys nitratoides exilis</em></td>
<td>E/E</td>
<td>Use sandy loam soils for excavation of burrows in gently undulating to level terrain in mildly to moderately alkaline areas. Herbaceous vegetation with scattered shrubs preferred.</td>
</tr>
</tbody>
</table>

### Table 3.4-6: STATE AND FEDERAL THREATENED, ENDANGERED, PROPOSED, AND CANDIDATE WILDLIFE SPECIES THAT MAY OCCUR IN THE PROJECT AREA (CONT.)

<table>
<thead>
<tr>
<th>Species</th>
<th>Status</th>
<th>Habitats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riparian woodrat <em>Neotoma fuscipes riparia</em></td>
<td>C/SSC</td>
<td>Prefers areas with a mixture of trees and shrubs with moderate canopy and brushy understory. Requires cavities in trees, snags, or logs for nesting. In the San Joaquin Valley, suitable habitat restricted primarily</td>
</tr>
</tbody>
</table>
3. Affected Environment

<table>
<thead>
<tr>
<th>Natural Terrestrial Habitats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riparian brush rabbit</td>
</tr>
<tr>
<td><em>Sylvilagus bachmani riparius</em></td>
</tr>
<tr>
<td>C/SSC</td>
</tr>
<tr>
<td>Occupy dense thickets of riparian shrubs including wild rose (<em>Rosa</em> sp.), willows (<em>Salix</em> sp.), and blackberries (<em>Rubus</em> sp.). Also uses weedy fields adjacent to shrubs. Currently only known on the lower Stanislaus River and possibly in the vicinity of the confluence of the Stanislaus and San Joaquin rivers.</td>
</tr>
<tr>
<td>San Joaquin kit fox</td>
</tr>
<tr>
<td><em>Vulpes macrotis mutica</em></td>
</tr>
<tr>
<td>E/T</td>
</tr>
<tr>
<td>Saltbrush scrub, valley grassland, oak woodlands, and freshwater scrub. Principally occurs in the San Joaquin Valley.</td>
</tr>
</tbody>
</table>

### Status

<table>
<thead>
<tr>
<th>Federal</th>
</tr>
</thead>
<tbody>
<tr>
<td>E = Listed as endangered under the federal Endangered Species Act</td>
</tr>
<tr>
<td>T = Listed as threatened under the federal Endangered Species Act</td>
</tr>
<tr>
<td>PE = Proposed for federal listing as endangered under the federal Endangered Species Act</td>
</tr>
<tr>
<td>C1 = Category 1 candidate for federal listing. Category 1 includes species for which U.S. Fish and Wildlife Service has on file enough substantial information on biological vulnerability and threat to support proposals to list them.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>E = Listed as endangered under the California Endangered Species Act</td>
</tr>
<tr>
<td>T = Listed as threatened under the California Endangered Species Act</td>
</tr>
<tr>
<td>SSC= Species of special concern</td>
</tr>
<tr>
<td>P = Fully protected in California</td>
</tr>
<tr>
<td>-- = No status</td>
</tr>
</tbody>
</table>

### 3.4.2.1 Natural Terrestrial Habitats

Annual grassland and valley foothill hardwood are the dominant natural terrestrial habitat types in the San Joaquin River region constituting approximately 58 percent of these habitats (USBR 1997d). Many wildlife species use annual grasslands for foraging, but some require special habitat features such as cliffs, caves, ponds, or habitats with woody plants for breeding, resting, and escape cover. Annual grasslands in the San Joaquin region are found in the lower foothills and often comprise the understory in oak savannas. Annual grasslands are largely used for livestock grazing but also provide habitat for wildlife. Reptiles that breed in annual grasslands include the western fence lizard, common garter snake, and western rattlesnake. Mammals commonly found in this habitat include black-tailed jackrabbit, California ground squirrel, western harvest mouse, California vole, badger, and coyote. Common birds that breed in annual grasslands include horned lark, and western meadowlark. Numerous threatened, endangered, or sensitive species use annual grasslands for breeding and foraging including burrowing owl, short-eared owl, white-tailed kite, prairie falcon, and San Joaquin kit fox.
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Valley foothill hardwood habitat varies from savanna-like to forest-like stands with partially closed canopies dominated by valley oaks (Conard et al. 1977). Denser hardwood stands are associated with valley soils along natural drainages (Mayer and Laudenslayer 1988). Valley foothill hardwood stands are often associated with riparian habitat along the Stanislaus, Merced, and Tuolumne rivers. Hardwood stands provide food and cover for a variety of wildlife, with oaks supplying an important food resource to some birds and mammals. TES species that may be found in this habitat include white-tailed kite, short-eared owl, and riparian woodrat.

3.4.2.2 Agricultural Lands

Agricultural habitats are generally of lower value to wildlife than are natural habitats. The major agricultural habitats in the San Joaquin River region are irrigated pasture, orchards, vineyards, grain, grasslands, and cotton (USBR 1997d). Agricultural areas interrupt riparian vegetation along the Stanislaus, Merced, and Tuolumne rivers (see Section 3.4.1) resulting in the fragmentation of natural habitats. Fragmentation greatly reduces the potential of riparian and valley hardwood stands to fulfill habitat requirements and act as corridors for many wildlife species. In addition, agricultural areas create abrupt edges with natural habitats creating conditions less-preferable by native species. Nonetheless, wildlife species have adapted to these intensively managed areas and use them for foraging and occasionally for breeding. Irrigated pasture provides the highest quality habitat for wildlife and may be used by RTES species. Irrigated pasture, grain, and grasslands used for hay production offer foraging opportunities for black-bellied plover, killdeer, long-billed curlew, white-faced ibis, red-tailed hawk, white-tailed kite, and prairie falcon (USBR 1997b). Small mammals occupying pasture habitat include California vole, Botta’s pocket gopher, and California ground squirrel (USBR 1997b). Ground-nesting birds, including ring-necked pheasant, waterfowl, and western meadowlark, occupy pasture habitat if adequate residual vegetation is present (USBR 1997b).

Orchard and vineyard habitat includes intensively managed cultivated fruit or nut-bearing trees, and grape vines planted in rows (USBR 1997b). Understory vegetation is usually absent, but in some areas grasses and other herbaceous plants are allowed to grow along tree rows and between vineyard rows to reduce erosion (Mayer and Laudenslayer 1988). Some wildlife species have adapted to orchard and vineyard habitats. Deer and rabbits browse on the trees or vines, and squirrels and numerous birds feed on fruits or nuts (Mayer and Laudenslayer 1988). Other wildlife species associated with vineyards include deer mouse, mourning dove, and black-tailed hare. In addition, nuts and fruits from orchards provides food for a variety of animals including American crow, scrub jay, yellow-billed magpie, northern mockingbird, black-headed grosbeak, California ground squirrel, western gray squirrel, coyote, and raccoon (Mayer and Laudenslayer 1988). Orchard and vineyard habitat provides little habitat value for RTES species.

Cotton is an annual crop which is planted in spring and harvested during the fall. Crop rotation, usually between annual and perennial plants, is a common practice applied to conserve soil nutrients
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in order to maintain soil productivity. Cropland vegetation is grown as a monoculture, using tillage or herbicides to eliminate unwanted vegetation (Mayer and Laudenslayer 1988). Today, many species of rodents and birds have adapted to croplands but are controlled by fencing, trapping, and poisoning to prevent excessive crop losses (CA Dept. Food and Agri. 1975). Croplands flooded for weed control, leaching, irrigation, or waterfowl hunting serve as freshwater wetlands for a variety of wetland wildlife such as shorebirds, wading birds, and gulls (Mayer and Laudenslayer 1988).
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#### 3.4 TERRESTRIAL RESOURCES

- **3.4.1 Vegetation**
  - 3.4.1.1 Background
  - 3.4.1.2 Current Conditions

- **3.4.2 Wildlife**
  - 3.4.2.1 Natural Terrestrial Habitats
  - 3.4.2.2 Agricultural Lands
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3.5 AQUATIC RESOURCES

From an ecosystem and historic perspective, this chapter describes the aquatic resources of the proposed project study area to provide a baseline by which potential impacts of the project can be evaluated. This description of existing aquatic resources elaborates on information contained in Chapter V of the Environmental Report, Appendix I of the 1995 WQCP (SWRCB 1995b), and Chapter III of the 1997 Administrative Draft SWRCB EIR (SWRCB 1997), for the implementation of the 1995 Water Quality Control Plan for the Bay/Delta. This chapter is patterned on the CALFED Bay/Delta program characterization of aquatic ecological habitat elements and stressors (CALFED 1997) and the Central Valley Project Improvement Act review of factors affecting the recovery of aquatic resources in the San Joaquin River system (USBR 1997d).

During the past century, the aquatic resources of the San Joaquin River study area have undergone very significant changes due to human related activities. Virtually all native species have declined in abundance, and many introduced species have become excessively abundant. The decline of native species has become a matter of considerable public concern and has resulted in the proposed actions being considered in this document. These actions are intended to help stem the decline and actively promote the restoration of the chinook salmon, as well as the general ecological health of the San Joaquin River Basin and the Bay/Delta Estuary. The characterization of the baseline abundance and distribution of aquatic resources in this chapter emphasizes manageable factors that contribute to the restoration of selected fish species by the proposed actions of this project. The characterization places into context the impacts that will be described in Section 4.4 of this EIS/EIR.

3.5.1 Habitats and Ecological Zones

The project area encompasses unique Ecological Zones (Figure 3.5-1) characterized by their predominant physical habitats and species assemblages as defined by the Ecosystem Restoration Program Plan (CALFED 1997). These ecological zones relate directly to the rivers, tributaries, and reservoirs of San Joaquin River Basin and include:

- San Joaquin River Ecological Zone
- East San Joaquin Basin Ecological Zone
- West San Joaquin Basin Ecological Zone
- Sacramento-San Joaquin Delta Ecological Zone (Delta)

The following sections describe the demarcation lines of each ecological zone, the salient ecological features, major tributaries and species assemblages.
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3. Affected Environment

3.5.1.1 San Joaquin River Ecological Zone

The San Joaquin Valley, the southern half of the great California Central Valley, extends some 290 miles from the Sacramento-San Joaquin Delta in the north, to the Tehachapi Mountains in the south. It is bordered on the east by the high mountains of the Sierra Nevada and to the west by the Coast Ranges. The San Joaquin Valley is divided into two distinct hydrologic zones: the Tulare Lake Basin in the south, and the San Joaquin River Basin in the north. The Tulare Lake Basin is separated from the San Joaquin River except in wet years by a low geological divide and, consequently, is not considered part of the San Joaquin River Ecological Zone (Figure 3.5-1). The San Joaquin River traverses the approximate center of the San Joaquin Valley emptying into the Sacramento-San Joaquin Delta at Vernalis. The San Joaquin River Ecological Zone (Figure 3.5-1) includes all of the 185-mile length of the San Joaquin River below Friant Dam, its confluence with other rivers, and drainage from adjacent wetlands.

Snowmelt from the Sierra Nevada mountain range is the primary source of water entering tributaries of the San Joaquin River Basin. Unimpaired flows in normal water years characteristically peak in May, June, and July as the snowpack melts in the spring and summer. Unimpaired flows the rest of the year are typically very low. The overall effect of water development in the San Joaquin River Basin is that water is stored in large reservoirs and then released more evenly throughout the year with generally highest flows in the early spring (CALED 1997, SWRCB 1997).

Water quality in the San Joaquin River varies seasonally, but in periods of low flow is generally degraded due to high temperatures, heavy metals, and pesticides from drainage (Saiki et al. 1992; Kuivila and Foe 1995). During the irrigation season (March - October) and occasionally following the flushing of the drainage water from duck clubs (January and February), degraded quality drainage water makes up a significant portion of the total San Joaquin River flow.

Within the project area, the San Joaquin River Ecological Zone is further subdivided into two ecological units that include:

- Vernalis Station to Merced River Ecological Unit
- Merced River to Mendota Pool Ecological Unit

The first unit, Vernalis to the mouth of the Merced River, is the most significant from the standpoint of the proposed project and from the perspective of the anadromous fish (salmon, steelhead, and striped bass) that use the San Joaquin River for migration or spawning. This 43-mile reach includes the confluence of the Merced, Tuolumne, and Stanislaus rivers, the main tributaries to the San Joaquin River, entering on the east side of the drainage (Figure 3.5-1). Levees confine the river on both sides and have limited the extent of available floodplain, wetland, or shaded riverine habitat (CALFED 1997). On the west side, broad alluvial river channels and floodplains connect to the San
3. Affected Environment

Joaquin, but water from these rivers rarely reaches the San Joaquin. Virtually all land adjacent to the river is under intensive agricultural development.

The Merced River to Mendota Pool Ecological Unit is 87 miles long and includes Salt and Mud sloughs, the Chowchilla River, and the Fresno River. It receives some flow from the Delta-Mendota Canal into the Mendota Pool (CALTED 1997). A significant amount of flow also comes from agricultural drainage via Salt and Mud sloughs. This reach is also used as a conduit for deliveries of irrigation water.

The reach of the San Joaquin River from Mendota Pool to Friant Dam contains two additional ecological units. Flows in this reach are governed under CVPIA Section 3406(c)(1) and are precluded from the project area and this document.

Shad and striped bass migrate from the Pacific Ocean via the Delta into the San Joaquin River to spawn in the spring. Splittail, squawfish, and other native species (Table 3.5-1) are also found in the San Joaquin River. However, this ecological zone is dominated by introduced species such as largemouth bass, silversides, green sunfish and brown bullhead (Brown and Moyle 1992). Introduced species dominate in terms of total numbers and biomass.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Native</th>
<th>Status</th>
<th>Delta</th>
<th>Rivers</th>
<th>Reservoir</th>
</tr>
</thead>
<tbody>
<tr>
<td>yellowfin goby</td>
<td>Acanthogobius flavimanus</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>white sturgeon</td>
<td>Acipenser transmontanus</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>green sturgeon</td>
<td>Acipenser medirostris</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>American shad</td>
<td>Alosa sapidissima</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>goldfish</td>
<td>Carassius auratus</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Sacramento sucker</td>
<td>Catostomus occidentalis</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Pacific herring</td>
<td>Clupea harengus pallasi</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>prickly sculpin</td>
<td>Cottus asper</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>riffle sculpin</td>
<td>Cottus gulosus</td>
<td>X</td>
<td>X</td>
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<td></td>
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<tr>
<td>carp</td>
<td>Cyprinus carpio</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>threadfin shad</td>
<td>Dorosoma petenense</td>
<td>X</td>
<td>X</td>
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<td>X</td>
<td></td>
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<tr>
<td>mosquitofish</td>
<td>Gambusia affinis</td>
<td>X</td>
<td>X</td>
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<td></td>
</tr>
<tr>
<td>threespine stickleback</td>
<td>Gasterosteus aculeatus</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>California roach</td>
<td>Hesperoleucus symmetricus</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Delta smelt</td>
<td>Hypomesus transpacificus</td>
<td>X</td>
<td>FT, ST</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>wakasagi</td>
<td>Hypomesus nipponensis</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. Affected Environment

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Native Status</th>
<th>Delta</th>
<th>Rivers²</th>
<th>Reservoir³</th>
</tr>
</thead>
<tbody>
<tr>
<td>surf smelt</td>
<td>Hypomesus pretiosus</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tule perch</td>
<td>Hysterocharpus traski</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.5-1: SAN JOAQUIN RIVER BASIN AND DELTA NATIVE AND NON-NATIVE FISH SPECIES (CONT.)

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Native Status</th>
<th>Delta</th>
<th>Rivers²</th>
<th>Reservoir³</th>
</tr>
</thead>
<tbody>
<tr>
<td>yellow bullhead</td>
<td>Ictalurus natalis</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>channel catfish</td>
<td>Ictalurus punctatus</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>black bullhead</td>
<td>Ictalurus melas</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>brown bullhead</td>
<td>Ictalurus nebulosus</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>white catfish</td>
<td>Ictalurus catus</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>blue catfish</td>
<td>Ictalurus fuscatus</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Pacific brook lamprey</td>
<td>Lampetra pacifica</td>
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<td>Lamptera ayreis</td>
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<td>Lavinia exilicauda</td>
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<td>pumpkinseed</td>
<td>Lepomis gibbosus</td>
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<tr>
<td>green sunfish</td>
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<td>X</td>
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<tr>
<td>warmouth</td>
<td>Lepomis gulosus</td>
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<td>X</td>
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<tr>
<td>redear sunfish</td>
<td>Lepomis microlophus</td>
<td>X</td>
<td>X</td>
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<td>bluegill</td>
<td>Lepomis macrochirus</td>
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<td>staghorn sculpin</td>
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<td>inland silverside</td>
<td>Menidia beryllina</td>
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<tr>
<td>spotted bass</td>
<td>Micropterus punctulatus</td>
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<td>smallmouth bass</td>
<td>Micropterus dolomieu</td>
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<td>striped bass</td>
<td>Morone saxatilis</td>
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<td>hardhead</td>
<td>Mylopharodon conocephalus</td>
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<tr>
<td>golden shiner</td>
<td>Notemigonus crysoleucas</td>
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<td>red shiner</td>
<td>Notropis lutrensis</td>
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<td>steelhead rainbow trout</td>
<td>Oncorhynchus mykiss</td>
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<td>X</td>
<td>FT</td>
<td>X X</td>
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<tr>
<td>chinook salmon</td>
<td>Oncorhynchus tshawytscha</td>
<td></td>
<td>X</td>
<td>FPT</td>
<td>X X</td>
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<tr>
<td>kokanee salmon</td>
<td>Oncorhynchus nerka</td>
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<td>Sacramento blackfish</td>
<td>Orthodon microlepidotus</td>
<td></td>
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<td>yellow perch</td>
<td>Perca flavescens</td>
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<td>bigscale logperch</td>
<td>Percina macrolepidota</td>
<td>X</td>
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<td>fathead minnow</td>
<td>Pimephales promelas</td>
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<td>starry flounder</td>
<td>Platichthys stellatus</td>
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<td>X</td>
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<td>Sacramento splittail</td>
<td>Pogonichthys macrolepidotus</td>
<td></td>
<td>X</td>
<td>FPT</td>
<td>X X</td>
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<td>black crappie</td>
<td>Pomoxis nigromaculatus</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
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<td>white crappie</td>
<td>Pomoxis annularis</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Sacramento pikeminnow formerly</td>
<td>Ptychocheilus grandis</td>
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### 3. Affected Environment

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Native Status</th>
<th>Delta</th>
<th>Rivers&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Reservoir&lt;sup&gt;3&lt;/sup&gt;</th>
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<tbody>
<tr>
<td>longfin smelt</td>
<td><em>Spirinchus thaleichthys</em></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>shimofuri goby</td>
<td><em>Tridentiger bifasciatus</em></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
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<tr>
<td>chameleon goby</td>
<td><em>Tridentiger trigonocephalus</em></td>
<td></td>
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</table>

Table 3.5-1: SAN JOAQUIN RIVER BASIN AND DELTA NATIVE AND NON-NATIVE FISH SPECIES (CONT.)

**Notes:**

FT = Federally listed Threatened, FPT = Federally Proposed Threatened, ST = State listed Threatened

1. Delta is the legal delta from Vernalis to Chipps Island.
2. Rivers is from Vernalis up to the first major dam.
3. See Table 3.5-3 for a compete list of reservoirs.
4. San Luis Reservoir only.

**References:**


### 3.5.1.2 West San Joaquin Basin Ecological Zone

This area comprises the west side of the San Joaquin Valley from the Delta in the north and Panoche Creek in the south (CALFED 1997). It is bounded by the interior coast range on the west side, which supports a few naturally flowing, small streams that flow into the San Joaquin River. The eastern slopes of the coast range mountains are arid, while the few remaining wet land areas adjacent to the San Joaquin River are remnants of a once vast floodplain. Most of the remaining wetlands lie in a topographic trough between the Mendota Pool and the Community of Gustine. These important wetlands are an integral part of the Pacific Flyway for millions of waterfowl which migrate through the Central Valley each spring and fall. The wetland sloughs scattered along the San Joaquin River in this zone are valuable resources for threatened and endangered wildlife. Many native species of fish no longer inhabit this area and introduced species such as striped bass, crappie, and catfish are now established in the San Luis Reservoir, O’Neill Forebay, and Los Banos Reservoir.
The San Luis Reservoir, the largest west side aquatic ecosystem, does not drain into the San Joaquin River. The San Luis Drain was designed to carry agricultural subsurface drainage from collectors along the west side of the San Joaquin River to the Sacramento-San Joaquin Delta for ultimate discharge to the ocean. However, only a portion of the drain was constructed, and it presently terminates in Mud Slough at the north end of Kesterson National Wildlife Refuge and carries drainage from the Westlands Water District only. Accumulations of selenium in the drainage water and sediments at Kesterson resulted in the closure of the refuge and the drain after 1985 (SWRCB 1987). The drain now serves as a conveyance facility for subsurface drainage water that would otherwise flow through the wetlands areas and then to the San Joaquin River.

3.5.1.3 East San Joaquin Basin Ecological Zone

This ecological zone (Figure 3.5-1) includes all the major east side tributaries of the San Joaquin River. The hydrographic elements of this zone include major rivers and many reservoirs of varying size in the upper parts of the watershed. The largest reservoirs are New Melones, New Don Pedro, and Lake McClure. The East San Joaquin River Ecological Zone has been divided into three riverine ecological units, representing the three major tributaries of the San Joaquin River:

- Stanislaus River Ecological Unit
- Tuolumne River Ecological Unit
- Merced River Ecological Unit

Stanislaus River Ecological Unit. The Stanislaus is the northern most major tributary to the San Joaquin River. Average monthly unimpaired flows at New Melones are approximately 96,000 acre-feet. These flows are reduced to approximately 57,000 acre-feet at Ripon, near the confluence with the San Joaquin River, due to flow diversion and regulation at Goodwin Dam.

New Melones Dam is located 60 miles upstream from the confluence of the Stanislaus and San Joaquin Rivers, and is operated by Reclamation as a key element of the CVP. New Melones Reservoir has a capacity of 2,420,000 acre-feet and is currently operated under the New Melones Interim Plan of Operation (USBR 1997c). Releases from New Melones are used for agricultural irrigation and water supply purposes, to meet water quality control standards at Vernalis, provide beneficial fishery flows, and for the positioning of the freshwater/saltwater interface in the Delta.

Goodwin Dam is located approximately 15 miles below New Melones. It serves as the terminus for the upstream migration of chinook salmon. Salmon spawn below the dam and the early life stages grow and develop in the river between the dam and the San Joaquin River before emigrating. There are approximately forty small, unscreened pump diversions (for agricultural purposes) along the river. The channelization of the river below Goodwin Dam has resulted in impaired rearing habitat for juvenile salmon.
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Water temperatures in the Stanislaus River are related to seasonal air temperatures and flow releases. Reclamation has developed a stream temperature model for the Stanislaus River that can be used to predict water temperatures given various flow and climate conditions.

The Stanislaus River, as well as the Tuolumne and Merced rivers, may have suitable habitat conditions to support steelhead even if steelhead are not present.

**Tuolumne River Ecological Unit.** The Tuolumne River is the largest of the San Joaquin River tributaries and has an average annual unimpaired flow of approximately 1.8 million acre-feet. The Tuolumne has a series of dams diverting water for municipal and irrigation uses as well as the generation of electric power. The City of San Francisco constructed the O’Shaughnessy Dam forming the Hetch-Hetchy Reservoir and another smaller dam to form Lake Eleanor in the 1920s. Cherry Dam, forming Lake Lloyd, was completed in 1956. Flow down the lower Tuolumne is regulated at the New Don Pedro Dam operated by the Turlock and Modesto Irrigation Districts. Don Pedro Reservoir has a maximum storage of approximately 2 million acre-feet.

La Grange Dam (built in 1893) is the upstream barrier to salmon migration. Spawning now takes place in the 25-mile reach below the dam, and juvenile rearing takes place throughout the lower river. The quantity and quality of habitat for salmon in the Tuolumne River has been degraded over the years by many factors including loss of riparian habitat due to cattle grazing, instream gravel mining, reduced instream flows, and elimination of upstream sources of gravel recruitment.

In 1995, a settlement agreement was signed by federal and state agencies, local irrigation districts, the City and County of San Francisco, and local environmental groups as part of an amendment to Article 37 of the FERC license for the operation of the New Don Pedro Project (TID/MID 1996). One of the results of this agreement is increased flow releases from New Don Pedro as part of a strategy for recovery of Tuolumne River chinook salmon.

**Merced River Ecological Unit.** The Merced River drains over 1,200 square miles of Sierra Nevada range including the southern part of Yosemite National Park and has an annual average, unimpaired runoff of approximately 1 million acre-feet per year (CALFED 1997). The unimpaired monthly flow peaks in April, May and June and then abruptly drops to flows of less than 100 cfs from August through November. Flow is regulated by a series of dams that allow for flood control, irrigation and power production. The New Exchequer Dam, operated by the Merced Irrigation District, blocks off the higher elevations of the Merced River creating Lake McClure with over one million acre-feet of storage capacity. Further downstream the McSwain Dam acts as an afterbay for New Exchequer Dam.

Habitat quantity and quality within the lower reaches of the Merced River are extensively degraded due to cattle grazing, removal of bank side vegetation, gravel mining in the river bed, agricultural
3. Affected Environment

Return flows into the reaches used by juvenile salmon and trout, low flows resulting in siltation of the spawning gravel, and lack of recruitment of new spawning gravel. Low flows in the lower reaches of the Merced River result in significantly degraded fish rearing habitat. The Merced Falls and Crocker-Huffman agricultural diversion dams divert approximately 500,000 acre-feet a year. Six major diversions in the salmon spawning reach from Crocker-Huffman to Snelling deplete virtually all available flow (CALFED 1997).

**Reservoirs of the East San Joaquin River Ecological Zone.** Reservoirs have become a major type of fish habitat in the east side tributaries since the development of the region’s surface water projects. The nature of each reservoir and its fish fauna is determined by its elevation, size, water management regime, water quality and fisheries management practices. Many of the reservoirs lie at mid-level elevations in the Sierra Nevada foothills and have characteristics of both warm-water and cold-water ecosystems. Reservoir ecosystems include: 1) littoral, or edge habitats down to the lower limit of the penetration of light; 2) the epilimnetic, or open water zone; 3) the hypolimnetic zone of cold water below the warmer surface water; and 4) benthic, or bottom zone. The east side reservoirs provide considerable recreational fishing diversity, although extensive drawdowns tend to limit species that are dependent on relatively stable shallow-water habitat for some component of their life cycle.

3.5.1.4 Sacramento-San Joaquin River Delta Ecological Zone

The Sacramento-San Joaquin Delta Ecological Zone (Figure 3.5-1) includes all of the legal delta from the Carquinez Straights, to the mouth of the American River in the north, to Vernalis on the San Joaquin River in the south. The proposed project alternatives primarily affect the southern and central portions of the Delta through changes in the magnitude and timing of flows at Vernalis. The Sacramento-San Joaquin Delta Ecological Zone is characterized by a mosaic of habitat types that support a diverse community of aquatic organisms (CALFED 1997; SWRCB 1997). This zone is also a key element linking the Pacific Ocean with the tributary rivers in the watershed on the east side of the coast range and the western side of the Sierra Nevada Mountains. Based on the aquatic habitat nomenclature of CALFED (1997), the main types of aquatic habitat found in the Delta include:

- shaded riverine aquatic (SRA)
- vegetated and non-vegetated shallow shoal areas
- open-ended sloughs
- dead-end sloughs
- large, open river channels
3. Affected Environment

Inflow to the Delta primarily comes from the large, open river channels of the Sacramento River with lesser amounts coming from the San Joaquin and Mokelumne rivers. The Sacramento River contributes approximately 75–80 percent of the water entering the Delta; the San Joaquin River contributes 10–15 percent of total inflows (SWRCB 1997). The cumulative flows of the Mokelumne and other east side rivers make up the balance of Delta inflows. Flows into the Delta vary greatly by water year type but on the average approximately 21 million acre-feet of water drains into the Delta each year (SWRCB 1997). Unimpaired monthly Delta outflows peak in March and drop off to their lowest levels in September. Development of water resources has greatly altered flow, resulting in significantly reduced spring peaks and higher flows in the late summer months. Flows are now regulated to maintain the 2 parts per thousand (ppt) isohaline (commonly referred to as X2) in Suisun Bay to prevent saltwater intrusion and benefit aquatic species.

The Delta is home to numerous species of aquatic plants and animals. Some of the fish species found in the Delta are migratory, using the Delta as a passage through which they move back and forth between Central Valley rivers and the ocean, while others spend their entire life there. Chinook salmon and striped bass are examples of anadromous, migratory species, while delta and longfin smelt are resident species.

3.5.2 Factors Affecting the Distribution and Abundance of Aquatic Resources in the San Joaquin River Basin and Bay/Delta Estuary

The aquatic resources of the San Joaquin River Basin and Delta are greatly reduced from their former status. The decline in distribution and abundance, and the causes of decline, have been documented extensively (SWRCB 1995b). This section will summarize the factors associated with the decline in fishery resources. These factors include: natural environmental variability; water development; introduction of non-native aquatic organisms; food supply limitations; harvest; pollution; and reservoir issues (DFG 1994; SFEP 1992a).

3.5.2.1 Natural Environmental Variability

The flow of fresh water to the San Joaquin River Basin and ultimately the Bay/Delta Estuary is primarily determined by the amount and timing of precipitation in the Central Valley watershed along with the rate of runoff generated by snowmelt. Just as total precipitation varies each year, the volume of water annually flowing through the basin will also vary. Inflows to the southern Delta from the San Joaquin River basin are measured at the USGS Vernalis gauging station. For planning and regulatory purposes, the SWRCB has developed a water year classification system that provides a relative estimate of the amount of water originating in the San Joaquin hydrologic basins from seasonal runoff and reservoir storage. The system has five types of water years: wet, above normal,
3. Affected Environment

below normal, dry, and critical. Table 3.5-2 shows the water year types for the San Joaquin River system for the period 1930–1997.
### 3. Affected Environment

**Table 3.5-2: WATER YEAR TYPES AND HISTORICAL SUMMARY FOR THE SAN JOAQUIN RIVER BASIN, 1930–1997**

<table>
<thead>
<tr>
<th>Water Year</th>
<th>Type</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
<td>1930</td>
<td>C</td>
<td>Lyons Reservoir on the Stanislaus River operational</td>
</tr>
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<td>1931</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>1932</td>
<td>AN</td>
<td></td>
</tr>
<tr>
<td>1933</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>1934</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>1935</td>
<td>AN</td>
<td></td>
</tr>
<tr>
<td>1936</td>
<td>AN</td>
<td></td>
</tr>
<tr>
<td>1937</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>1938</td>
<td>W</td>
<td>Hetch Hetchy Reservoir on the Tuolumne River operational</td>
</tr>
<tr>
<td>1939</td>
<td>D</td>
<td>Friant Dam construction begins</td>
</tr>
<tr>
<td>1940</td>
<td>AN</td>
<td></td>
</tr>
<tr>
<td>1941</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>1942</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>1943</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>1944</td>
<td>BN</td>
<td>Friant Dam is allowed to regulate San Joaquin River flow</td>
</tr>
<tr>
<td>1945</td>
<td>AB</td>
<td></td>
</tr>
<tr>
<td>1946</td>
<td>AB</td>
<td></td>
</tr>
<tr>
<td>1947</td>
<td>D</td>
<td>Friant Dam construction completed, Millerton Reservoir on the San Joaquin River operational</td>
</tr>
<tr>
<td>1948</td>
<td>BN</td>
<td></td>
</tr>
<tr>
<td>1949</td>
<td>BN</td>
<td></td>
</tr>
<tr>
<td>1950</td>
<td>BN</td>
<td>Redinger Reservoir on the San Joaquin River operational</td>
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<tr>
<td>1951</td>
<td>AN</td>
<td>Friant Dam begins full operation, USBR Tracy Pumping Plant</td>
</tr>
<tr>
<td>1952</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>1953</td>
<td>BN</td>
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</tr>
<tr>
<td>1954</td>
<td>BN</td>
<td>Thomas Edison Reservoir on the San Joaquin River operational</td>
</tr>
<tr>
<td>1955</td>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>
### 3. Affected Environment

W = Wet, AN = Above normal, BN = Below normal, D = Dry, C = Critical

#### Table 3.5-2: WATER YEAR TYPES AND HISTORICAL SUMMARY FOR THE SAN JOAQUIN RIVER BASIN, 1930–1997 (CONT.)

<table>
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<td>1956</td>
<td>W</td>
<td>Cherry Reservoir on the Tuolumne River operational</td>
</tr>
<tr>
<td>1957</td>
<td>BN</td>
<td>Beardsley, Tulloch, and Donnells reservoirs on the Stanislaus River operational</td>
</tr>
<tr>
<td>1958</td>
<td>W</td>
<td>Mammoth Pool Reservoir on the San Joaquin River operational, drought year</td>
</tr>
<tr>
<td>1959</td>
<td>D</td>
<td>Mammoth Pool Reservoir on the San Joaquin River operational, drought year</td>
</tr>
<tr>
<td>1960</td>
<td>C</td>
<td>Drought year</td>
</tr>
<tr>
<td>1961</td>
<td>C</td>
<td>State Water Rights Board adopted Water Rights Decision 990 approving water rights for the CVP</td>
</tr>
<tr>
<td>1962</td>
<td>BN</td>
<td></td>
</tr>
<tr>
<td>1963</td>
<td>AN</td>
<td></td>
</tr>
<tr>
<td>1964</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>1965</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>1966</td>
<td>BN</td>
<td>New Exchequer Dam on Merced operational</td>
</tr>
<tr>
<td>1967</td>
<td>W</td>
<td>Water Rights Decision 1275 approving water rights for the SWP including agricultural salinity standards. McSwain and McClure reservoirs on the Merced River operational</td>
</tr>
<tr>
<td>1968</td>
<td>D</td>
<td>Banks Pumping Plant operational</td>
</tr>
<tr>
<td>1969</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>AN</td>
<td>Merced River Fish Facility</td>
</tr>
<tr>
<td>1971</td>
<td>BN</td>
<td>D-1379 requiring SWP and CVP comment fish and wildlife use in additional to agricultural, municipal, and industry. Don Pedro Reservoir on the Tuolumne River operational</td>
</tr>
<tr>
<td>1972</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>1973</td>
<td>AN</td>
<td></td>
</tr>
<tr>
<td>1974</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>1975</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>1976</td>
<td>C</td>
<td>Drought year</td>
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### Table 3.5-2: WATER YEAR TYPES AND HISTORICAL SUMMARY FOR THE SAN JOAQUIN RIVER BASIN, 1930–1997 (CONT.)

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<td>1977</td>
<td>C</td>
<td>Drought year</td>
</tr>
<tr>
<td>1978</td>
<td>W</td>
<td>D-1485 requires DWR and USBR to meet Bay/Delta standards. New Melones Reservoir on the Stanislaus River operational.</td>
</tr>
<tr>
<td>1979</td>
<td>AN</td>
<td></td>
</tr>
<tr>
<td>1980</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>1981</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>1982</td>
<td>W</td>
<td></td>
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<td>AN</td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>1986</td>
<td>W</td>
<td>Federal/State Coordinated Operation Agreement for operation/export pumps is signed</td>
</tr>
<tr>
<td>1987</td>
<td>C</td>
<td>drought year</td>
</tr>
<tr>
<td>1988</td>
<td>C</td>
<td>drought year</td>
</tr>
<tr>
<td>1989</td>
<td>C</td>
<td>drought year</td>
</tr>
<tr>
<td>1990</td>
<td>C</td>
<td>Formation of San Joaquin River Management Plan Advisory Council, Spicer Meadows Reservoir on the Stanislaus River operational, drought year</td>
</tr>
<tr>
<td>1991</td>
<td>C</td>
<td>drought year</td>
</tr>
<tr>
<td>1992</td>
<td>C</td>
<td>drought year, CVPIA enacted, electric barrier on San Joaquin River</td>
</tr>
<tr>
<td>1993</td>
<td>W</td>
<td>NMFS Biological Opinion on winter run chinook salmon</td>
</tr>
<tr>
<td>1994</td>
<td>C</td>
<td>Bay/Delta Accord and the creation of CALFED Delta Smelt Biological Opinion by USFWS</td>
</tr>
<tr>
<td>1996</td>
<td>W</td>
<td>January flood, very dry spring</td>
</tr>
<tr>
<td>1997</td>
<td>W</td>
<td>El Niño</td>
</tr>
<tr>
<td>1998</td>
<td>W</td>
<td>El Niño</td>
</tr>
</tbody>
</table>
Variation in the amount of flow to the Bay/Delta Estuary is the most commonly cited factor controlling abundance, distribution, and reproductive success of many aquatic species in the project area (SWRCB 1995a; USBR 1997d). Drought and low flow conditions can have wide-ranging impacts on aquatic resources, depending on the species and life stage requirements. For many fish species, drought conditions can reduce the amount of habitat available, elevate water temperatures, reduce the food supply, increase susceptibility to predation, and degrade spawning and rearing habitats. Impaired habitat conditions result in reduced egg and young survivals for that year and a diminished year class in the adult population. The combination of floods and severe drought in the 1980s and 1990s contributed to, and accelerated the declines in populations of aquatic resources in the San Joaquin River Basin and the Bay/Delta Estuary (SWRCB 1995b).

Natural variability in the cycle of Pacific oceanic currents also may have contributed to the decline of some of the anadromous species. El Niño conditions disrupt the natural upwelling that occurs off the coast, reducing the amount of nutrients brought up from deep, nutrient rich strata of the ocean. Fewer nutrients result in greatly reduced plankton blooms and, therefore, less food for juvenile salmon and striped bass. While such natural variation is beyond the control of resource managers, these events accentuate and focus attention on the need to create robust aquatic ecological habitat so that essential species can survive the natural range of irregular geoclimatic conditions.

### 3.5.2.2 Water Development

Land reclamation projects and waterway modifications have caused major ecological changes throughout the San Joaquin River Basin and in the Delta. These practices have removed most of the seasonally-flooded wetlands on the valley floor and the tidal marshes in the Delta. The loss of wetland habitat greatly reduced the critical habitats for many riverine and delta species at all trophic levels, and has resulted in a significant reduction in population sizes, especially of those species that utilize shallow, back-water habitats, sloughs, or intertidal zones during all or part of their life cycle. Species that utilize flooded vegetation for spawning habitat, have either become extinct or greatly declined in abundance (CUWA 1994).

The progressive losses of habitat that have occurred throughout the Central Valley have reduced the ability of certain populations to rebound from natural and man-induced environmental changes. The following changes associated with water development have affected aquatic resources: alteration of seasonal flow regimes, diminished flow, modification of the entrapment zone location, export of water from the Delta, and modification and use of the Delta as a water conveyance facility.

The use of the Delta to convey water to South Delta export facilities (see Section 3.2) has played a particularly large role in modifying natural flow patterns. When export rates are high and Delta
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inflows are low, water from the central Delta and San Joaquin River is drawn into the channels that feed the CVP and SWP pumping plants. This net upstream flow of water toward the export pump is known as reverse flow. Reverse flows occur primarily in the south and central delta. The magnitude, duration, and extent of reverse flows varies with season, water year type, and stream inflow to the Delta. Reverse flows reportedly disorient anadromous fish as they migrate either upstream or downstream following the salinity gradient (SWRCB 1997). Reverse flows carry young fish into the central or southern Delta, where habitat may not be as good or where they may be more susceptible to entrainment (DWR 1992). Entainment losses also occur as a result of pumps used at many of the agricultural diversions found throughout the San Joaquin River Basin and Delta.

3.5.2.3 Introduced Species

The San Joaquin River Basin and the Bay/Delta Estuary is home to more than 150 introduced aquatic species of plants and animals. About 28 of these introduced species are non-native fish, and over 100 are non-native invertebrates (BDOC 1994). A list of the native and non-native fish species is presented in Table 3.5-1. Introduced species affect native species through a wide variety of mechanisms including competition for food and space, predation, habitat alteration, disturbance, hybridization, and acting as pathways for and sources of diseases (BDOC 1994).

3.5.2.4 Food Supply

Food supply can affect the abundances of aquatic organisms at all trophic levels. Food may be limited in various ways, including decreased availability of nutrients and decreased abundance and availability of food items. Orsi et al. (1996) reported a strong correlation between changes in the Delta food web base and the decline in the aquatic resources of the Bay/Delta Estuary. Dams, levees, enlarged river channels, and filling tidal wetlands have all reduced the loadings of land-derived detritus and dissolved organic carbon, which are primary nutrient sources for the lowest members of the food web (DWR 1994). These changes may affect the foraging success of fish species using the San Joaquin River Basin and Delta during all of parts of their life cycle.

3.5.2.5 Harvest

The legal harvest of various fish decreases the number of spawning adults and the average age of adults. The possibility of overharvesting is greatest for game species (e.g., striped bass, white sturgeon, chinook salmon). While current federal and state fisheries management regulations should prevent over fishing, even with full enforcement of these statutes, some species may be over harvested.

Management of salmon fisheries is complicated because of sport, commercial, and illegal fishing in the ocean, the presence of several regulatory agencies, and the support of populations by hatchery production. While ocean harvests of salmon substantially reduce spawning escapement, resource
3. Affected Environment

agencies maintain that harvests (legal or illegal) are not the principal limiting factor for salmon abundance. Similar to many other fisheries in decline around the globe, increased fishing efforts (despite hatchery production) would result in over harvesting of wild salmon stocks (DFG 1994), including those occurring within the San Joaquin Basin.

Over harvest of game species in reservoirs by sport fishing is controlled not only by regulations but also by stocking reservoirs on an annual basis or when fish populations begin to decline. Reservoirs rarely provide sufficient habitat quantity or quality for game fish species, and most game fish species in reservoirs are not considered to be part of self-sustaining populations.

3.5.2.6 Pollution

As urban, industrial, and agricultural activities expanded throughout the Central Valley watershed, pollutant loads and associated impacts on aquatic resources increased. By the early 1900s, pollution contributed to the decline in salmon, sturgeon, and striped bass commercial fisheries (SFEP 1992b). There is growing concern about non-urban runoff in the San Joaquin Basin watersheds, particularly the agricultural component (SFEP 1992b). Agricultural return flows, which contain pesticides, trace elements, and solvents, may contribute most of the flow of the San Joaquin River in the summer (SFEP 1991).

Recently, the dormant spray pesticide diazinon, which is applied to orchards in the winter, has been identified in the San Joaquin River at levels that are acutely toxic to some aquatic organisms. The elevated concentrations of pesticides in the river immediately followed rainfall events, when runoff from agricultural and urban areas is most pronounced (DWR 1994; SFEP 1992b). The pesticides can also result in chronic toxicity to aquatic fauna in the river. Secondary adverse impacts also can occur due to pesticide toxicity to zooplankton, resulting in malnutrition of the fish.

In addition to being a source of pesticides, agricultural return flows can increase the salinity of receiving waters to levels which adversely affect some aquatic species. This occurs in the lower San Joaquin River where striped bass spawning habitat is impacted as the result of a combination of saline agricultural return flows and reduced freshwater flows.

It is unlikely that pollution is the principal cause of the widespread declines in fishery resources over the last 20 years because of the major pollutant abatement actions that have occurred during that period (DFG 1994). But it is still reasonable to conclude that toxic pollutants have been, and continue to be, among the factors which contribute to the decline of many species, in spite of an increased awareness of pollution and its impact on the aquatic resources of the San Joaquin River Basin.

3.5.2.7 Reservoir Issues
The project area and vicinity include 36 reservoirs of various size. Table 3.5-3 summarizes the reservoirs by name, watershed, and principal species. The three major reservoirs in the project area
### 3. Affected Environment

#### Table 3.5-3: SAN JOAQUIN BASIN RESERVOIRS BY NAME, WATERSHED, AND PRINCIPAL SPECIES

<table>
<thead>
<tr>
<th>Reservoir Name/Date</th>
<th>Watershed</th>
<th>Principal Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beardsley Lake (1957)</td>
<td>Stanislaus River</td>
<td>rainbow trout, brown trout, and brook trout</td>
</tr>
<tr>
<td>Donnells Reservoir (1957)</td>
<td>Stanislaus River</td>
<td>rainbow trout, brown trout, and brook trout</td>
</tr>
<tr>
<td>Goodwin Reservoir (1912)</td>
<td>Stanislaus River</td>
<td>not known</td>
</tr>
<tr>
<td>Lake Alpine (1908)</td>
<td>Stanislaus River</td>
<td>rainbow trout</td>
</tr>
<tr>
<td>Lake Tulloch (1957)</td>
<td>Stanislaus River</td>
<td>rainbow trout, smallmouth bass, largemouth bass, bluegill, catfish, and crappie</td>
</tr>
<tr>
<td>Lyons Reservoir (1930)</td>
<td>Stanislaus River</td>
<td>not known</td>
</tr>
<tr>
<td>New Melones (1979)</td>
<td>Stanislaus River</td>
<td>rainbow trout, brown trout, largemouth bass, smallmouth bass, bluegill, catfish, and crappie</td>
</tr>
<tr>
<td>Pinecrest Lake (1916)</td>
<td>Stanislaus River</td>
<td>rainbow trout, brown trout, and brook trout</td>
</tr>
<tr>
<td>Relief (1910)</td>
<td>Stanislaus River</td>
<td>not known</td>
</tr>
<tr>
<td>Spicer Meadows Reservoir (1990)</td>
<td>Stanislaus River</td>
<td>rainbow trout, brook trout, brown trout, black bass, and channel catfish</td>
</tr>
<tr>
<td>Union Reservoir (1902)</td>
<td>Stanislaus River</td>
<td>rainbow trout, brook trout, brown trout, black bass, and channel catfish</td>
</tr>
<tr>
<td>Utica Reservoir (1910)</td>
<td>Stanislaus River</td>
<td>rainbow trout, brook trout, brown trout, black bass, and channel catfish</td>
</tr>
<tr>
<td>Eleanor Lake (1918)</td>
<td>Tuolumne River</td>
<td>not known</td>
</tr>
<tr>
<td>Hetchy Hetchy (1938)</td>
<td>Tuolumne River</td>
<td>not known</td>
</tr>
<tr>
<td>LaGrange (1893)</td>
<td>Tuolumne River</td>
<td>not known</td>
</tr>
<tr>
<td>Lloyd Lake (1956)</td>
<td>Tuolumne River</td>
<td>rainbow trout, brown trout, and brook trout</td>
</tr>
<tr>
<td>New Don Pedro (1971)</td>
<td>Tuolumne River</td>
<td>trout, catfish, bluegill, crappie, sunfishes, silver salmon, and black bass</td>
</tr>
<tr>
<td>Crocker-Huffman Dam (1910)</td>
<td>Merced River</td>
<td>not known</td>
</tr>
<tr>
<td>Lake McClure (1967)</td>
<td>Merced River</td>
<td>trout, salmon, catfish, bluegill, crappie, sunfishes, and black bass</td>
</tr>
<tr>
<td>Lake McSwain (1967)</td>
<td>Merced River</td>
<td>trout, salmon, catfish, bluegill, crappie, sunfishes, and black bass</td>
</tr>
<tr>
<td>Merced Falls (1910)</td>
<td>Merced River</td>
<td>not known</td>
</tr>
<tr>
<td>Bass Lake (1901)</td>
<td>San Joaquin River</td>
<td>rainbow trout, brown trout, catfish, bluegill, sunfishes, crappie, black bass, and kokanee salmon</td>
</tr>
<tr>
<td>Florence Lake (1925)</td>
<td>San Joaquin River</td>
<td>rainbow trout, brown trout, and brook trout</td>
</tr>
</tbody>
</table>
3. Affected Environment

Table 3.5-3: SAN JOAQUIN BASIN RESERVOIRS BY NAME, WATERSHED, AND PRINCIPAL SPECIES (CONT.)

<table>
<thead>
<tr>
<th>Reservoir Name/Date</th>
<th>Watershed</th>
<th>Principal Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huntington Lake (1913)</td>
<td>San Joaquin River</td>
<td>rainbow trout, brown trout, brook trout, kokanee salmon</td>
</tr>
<tr>
<td>Kerckhoff Reservoir (1920)</td>
<td>San Joaquin River</td>
<td>striped bass</td>
</tr>
<tr>
<td>Mammoth Pool Reservoir (1954)</td>
<td>San Joaquin River</td>
<td>rainbow trout, brown trout, and brook trout</td>
</tr>
<tr>
<td>Millerton Lake (1947)</td>
<td>San Joaquin River</td>
<td>spotted bass, largemouth bass, smallmouth bass, and catfish</td>
</tr>
<tr>
<td>Redinger Lake (1950)</td>
<td>San Joaquin River</td>
<td>striped bass</td>
</tr>
<tr>
<td>Salt Springs Reservoir (1882)</td>
<td>San Joaquin River</td>
<td>rainbow trout, brown trout, and brook trout</td>
</tr>
<tr>
<td>Shaver Lake (1927)</td>
<td>San Joaquin River</td>
<td>rainbow trout, brown trout, brook trout, largemouth bass, smallmouth bass, catfish</td>
</tr>
<tr>
<td>Thomas Edison Lake (1954)</td>
<td>San Joaquin River/Mokelumne River</td>
<td>rainbow trout, brown trout, and brook trout</td>
</tr>
<tr>
<td>San Luis Reservoir (1967)</td>
<td>California Aqueduct</td>
<td>catfish, bluegill, crappie, striped bass, black bass, sturgeon, and shad</td>
</tr>
</tbody>
</table>

References:


that regulate flow in the Stanislaus, Tuolumne, and Merced rivers are New Melones, New Don Pedro, and Lake McClure, respectively. Factors limiting optimal sport fishery development in the project area reservoirs include periodicity and magnitude of water level fluctuation, quality and extent of riparian habitat, over fishing, and bank erosion (Leidy and Meyers 1984). Water-level fluctuation is a direct result of reservoir management operation decisions that are designed to meet water user needs. Reservoirs in the project area are operated to store water during winter and spring and to release water in summer and fall to meet agricultural and other requirements. Surface water elevation fluctuations may exceed 20 feet annually depending on the reservoir, precipitation, and demand.
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Drawdowns directly affect reservoir productivity in several ways. As the reservoir surface elevation drops, the surface area decreases, reducing the areas of primary production and the living space of fish. The reduction in the extent of littoral area is the most adverse effect for nest building fish. Largemouth bass, crappie, and many other species tend to build nests and spawn in the littoral areas during the spring months, just as the reservoirs are being drawn down to provide water for other beneficial uses. The drawdown also affects temperature stratification, as well as mineral and gas distribution, thereby decreasing usable habitats for cold water fish such as trout. The drawdown also draws off plankton and small fish, and prevents stabilization of fish and invertebrate communities.

3.5.3 Indicator Species Population Trends

The San Joaquin River Basin, its associated tributaries and reservoirs, and the Delta contain approximately 58 species of native and non-native fish. Table 3.5-1 lists the species, the ecological zone(s) they inhabit, and any applicable designation of State or Federal status.

The fish species discussed in this report are considered indicator species because they are dominant within their habitat or have unique value to the ecosystem or regional economy due to their importance as a commercial or recreational target species. Three native species, the splittail, delta smelt, and longfin smelt, are included because of their decline over the last two decades. Sensitive fish species found in the San Joaquin River Basin are listed in Table 3.5-4. A complete listing of all Federal and State listed threatened and endangered species, including plants and animals, is found in Appendix D.

Table 3.5-4: SENSITIVE FISH SPECIES IN THE SAN JOAQUIN RIVER BASIN

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>State</th>
<th>Federal</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Acipenser medirostris</em></td>
<td>Green sturgeon</td>
<td>SSC</td>
<td></td>
</tr>
<tr>
<td><em>Hesperoleucus symmetricus</em></td>
<td>California roach</td>
<td>SSC</td>
<td></td>
</tr>
<tr>
<td><em>Hypomesus transpacificus</em></td>
<td>Delta smelt</td>
<td>ST</td>
<td>FT</td>
</tr>
<tr>
<td><em>Lampetra ayresi</em></td>
<td>River lamprey</td>
<td>SSC</td>
<td></td>
</tr>
<tr>
<td><em>Lampetra habsii</em></td>
<td>Kern brook lamprey</td>
<td>SSC</td>
<td></td>
</tr>
<tr>
<td><em>Mylopharodon conocephalus</em></td>
<td>Hardhead</td>
<td>SSC</td>
<td></td>
</tr>
<tr>
<td><em>Oncorhynchus tshawytscha</em></td>
<td>Fall-run chinook salmon</td>
<td>SSC</td>
<td>FPT</td>
</tr>
<tr>
<td><em>Oncorhynchus mykiss</em></td>
<td>Central Valley steelhead</td>
<td>SC</td>
<td>FT</td>
</tr>
<tr>
<td><em>Pogonichthys macrolepidotus</em></td>
<td>Splittail</td>
<td>SSC</td>
<td>FPT</td>
</tr>
</tbody>
</table>

STATE: ST=threatened, SC=candidate for listing, SSC=special concern.
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3.5.3.1 Chinook Salmon

Chinook salmon are an anadromous species that spend most of their adult life in open ocean waters and return to freshwater inland streams to spawn. As adult salmon migrate upstream, water must be cool enough and have sufficient dissolved oxygen to avoid stressing the fish. If these conditions are not met, adult fish may delay their migration (USFWS 1995b). Adult chinook salmon in the San Joaquin Basin typically spawn in upper reaches of the major tributaries. They select areas with gravel substrates and prefer loose, clean gravel about 1 to 4 inches in diameter, with preferred water depths ranging from 0.5 to 3.0 feet, and preferred water velocities of 1 to 3 feet per second (USFWS 1995b). For optimal development of embryos and survival of alevins (very young salmon with a yolk sac attached), water should contain high concentrations of dissolved oxygen and range in temperature from 41 to 55 degrees Fahrenheit (Vogel and Marine 1991 as cited in USFWS 1995b). Adult salmon typically do not feed while in freshwater, and all adult salmon die after spawning.

Fall-run chinook salmon in the San Joaquin Basin return to their natal streams to spawn from mid-October through December, with most spawning occurring in November. Eggs are fertilized and buried in gravels where they develop for a period of 40-60 days. After the eggs hatch, the alevins remain in the gravels for up to 30 days prior to emerging. Most salmon fry (young salmon with yolk sac absorbed) emerge from the gravels and rear in the streams from mid-January through March prior to emigrating back to the ocean as smolts from April through early June. In high flow years, fry may be displaced downstream or begin to migrate downstream earlier than in other years. For example, during the high flows of 1998, many fall-run fry emigrated from the San Joaquin tributaries to the lower San Joaquin River and Delta in January and February, according to the NMFS. Chinook salmon from the San Joaquin Basin spend two to four years maturing at sea before returning to spawn.

Four separate races of Central Valley chinook salmon have been identified: the fall, late-fall, winter, and spring runs, based on the timing of the upstream migration. Spring-run chinook salmon in the San Joaquin River Basin became extinct following the construction of impassible dams on major tributaries. Currently, the entire chinook salmon population in the San Joaquin River is made up of fall-run chinook salmon that spawn between October and December (USFWS 1995). Small numbers of spawners have been observed in the Tuolumne River as late as February. Although it has been suggested that these represent a distinct late-fall run, these late-fall salmon are more usually viewed as stragglers, or strays from other river systems (ORNL 1994; Yoshiyama and Moyle 1995).

San Joaquin fall-run chinook are usually regarded as forming a distinct stock, on the basis of geographical distribution and life-history timing. Evidence of genetic separation between Sacramento and San Joaquin fall chinook salmon is weak. Tag returns indicate straying from the Sacramento River system to the San Joaquin (USFWS 1996a). Mixing of genetic stocks has also
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occurred due to the initial use of Stanislaus River brood stock at the Merced River Fish Facility (MRFF), and the outplanting of MRFF-reared smolts and yearlings in the Stanislaus, Tuolumne, and San Joaquin rivers, and in the Delta (USFWS 1995a).

Population Trends

The annual spawning escapement of fall-run chinook salmon in the San Joaquin River basin has been estimated for most years since 1940, but early estimates are often incomplete and based on subjective methods (USBR 1986). Table 3.5-5 shows the estimated run sizes in each of the tributaries since 1940 (Ford 1997, personal communication). Methods for estimating the number of returning adults have improved over the last five decades, and the estimates show a pattern of cyclical returns, as indicated in Figure 3.5-2. Recent spawning escapement of chinook salmon in the Merced, Tuolumne, and Stanislaus rivers is highly variable. Higher returns are strongly correlated with above normal and wet water year types. Similarly, lower spawning escapements are correlated with normal, dry, and critically dry water years (USFWS 1995a). Very low spawning escapements since 1990 are related to recent drought conditions (1987–1992).

Low returns of fall-run chinook salmon to all three tributaries in the 1960s (Figure 3.5-2) were attributed to low San Joaquin River flows, flow reversals, and low dissolved oxygen levels in the lower San Joaquin River and south Delta channels. Nearly complete run failures occurred in 1962 and 1963. The failures appeared to be related to low spring flows in 1959, 1960, and 1961 rather than to fall migration conditions (Hallock et al. 1970). Similar run failures occurred in 1990 and 1991.

Causes of decline for chinook salmon populations have been attributed to: isolation from historical spawning areas; loss of habitat; impaired conditions for smolt emigration, including decreasing flows and increased water temperatures; legal and illegal harvest; introgression with hatchery stocks; presence of pesticides and agricultural chemicals; and entrainment of smolts in SWP/CVP water export system (USFWS 1995b). All the major rivers of the San Joaquin basin have dams at fairly low elevations which are impassable to salmon, preventing their migration into the tributary streams of the Sierra Nevada mountains.

In addition to physically blocking access to upstream habitat, the many dams and reservoirs in the basin have altered natural hydraulic regimes on the rivers, resulting in changes in river morphology, prevention of gravel recruitment, sedimentation of fines into the spawning gravels, and changes to seasonal patterns of flow and water temperatures (USFWS 1995).
Table 3.5-5: SAN JOAQUIN BASIN FALL-RUN CHINOOK SALMON ESCAPEMENT ESTIMATES (THOUSANDS), 1940-1996

<table>
<thead>
<tr>
<th>Year</th>
<th>Stanislaus</th>
<th>Tuolumne</th>
<th>Merced</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1940</td>
<td>3</td>
<td>122</td>
<td>1</td>
<td>126</td>
</tr>
<tr>
<td>1941</td>
<td>1</td>
<td>27</td>
<td>1</td>
<td>29</td>
</tr>
<tr>
<td>1942</td>
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<td>1946</td>
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<td></td>
<td>7</td>
</tr>
<tr>
<td>1952</td>
<td>10</td>
<td>10</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>1953</td>
<td>35</td>
<td>45</td>
<td>0.5</td>
<td>81.5</td>
</tr>
<tr>
<td>1954</td>
<td>22</td>
<td>40</td>
<td>4</td>
<td>66</td>
</tr>
<tr>
<td>1955</td>
<td>7</td>
<td>20</td>
<td></td>
<td>27</td>
</tr>
<tr>
<td>1956</td>
<td>5</td>
<td>6</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>1957</td>
<td>4</td>
<td>8</td>
<td>0.4</td>
<td>12.4</td>
</tr>
<tr>
<td>1958</td>
<td>6</td>
<td>32</td>
<td>0.5</td>
<td>38.5</td>
</tr>
<tr>
<td>1959</td>
<td>4</td>
<td>46</td>
<td>0.4</td>
<td>50.4</td>
</tr>
<tr>
<td>1960</td>
<td>8</td>
<td>45</td>
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### Table 3.5-5: SAN JOAQUIN BASIN FALL-RUN CHINOOK SALMON ESCAPEMENT ESTIMATES (THOUSANDS), 1940-1996 (CONT.)

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3. Affected Environment

ESCAPEMENT ESTIMATES (THOUSANDS), 1940-1996
(CONT.)

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<th>Tuolumne</th>
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Streamflow is an important factor affecting the productivity of the remaining habitat in the basin. Fall flows provide access to the spawning gravels and may be important in attracting returning spawners to the San Joaquin system. Spring flows may stimulate and transport migrating smolts out of the tributaries, provide suitable conditions for migrants in the San Joaquin River, and maintain acceptable water temperatures for juveniles (SWRCB 1995b). Increased flows for the benefit of salmon have been negotiated on the Stanislaus River, as part of the New Melones Interim Operation Plan, and on the Tuolumne River, as part of the re-evaluation of instream flows from the New Don Pedro Project by the Federal Energy Regulatory Commission (FERC). Increased flows are also being negotiated for the Merced River (CALFED 1997).

In-river gravel mining has left many large, deep pools in or adjacent to the tributaries. These pools provide habitat for salmon predators, particularly black bass, and are believed to be responsible for significant losses to out-migrating smolts (EA 1992). Some efforts are underway to isolate the pits or to restore the channel geometry (McBain and Trush 1998).

Additional factors leading to the decline of salmon populations include inadequate flow conditions during smolt emigration and adult immigration, and excessive water temperatures during spawning, incubation, and rearing life stages. Salmon migrating to and from the spawning tributaries must pass through the San Joaquin River upstream of the Delta. During the normal smolt emigration period, in low flow years, mean water temperatures in these reaches may exceed levels thought to be harmful to chinook salmon smolts. Stream temperatures are recorded at USGS and DWR gauging stations located in the San Joaquin Basin. In addition, the California Department of Fish and Game is compiling a database of stream temperatures from a series of thermographs (temperature recorders) located in each of the major tributaries (DFG 1995). TID and MID have compiled a database of their thermograph data for the Tuolumne River and San Joaquin River. Temperature models that show
3. Affected Environment

Predicted water temperatures under various flow conditions have also been developed, or are being developed, for each major tributary.

Other water quality problems which are potentially of concern for salmon include high salinities and low dissolved oxygen in the San Joaquin River and Delta (USFWS 1995a). Dissolved oxygen levels less than 5 ppm (parts per million) and water temperatures higher than 66°F near Stockton have been identified as the cause of delays in the migration of adult chinook salmon (Hallock et al. 1970). Improved waste water treatment facilities at Stockton and the installation of a physical barrier at the head of Old River in dry years, which directs San Joaquin flows down the mainstem of the San Joaquin River, appear to have benefited the returning adult salmon to some extent.

At low river flow, high diversion rates at the CVP/SWP export facilities increase the proportion of San Joaquin River flow drawn toward the pumps via the Old River branch of the San Joaquin. Most chinook salmon reaching the CVP/SWP export facilities in the south Delta are from the San Joaquin River Basin (USBR 1986). Juvenile salmon, diverted towards the central Delta, experience reduced survival due to increased emigration time, high water temperatures, predation, entrainment in unscreened agricultural diversions, and Delta export pumping.

Mark-recapture studies since 1985 demonstrated that chinook salmon smolts released in the San Joaquin River downstream of the head of Old River survived better than those released into Old River (DFG 1992a). Maximum survival benefits are expected as a result of reduced exports, increased San Joaquin flows at Vernalis, and a barrier at the head of Old River during the spring emigration period (USFWS 1993). The barrier prevents salmon smolts from entering the south delta and avoids the influence of the export pumps at the spring.

Short-term increases in freshwater flows are termed pulsed flows. Pulsed flows in the tributaries are intended to benefit salmon by providing cues for salmon that stimulate migratory behavior. In spring, pulse flows can trigger the emigration of smolts from the tributaries to the ocean. In the fall, pulse flows signal the upstream migration of adults and may aid adults in identifying their natal systems. Pulsed flows also increase turbidity, thereby reducing visibility and predation losses during smolt emigration (EA 1992).

Since 1970, the Merced River run has been sustained in part by production of yearling fall-run salmon at the Merced River Fish Hatchery (DFG 1987). Because of low flows on the Merced, there has been a tendency for returning adult salmon to stray into agricultural drainage ditches, especially at Mud and Salt sloughs, and lose the opportunity to spawn. In the fall of 1991, an estimated 35 percent of the San Joaquin River salmon strayed into westside canals (DFG 1993). Since 1992, electrical and physical barriers have been installed to keep the migrating adults in the Merced River and out of the sloughs.

3.5.3.2 Steelhead/Rainbow Trout
Steelhead/rainbow trout have a broad range of life history strategies that include strains that always emigrate to the ocean and other strains that generally do not. Strains that do emigrate to the sea are called steelhead, and strains that remain resident in freshwater are termed rainbow trout. Both adult steelhead and rainbow trout typically survive after spawning, though it is rare that adults will spawn more than twice. Adult steelhead are generally larger than adult rainbow trout.

Steelhead have a life history similar to salmon. The primary difference is that juveniles will remain in the tributaries for at least one year before smolting. The majority of the spawning for winter-run steelhead generally occurs in December. Steelhead eggs are deposited in gravels and hatch in 30-60 days. Fry generally emerge during April and May, and juvenile steelhead will spend 1–3 years in freshwater before emigrating to the ocean, where they will spend 2–4 years before returning to spawn. Adults that survive spawning return to the ocean from April through June. Juveniles will usually emigrate from November through May.

Historically, winter-run steelhead are the only race found in the Central Valley and are native to the Sacramento and San Joaquin River Basins (USBR 1997g). In the San Joaquin River Basin, steelhead populations have been reduced to remnant levels. However, there is some evidence of a distinct anadromous run of steelhead in the Stanislaus River. Large rainbow trout are present in the upper reaches, and juvenile rainbow trout showing signs of smolting are trapped in the lower reach during studies designed to sample emigration of salmon smolts. Genetic studies are underway to determine whether these fish are part of a reproducing steelhead population within the Stanislaus River, strays from another basin, or resident rainbow trout (CALFED 1997). Past monitoring efforts have been inconclusive in determining the presence or absence of steelhead populations in the Tuolumne and Merced rivers, or the San Joaquin River upstream of the Stanislaus River. Recently, Central Valley steelhead were listed by the Federal government as a threatened species (USFWS 1998).

Resident rainbow trout can be found in the San Joaquin River, its tributaries, the Delta, and San Joaquin Basin reservoirs, but in numbers that are greatly reduced from their historical abundance in those areas (Yoshiyama et al. 1996).

**Population Trends**

There are a variety of indications that self sustaining stocks of rainbow trout continue to exist in the San Joaquin River system. Evidence is not as clear, however, concerning steelhead. DFG records contain reference to a small population characterized as emigrating steelhead smolts that are captured at the DFG Kodiak trawl survey station at Mossdale on the lower San Joaquin River each year. A few ripe rainbow trout which could be large enough to be small steelhead enter the fish traps at the Merced River Fish Hatchery every year.
3. Affected Environment

There is some evidence of a distinct run of steelhead that may be using the Stanislaus river for spawning and rearing based on the presence of adult-sized rainbow trout in the upper part of the river and a small number of smolt-sized trout captured near the mouth of the river in 1996-1997 (Demko 1995).

3.5.3.3 Striped Bass

The striped bass (*Morone saxatilis*) is native to streams and bays of the Atlantic Coast. It was first introduced into the Bay/Delta Estuary in 1879. Within 10 years, this highly fecund and voracious predator was supporting a commercial fishery (SFEP 1992a).

California striped bass spend most of their life in the Bay/Delta Estuary and along the Pacific Coast, within a few miles north and south of the Golden Gate (DWR 1992). Landlocked populations of striped bass are also found in the Millerton and San Luis reservoirs.

Approximately one-half to two-thirds of bass spawning occurs in the Sacramento River system, while the remainder spawn in the Delta and the lower San Joaquin River below Vernalis (BDOC 1993). Important spawning areas include the area between Antioch Bridge and the mouth of Middle River in the San Joaquin River. Striped bass begin spawning in the Delta in spring, during April and May, when water temperatures reach about 60°F; most spawning occurs when water temperatures are between 61 and 69°F (BDOC 1993).

Striped bass spawn in fresh water where there is moderate to swift current. In slower currents, many eggs (which are slightly heavier than water) sink to the bottom and die (DFG 1993). The semi-buoyant striped bass eggs drift with river currents and are carried downstream. Larvae hatch two to three days after spawning. Initially, the larvae receive nourishment from the yolk sac, which is absorbed in five to ten days. As they move downstream toward the Delta, larvae begin feeding on small zooplankton. Upon reaching the western Delta, which is presently their primary rearing area, larvae are large enough to begin feeding on larger organisms such as the opossum shrimp (*Neomysis mercedis*). *Neomysis* remains the main food source until the striped bass reach their second year, when they become large enough to feed on bay shrimp and small forage fish. They reach maturity at 3–4 years of age and may live to 20–30 years of age. In recent years, most of the adult striped bass in the Bay/Delta system have been in the 4–7 year age classes. The older, more fecund fish, are no longer present in great numbers (DWR 1993c).

Population Trends

Beginning in 1982, the DFG stocked striped bass in the Estuary, largely as mitigation for various projects, in an effort to maintain the population. The stocking program was stopped in 1992 due to concerns that the effort was adding predators which might eat the endangered winter-run chinook salmon (BDOC 1994).
3. Affected Environment

The decline in young bass is predominately due to a decreased survival rate during the first year of life. Increased mortality of striped bass eggs and larvae is due to increased entrainment losses at the CVP and SWP export facilities and at agricultural pumps in the Delta (DFG 1992b; DWR 1992).

Losses to export and entrainment are affected by freshwater diversion, specifically by the proportion of water diverted for export and within-Delta use (Jassby et al. 1994). Higher outflows move a higher percentage of eggs and larvae away from potential entrainment, while diversions lead to higher percentages of entrainment of eggs and embryos (SFEP 1992a). Higher outflows may also shift the entrapment zone to a location downstream of the Delta, where larval striped bass appear to survive better (DWR 1992).

Measurements, dating back to 1959, indicate that young striped bass survival increases in proportion to Delta outflow during April through July. There is also evidence that Delta outflow continues to influence bass survival through December. The DFG’s statistical model for striped bass indicates that the survival of striped bass during their first year is directly correlated with the magnitudes of Delta outflow and State and Federal exports in the southern Delta, and that these first year conditions could determine subsequent abundance of adult bass (BDOC 1993). Besides reducing the likelihood of entrainment at diversions, higher outflows provide additional benefits for striped bass by increasing low salinity nursery habitat in Suisun Bay, increasing primary productivity (food supply), increasing turbidity (reduces predation on young), and diluting pollutants (SFEP 1992a).

Other factors contributed to the decline in abundance of striped bass are; food supply, competition with other species, toxicity, and illegal harvest.

3.5.3.4 Splittail

The splittail (*Pogonichthys macrolepidotus*), or Sacramento splittail as it was formerly named, is a large minnow endemic to the Bay/Delta Estuary and San Joaquin Basin. It is presently proposed for listing under the Federal Endangered Species Act as a threatened species. Once found throughout low elevation lakes and rivers of the Central Valley, from Redding to Fresno, this native species is now confined to the lower reaches of the Sacramento and San Joaquin rivers, the Delta, Suisun and Napa marshes, and tributaries of north San Pablo Bay. Although the splittail is generally considered a freshwater species, the adults and sub-adults have an unusually high tolerance for saline waters for a member of the minnow family. Therefore, the splittail is often considered an estuarine species.

The splittail, which has a high reproductive capacity, can live 5–7 years and generally begin spawning at 1–2 years of age. Spawning, which is triggered by increasing water temperatures and day length, occurs over beds of submerged vegetation in slow-moving stretches of water, such as flooded terrestrial areas and dead-end sloughs. Year class strength has been highly variable over the last decade, with particularly strong year classes associated with seasonally flooded wetlands that provide optimum spawning and larval rearing habitat. Adults spawn from March through May in
3. Affected Environment

sloughs of the Delta, Napa Marsh, Suisun Marsh and on the inundated floodplains of large rivers during wet years. Hatched larvae remain in shallow, weedy areas until they move to deeper offshore habitat later in the summer. Young splittail may occur in shallow and open waters of the Delta and San Pablo Bay, but they are particularly abundant in the northern and western Delta (DFG 1992c; DWR 1992).

Splittail are benthic foragers that feed extensively on opossum shrimp (*Neomysis mercedis*) and opportunistically on earthworms, clams, insect larvae, and other invertebrates. They are preyed upon primarily by striped bass.

**Population Trends**

Population levels appear to fluctuate widely from year to year, but since 1980 splittail numbers have declined steadily, reaching their lowest recorded numbers in 1994. The overall decline in splittail numbers can be attributed to a variety of factors including: modification of spawning habitat, changed estuarine hydraulics, climatic variation, toxic substances, introduced species, predation, and exploitation (NHI 1992b). Splittail have disappeared from much of their native range because dams, diversions, and agricultural development have eliminated or drastically altered much of the lowland habitat these fish once occupied. Splittail foraging and spawning habitat has been lost due to land reclamation activities (CUWA 1994; DFG 1992c). The construction of levees where flood waters formerly inundated low lands has prevented the splittail from moving into habitat critical for its spawning and early life history.

Successful reproduction is strongly associated with high outflows preceding, during, and following spawning, as demonstrated by high correlations between abundance of splittail in the fall mid-water trawl survey and various monthly combinations of Delta outflow from the previous winter through early summer (DFG 1992b). The strong correlation of the abundance of young Sacramento splittail with freshwater outflows during the late winter and spring accounts, in part, for the observed decline in juvenile production during the recent drought period (NHI 1992b; DFG 1992b; Hanson 1994).

3.5.3.5 Reservoir Species

The reservoirs of the San Joaquin Basin have a wide variety of fish species (Table 3.5-1). Reservoir communities of fish are highly stratified by preferred habitat. In general, reservoirs are less productive per surface acre than lakes because their typically deep, steep-sloped basins and fluctuating water levels greatly limit habitat diversity.

The exact species composition in any given reservoir varies. Commonly introduced species include game fish such as largemouth bass, bluegill, black crappie and brown bullhead. Native species present may include Sacramento sucker, hitch, and tui chub. Hatchery strains of rainbow trout along with hatchery strains of chinook and kokanee salmon are often introduced into larger reservoirs.
3. Affected Environment

Population Trends

Extensive draw down of reservoirs and fluctuating water levels are the primary causes of declines in reservoir fish species populations. Habitat quantity and quality are affected by reservoir operational practices during seasonal periods of irrigation, power generation, or reservoir recharge. However, reservoirs represent a highly managed ecosystem where naturally reproducing populations rarely exist and where most reservoir species populations are sustained by artificial means.

3.5.3.6 Delta Smelt

The delta smelt (*Hypomesus transpacificus*) is a small, short-lived, native fish which is found only in the Bay/Delta. Typical adults are nearly transparent and generally only 2–3 inches long. They formerly were one of the most abundant species in the Delta. Delta smelt tend to school in open waters adjacent to areas with aquatic vegetation (DWR 1992; SFEP 1992a). Delta smelt have been found as far upstream as Mossdale, on the San Joaquin River. Their normal downstream limit appears to be western Suisun Bay. Although, during periods of high outflow, they can be washed into San Pablo and San Francisco bays, they do not establish permanent populations there (SFEP 1992a). They usually inhabit the upper portion of the water column near the interface between intruding water from San Francisco Bay and water flowing out of the estuary (entrainment zone), where salinities range from 2 to 10 ppt (DFG 1992d).

Delta smelt typically live only one year and have low fecundity (SFEP 1992a). The location of delta smelt spawning varies from year to year, ranging from the lower San Joaquin and Sacramento rivers out to Suisun Marsh (DFG 1992d; USFWS 1994a). Though delta smelt larvae may be found almost anywhere in the Delta, they generally do not spawn in abundance in the southern Delta. Based on ongoing sampling programs, it appears that a significant portion of delta smelt spawning takes place in the northern and western Delta (DWR 1992).

The spawning season also varies from year to year and may occur from late winter (December) to early summer (July). In 1989 and 1990, peak spawning occurred in late-April and early-May (USFWS 1994a). The adhesive eggs descend through the water column and attach to submerged substrates such as tree roots, vegetation, and gravel (DFG 1992d). After hatching, the planktonic larvae are transported downstream to the entrainment zone where they feed on zooplankton (USFWS 1994b).

Population Trends

Information from independent data sets have demonstrated a dramatic decline in the delta smelt population, with particularly low levels since 1983 (DFG 1994). The exact timing of the decline is different in most of the sampling programs but falls between 1982 and 1985 (SFEP 1992a).
3. Affected Environment

delta smelt was listed as a Federal threatened species by the USFWS in March 1993 and as a State threatened species by the DFG in December 1993.

Declines in delta smelt have been attributed primarily to restricted habitat and increased entrainment losses at Delta export facilities and diversions (DWR 1992; SFEP 1992a; USFWS 1994b). Reductions in available habitat occur when the entrapment zone moves out of the productive shallows of Suisun Bay and into the channels of the lower Sacramento and San Joaquin rivers as a result of low Delta outflow. The movement of the entrapment zone to the river channels potentially decreases the amount of area that can be occupied by smelt, and may also result in decreased production of phytoplankton and zooplankton (SFEP 1992a). When low flows result in movement of the entrapment zone into the central Delta, the delta smelt become more vulnerable to entrainment by the pumps of the SWP and the CVP, as well as by local agricultural riparian pumps (DWR 1992; NHI 1992a; SFEP 1992a).

The decline in delta smelt coincides with increases in the proportion of water diverted upstream of and within the Delta in recent years. Since 1984, the proportion of the water diverted at the export pumps from October through March has been higher, and has stayed higher for longer periods of time, than during any previous period, including the severe 1976–1977 drought. In order to avoid the effects of reversed flows, it is believed that higher Delta outflows are needed during February-June to transport larval and juvenile delta smelt into low salinity, productive rearing habitat in Suisun Bay and Suisun Marsh (USFWS 1994a).

Other contributing factors to the decline in the delta smelt population include: the presence of toxic compounds in the water, displacement of native copepods by introduced species, invasion of the Bay/Delta Estuary by the Asian clam (Potamocorbula amurensis), predation, very high floodflows, and low spawning stock (DFG 1992d, SFEP 1992a, USFWS 1994a).

The 1995 U.S. Fish and Wildlife Service (USFWS) Biological Opinion on the delta smelt called for a variety of measures to protect this species, including an intensified sampling program for all life stages. These surveys provide data on the distribution of eggs, larvae, and adults so that action can be taken to help move the smelt away from the zone of pump influence in the central and southern Delta. In addition, limits have been set for incidental take of delta smelt at the pumps and Federal/State sampling programs. When excessive numbers of delta smelt are taken, export and sampling operations must be reduced to conform to agreed limits, as occurred in 1997. Investigations of the delta smelt population have continued, and the species remains listed as threatened by state and federal agencies.

3.5.3.7 Longfin Smelt

The longfin smelt (Spirinchus thaleichthys) is a small, planktivorous fish that is found in several Pacific Coast estuaries from San Francisco Bay to Prince William Sound, Alaska. Within California,
3. Affected Environment

Longfin smelt have been reported in Humboldt Bay and the mouth of the Eel River, but the largest population inhabits the Bay/Delta Estuary. Longfin smelt can tolerate salinities ranging from fresh water to sea water. Spawning occurs in fresh to brackish water over sandy-gravel substrates, rocks, or aquatic vegetation. In the Bay/Delta Estuary, the longfin smelt life cycle begins with spawning in the lower Sacramento and San Joaquin rivers, the Delta, and freshwater portions of Suisun Bay. Spawning may take place as early as November and extend into June, with the peak spawning period occurring from February to April.

The eggs are adhesive and, after hatching, the larvae are carried downstream by freshwater outflow to nursery areas in the lower Delta, and Suisun and San Pablo bays (Wang 1991; DFG 1992b). Longfin smelt form a gas bladder shortly after hatching which keeps them near the surface as they migrate downstream past the entrapment zone, and into the more saline waters of San Pablo and San Francisco bays. This is in contrast to the delta smelt, which does not form a gas bladder until several months after hatching. The lack of a gas bladder keeps delta smelt near the bottom and on the freshwater side of the entrapment zone. Adult longfin smelt are found mainly in Suisun, San Pablo, and San Francisco bays, although their distribution shifts upstream during years of low outflow.

Although both longfin and delta smelt spawn adhesive eggs in river channels of the eastern Delta, and have larvae that are carried to nursery areas by freshwater outflow, the two species differ substantially. Consistently, a measurable portion of the longfin smelt population survives into a second year. During the second year of life, they inhabit San Francisco Bay and, occasionally, the Gulf of the Farallones; thus, longfin smelt are often considered anadromous. Longfin smelt are also more broadly distributed throughout the Estuary and are found at higher salinities than are delta smelt.

Because longfin smelt seldom occur in fresh water except to spawn, but are widely dispersed in brackish waters of the Bay, their range formerly extended as far up into the Delta as salt water intruded. The easternmost catch of longfin smelt in fall mid-water trawl samples has been at Medford Island in the central Delta. Utilization of different water depth is a pronounced difference between the two species in their region of overlap in Suisun Bay.

The main food of longfin smelt is the opossum shrimp, *Neomysis mercedis*, although copepods and other crustaceans are important at times, especially to small fish. Longfin smelt, in turn, are eaten by a variety of predatory fishes, birds, and marine mammals.

Population Trends

Longfin smelt were once one of the most common fish in the Sacramento-San Joaquin estuary. Their abundance has fluctuated widely in the past, reaching their lowest levels during drought years but quickly recovering when adequate winter and spring flows were available. Since 1982, longfin smelt abundance has plummeted and remained at record low numbers. Their numbers also have
declined in relative abundance to other fishes, dropping from first or second in abundance in most trawl surveys during the 1960s and 1970s, to being seventh or eighth in abundance.

The potential causes of decline are multiple and synergistic including: reduction in outflows, entrainment losses to water diversions, climatic variation, toxic substances, predation, and introduced species. Though longfin smelt have declined significantly in the last two decades, a petition to list them under the Federal Endangered Species Act was rejected by the USFWS in 1994 (USFWS 1994b). Currently the longfin smelt is listed as a Federal and State species of special concern.

3.5.4 Summary

Aquatic resources in the San Joaquin River Basin and Delta are varied and form complex interactions of species assemblages and habitats. Water development projects, the introduction of non-native species, and the creation of dams and large reservoirs over the past century have dramatically altered the habitats and reduced the abundance and distribution of many fish species.

By characterizing the ecological habitats and the factors affecting the recovery of these species within the project area, the potential impacts of the project can be evaluated. Specific habitats, such as spawning, rearing, and those used for migration of anadromous species have been identified as being vital to the species of prime importance and those which are considered indicators of a functional ecosystem. Factors identified as manageable and that contribute to the overall ability of a species to recover include habitat restoration, streamflow, and water quality.
# 3. Affected Environment

## 3.5 AQUATIC RESOURCES

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</table>
3. Affected Environment

3.6 LAND USES

This chapter describes existing land uses and related socioeconomic conditions in the San Joaquin Valley project area and vicinity with comparisons to other geographic areas as appropriate. The affected environment is the socioeconomic context in which the alternative actions to provide additional water for instream flows occurs. The primary issue for the subsequent impact analyses in Section 4.6 is the potential for the alternative actions to affect agricultural activity and land use. In this section, population data are presented for the counties and cities comprising the project area, including population density. Employment in the agricultural industry spotlights the significance of agriculture to the regional economy. This is followed by a discussion of land uses in the project area focusing on agriculture, the primary land use.

3.6.1 Socioeconomic Environment

The boundaries of 14 counties are partially or wholly within the entire San Joaquin River basin. Of these, seven contain the major facilities and irrigation districts associated with the no action, proposed action, and other alternative action; these are used to represent the San Joaquin River project area and vicinity. An eighth county, Calaveras, contains part of the New Melones and Tulloch Reservoirs because the Calaveras/Tuolumne county boundary runs through the reservoirs. Calaveras County is not included in the tables in this section because it covers an extensive area unrelated to the alternatives. Tuloumne County covers portions of these reservoirs and all of New Don Pedro Reservoir, while all of Lake McClure is located in Mariposa County.

The districts who are willing sellers have service areas that are located in the following counties (see Figure 3.1-1):

- Exchange Contractors Water Authority: Fresno, Merced, Madera, Stanislaus counties
- Oakdale Irrigation District: San Joaquin and Stanislaus counties
- South San Joaquin Irrigation District: San Joaquin County
- Modesto Irrigation District: Stanislaus County
- Turlock Irrigation District: Stanislaus and Merced counties
- Merced Irrigation District: Merced County

Either these seven counties or other geographic approximations of the project area are used to describe the affected rural environment, depending on the availability of information. The other geographic areas used are:

- Reclamation’s San Joaquin River Region comprised of eight counties and used in the 1997 Draft PEIS on the CVPIA (USBR 1997d), and
- San Joaquin River Region as described in the 1998 Draft PEIS/EIR (CALFED 1998).

These two regions are explained further in the text the first time each is used. For information on poverty and ethnicity, see Section 3.11, Environmental Justice.
3. Affected Environment

3.6.1.1 Population

The total county population and recent growth in the San Joaquin River project area and vicinity (Table 3.6-1) document that growth for the area since the 1990 Census was 106,162 people or 5.2 percent, which is close to the rate of growth in the state as a whole. Both Fresno and Madera counties have higher growth rates, 6.7 percent and 6.8 percent respectively, which reflect more rapid urbanization here than in many other counties in California.

Table 3.6-1: POPULATION GROWTH, 1990-1998

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresno</td>
<td>786,800</td>
<td>737,289</td>
<td>49,511</td>
<td>6.7</td>
</tr>
<tr>
<td>Madera</td>
<td>114,300</td>
<td>107,004</td>
<td>7,296</td>
<td>6.8</td>
</tr>
<tr>
<td>Mariposa</td>
<td>16,150</td>
<td>15,772</td>
<td>378</td>
<td>2.4</td>
</tr>
<tr>
<td>Merced</td>
<td>204,400</td>
<td>194,407</td>
<td>9,993</td>
<td>5.1</td>
</tr>
<tr>
<td>San Joaquin</td>
<td>545,200</td>
<td>523,969</td>
<td>21,231</td>
<td>4.1</td>
</tr>
<tr>
<td>Stanislaus</td>
<td>427,600</td>
<td>410,870</td>
<td>16,730</td>
<td>3.9</td>
</tr>
<tr>
<td>Tuolumne</td>
<td>52,800</td>
<td>51,777</td>
<td>1,023</td>
<td>2.0</td>
</tr>
<tr>
<td>San Joaquin River Area</td>
<td>2,147,250</td>
<td>2,041,088</td>
<td>106,162</td>
<td>5.2</td>
</tr>
<tr>
<td>State</td>
<td>33,252,000</td>
<td>31,589,153</td>
<td>1,662,847</td>
<td>5.3</td>
</tr>
</tbody>
</table>

Sources:
*California Department of Finance, Demographic Research Unit, City/County Population Estimates, May 1998.
**Hall and Gaquin, 1997 City and County Extra, pp. 66-67.

The centers of municipal and industrial land use in the San Joaquin River project area and vicinity include the cities of Fresno, Stockton, Modesto, and Merced. The cities of Stockton and Tracy have grown recently, largely in response to job development and housing constraints in the nearby San Francisco Bay Area. Fresno continues to be the major municipal and industrial center of the San Joaquin Valley (USBR 1997d), and it contains 19 percent of the San Joaquin River Area’s 1998 population. Table 3.6-2 contains the 1998 population totals for the major cities located within the seven San Joaquin River project area counties.

Table 3.6-2: CITY POPULATIONS, 1998

<table>
<thead>
<tr>
<th>City</th>
<th>County</th>
<th>Total Population January 1, 1998</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresno</td>
<td>Fresno</td>
<td>411,600</td>
</tr>
<tr>
<td>Clovis</td>
<td>Fresno</td>
<td>67,700</td>
</tr>
<tr>
<td>Madera</td>
<td>Madera</td>
<td>36,350</td>
</tr>
<tr>
<td>Merced</td>
<td>Merced</td>
<td>62,100</td>
</tr>
<tr>
<td>Lodi</td>
<td>San Joaquin</td>
<td>55,700</td>
</tr>
<tr>
<td>Los Banos</td>
<td>Merced</td>
<td>21,400</td>
</tr>
<tr>
<td>Manteca</td>
<td>San Joaquin</td>
<td>47,100</td>
</tr>
<tr>
<td>Stockton</td>
<td>San Joaquin</td>
<td>241,100</td>
</tr>
<tr>
<td>Tracy</td>
<td>San Joaquin</td>
<td>47,550</td>
</tr>
<tr>
<td>Modesto</td>
<td>Stanislaus</td>
<td>182,700</td>
</tr>
<tr>
<td>Turlock</td>
<td>Stanislaus</td>
<td>50,900</td>
</tr>
</tbody>
</table>
3. Affected Environment

Source: California Department of Finance, Demographic Research Unit, City/County Population Estimates, May 1998.

3.6.1.2 Population Density

Although the project area contains major cities (Table 3.6-2), it also contains substantial nonurbanized or rural land which reduces overall population density. The San Joaquin River area’s population density rounded to the nearest person is 50 persons per square kilometer (sq km), which is 39 percent less dense than the state as a whole with 82 persons per sq km (Table 3.6-3). San Joaquin County’s population density is the highest in part because the land area excludes portions in the Delta usually covered by water.

<table>
<thead>
<tr>
<th>County</th>
<th>Land Area (sq km)*</th>
<th>Total Population** January 1, 1998</th>
<th>Population Density (persons/sq km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresno</td>
<td>15,445</td>
<td>786,800</td>
<td>51</td>
</tr>
<tr>
<td>Madera</td>
<td>5,539</td>
<td>114,300</td>
<td>21</td>
</tr>
<tr>
<td>Mariposa</td>
<td>3,759</td>
<td>16,150</td>
<td>4</td>
</tr>
<tr>
<td>Merced</td>
<td>4,996</td>
<td>204,400</td>
<td>41</td>
</tr>
<tr>
<td>San Joaquin</td>
<td>3,625</td>
<td>545,200</td>
<td>150</td>
</tr>
<tr>
<td>Stanislaus</td>
<td>3,871</td>
<td>427,600</td>
<td>110</td>
</tr>
<tr>
<td>Tuolumne</td>
<td>5,790</td>
<td>52,800</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total Region</strong></td>
<td>43,025</td>
<td>2,147,250</td>
<td>50</td>
</tr>
<tr>
<td><strong>State</strong></td>
<td>403,970</td>
<td>33,252,000</td>
<td>82</td>
</tr>
</tbody>
</table>

Sources:
*Hall and Gaguin, 1997 County and City Extra, pp. 2, 66.
**California Department of Finance, Demographic Research Unit, City/County Population Estimates, May 1998.

3.6.1.3 Employment

As reported by Reclamation in the Draft PEIS on the CVPIA, the San Joaquin River Region is comprised of eight counties: Calaveras, Fresno, Madera, Mariposa, Merced, San Joaquin, Stanislaus, and Tuolumne counties (USBR 1997d). This region is slightly larger than the San Joaquin River area project and vicinity discussed above which excludes Calaveras County (population 37,100 for January 1, 1998). Employment in the San Joaquin River Region is described in Technical Appendix, Volume 5 and summarized here (USBR 1997i).

In 1940, agriculture was the largest single employer out of the following industry sectors: agriculture, mining, construction, manufacturing, transportation/communications/utilities, trade,
3. Affected Environment

finance/insurance/real estate, services, and government. At that time, agricultural production provided 34.9 percent of total household employment in the region. By 1992, agricultural production provided only 8.3 percent of total wage and salary employment in the area or about 56,000 jobs. Currently, the largest proportions of wage and salary jobs in the region are in services, wholesale and retail trade, and government sectors, respectively (USBR 1997i).
3. Affected Environment

More recent data on agricultural wage and salary employment is available from the California Employment Development Department (EDD 1998). Table 3.6-4 presents the average employment during March 1996, with March used as a benchmark since agricultural employment peaks during the period May through September with short term and migrant labor. Total agricultural wage and salary employment in the seven county San Joaquin River area averaged 118,290 jobs or nearly 15 percent of all wage and salary jobs in the region. In contrast, only 3 percent of all the jobs in the state were in agriculture in 1996. About 25 percent of the state’s farm employment of 408,300 is located in the San Joaquin River area. Wage and salary workers are all employees receiving compensation from agricultural employers, both production workers and other staff not involved in production.

Table 3.6-4: ANNUAL AVERAGE INDUSTRY EMPLOYMENT, MARCH 1996 BENCHMARK

<table>
<thead>
<tr>
<th>County</th>
<th>Total Employment All Industries</th>
<th>Farm Employment</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>Production</td>
<td>Services</td>
</tr>
<tr>
<td>Fresno</td>
<td>312,700</td>
<td>65,900</td>
<td>25,800</td>
<td>40,100</td>
</tr>
<tr>
<td>Madera</td>
<td>33,880</td>
<td>10,010</td>
<td>5,180</td>
<td>4,830</td>
</tr>
<tr>
<td>Mariposa</td>
<td>5,210</td>
<td>30</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Merced</td>
<td>58,700</td>
<td>11,000</td>
<td>7,500</td>
<td>3,500</td>
</tr>
<tr>
<td>Stockton-Lodi MSA¹ (San Joaquin County)</td>
<td>179,500</td>
<td>16,000</td>
<td>10,600</td>
<td>5,400</td>
</tr>
<tr>
<td>Modesto MSA¹ (Stanislaus County)</td>
<td>143,000</td>
<td>15,200</td>
<td>8,800</td>
<td>6,400</td>
</tr>
<tr>
<td>Tuolumne</td>
<td>14,060</td>
<td>150</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>San Joaquin River Area</td>
<td>747,050</td>
<td>118,290</td>
<td>57,880</td>
<td>60,230</td>
</tr>
<tr>
<td>State</td>
<td>13,151,700</td>
<td>408,300</td>
<td>225,700</td>
<td>182,600</td>
</tr>
</tbody>
</table>

NA = Data not available.
¹1990 Census Metropolitan Statistical Area
3. Affected Environment

3.6.2 Land Uses

The following discussion of land uses refers to other geographic areas that approximate the San Joaquin River project area and vicinity. These areas are defined in the text as appropriate.

3.6.2.1 General Land Uses

Land use within the San Joaquin River Region (i.e., CALFED’s San Joaquin and Tulare Lake hydrologic basins) consists largely of agriculture, particularly in the western portion of the San Joaquin River basin. The foothills of the Sierra Nevada range, located in the eastern portion of the basin is largely open space. Watershed lands, such as the Merced River watershed, contain forest resources at the higher elevations: ponderosa pine, sugar pine, Douglas fir, white fir, incense cedar, black cottonwood, black oak, broad-leaf maple, and California dogwood (Storer and Usinger 1963).

In 1990, urban land use was approximately 295,000 acres (CALFED 1998). Urban areas include the cities of Stockton, Modesto, Merced, and Tracy, as well as smaller communities such as Lodi, Galt, Madera, and Manteca. The western side of the region is sparsely populated. Small farming communities, all along Highway 33, provide services for farms and ranches in the area. CALFED reports that about 4,750,000 acres of important farmland were mapped in the San Joaquin River Region in 1994, excluding the legal Delta portion of San Joaquin County (CALFED 1998).

San Joaquin River

The San Joaquin River flows through an extensive area in the eastern San Joaquin Valley including the counties of San Joaquin, Stanislaus, Merced, and Fresno. In the upper reaches of the project area, it flows through San Luis and Kesterson National Wildlife Refuges. It runs though rural residential and agricultural areas until it enters the Delta near the community of Vernalis, below the confluence with the Stanislaus River.

Stanislaus River

Upstream of Knight’s Ferry, the Stanislaus River is the boundary between Calaveras and Tuolumne counties which splits New Melones and Tulloch Reservoirs. Predominant land use within the Stanislaus County portion of the Stanislaus River watershed is agriculture. As the Stanislaus River passes through the city of Oakdale, land uses consist of urban uses including commercial and residential. In the San Joaquin County portion of the watershed, land uses are primarily agriculture and open space. The community of Ripon is located within the lower reaches of the watershed.
3. Affected Environment

Tuolumne River

Land use in the Tuolumne River watershed is primarily agriculture. Urban land uses in the lower reaches of the Tuolumne River watershed include the city of Modesto and the communities of Waterford and Ceres.

Merced River

Land use in the Merced River watershed is primarily open space (foothill pasture) within the upper reaches, and agriculture in the lower reaches. A few rural communities are located within the watershed with the largest being the town of Livingston.

3.6.2.2 Agricultural Land Use

The San Joaquin River Region is located in Central Valley and includes the San Joaquin and the Tulare Lake hydrologic basins. Statistically, CALFED’s San Joaquin River Region is comprised of the following counties: Fresno, Kern, King, Madera, Merced, 54 percent of San Joaquin, Stanislaus, and Tulare. The Tulare Lake area is in King County and is, therefore, within the San Joaquin River Region. This area is an important agricultural region for both California and the United States. California has one of the most diversified economies in the world, producing more than 250 crop and livestock commodities. The San Joaquin River Region encompasses approximately 64 percent of farmland in the Central Valley (CALFED 1998).

The importance of agricultural land in the San Joaquin River project area and vicinity (seven counties) is shown in Table 3.6-5 which provides information on land devoted to agriculture: land in farms, cropland, and irrigated acreage. The San Joaquin River area contains 5,391,000 acres of farmland as of 1992. This acreage represents nearly 51 percent of the total land area in the seven counties (10,631,331 total acres) and nearly 19 percent of the total farmland in California. Irrigated acreage in the San Joaquin River area was 2,511,000 acres, over 46 percent of the area’s total farmland, which is substantially higher than the 26 percent irrigated farmland for the state.

<table>
<thead>
<tr>
<th>County</th>
<th>Total Land in Farms (1,000 acres)</th>
<th>Total Cropland (1,000 acres)</th>
<th>Total Irrigated Acreage (1,000 acres)</th>
<th>Percent Irrigated Farmland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresno</td>
<td>1,775</td>
<td>1,208</td>
<td>999</td>
<td>56.3</td>
</tr>
</tbody>
</table>

Table 3.6-5: AGRICULTURAL LAND AND IRRIGATED ACREAGE, 1992
3. Affected Environment

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Madera</td>
<td>749</td>
<td>322</td>
<td>276</td>
<td>36.8</td>
</tr>
<tr>
<td>Mariposa</td>
<td>206</td>
<td>17</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Merced</td>
<td>979</td>
<td>534</td>
<td>428</td>
<td>54.6</td>
</tr>
<tr>
<td>San Joaquin</td>
<td>784</td>
<td>556</td>
<td>468</td>
<td>59.7</td>
</tr>
<tr>
<td>Stanislaus</td>
<td>760</td>
<td>372</td>
<td>334</td>
<td>43.9</td>
</tr>
<tr>
<td>Tuolumne</td>
<td>138</td>
<td>11</td>
<td>5</td>
<td>3.6</td>
</tr>
<tr>
<td>San Joaquin River Area</td>
<td>5,391</td>
<td>3,202</td>
<td>2,511</td>
<td>46.6</td>
</tr>
<tr>
<td><strong>State Total</strong></td>
<td><strong>28,979</strong></td>
<td><strong>10,479</strong></td>
<td><strong>7,571</strong></td>
<td><strong>26.1</strong></td>
</tr>
</tbody>
</table>

Source: Hall and Gaquin, *1997 City and County Extra*, pp 13, 74-75.

California leads all other states in the value of crops produced, and Central Valley crops, which account for about 10 percent of total U.S. market value of agricultural crops, are responsible for most of this production (USBR 1997d). In the San Joaquin River Region, fruit and nuts, vegetables and cotton account for approximately 50 percent, 20 percent, and 10 percent respectively of the total value of crop production (CALFED 1998).

Cotton is the number one crop in the CALFED San Joaquin River Region in terms of irrigated/harvested acres. It accounts for 25 percent of the region’s total irrigated acres. Other important crops in the region are field crops (15 percent), orchards (13 percent), grapes (10 percent), and alfalfa (10 percent). Between 1986 and 1995, grapes and orchards together accounted for less than 25 percent of the total harvest acreage, but they produced about 50 percent of the total production value. Pasture, alfalfa, grains, and field crops produced less than 20 percent of total production value with more than 50 percent of total irrigated acres. Table 3.6-6 presents this irrigated acreage by crop category and the production value of that acreage (CALFED 1998).
### Table 3.6-6: IRRIGATED ACRES AND PRODUCTION VALUE IN THE SAN JOAQUIN RIVER REGION, 1986 TO 1995

<table>
<thead>
<tr>
<th>Crop Category</th>
<th>Irrigated Acres (1,000 acres)</th>
<th>Production Value (million dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasture</td>
<td>290</td>
<td>34</td>
</tr>
<tr>
<td>Rice</td>
<td>527</td>
<td>374</td>
</tr>
<tr>
<td>Truck crops</td>
<td>51</td>
<td>54</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>786</td>
<td>532</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td>Sugar beets</td>
<td>301</td>
<td>982</td>
</tr>
<tr>
<td>Field crops</td>
<td>180</td>
<td>433</td>
</tr>
<tr>
<td>Orchards</td>
<td>668</td>
<td>2,074</td>
</tr>
<tr>
<td>Grains</td>
<td>344</td>
<td>103</td>
</tr>
<tr>
<td>Grapes</td>
<td>507</td>
<td>1,681</td>
</tr>
<tr>
<td>Cotton</td>
<td>1,269</td>
<td>1,153</td>
</tr>
<tr>
<td>Subtropical orchards</td>
<td>221</td>
<td>973</td>
</tr>
<tr>
<td>Total</td>
<td>5,162</td>
<td>8,403</td>
</tr>
</tbody>
</table>


Agriculture in the CALFED San Joaquin River Region receives irrigation water from the CVP, the SWP, local water rights and water projects, and groundwater as shown in Table 3.6-7. Most of this water is delivered to farmers through irrigation districts and other water agencies (CALFED 1988). About 40 percent of irrigation water sources in the San Joaquin River Region are from local water rights or local water projects. CVP water provides 35 percent of total irrigation water uses, mostly to the Westlands Water District, which is south of the project area. The rest of the region’s water is from the SWP and groundwater pumping (CALFED 1998).
3. Affected Environment

Table 3.6-7: IRRIGATION APPLIED WATER USE IN THE
SAN JOAQUIN RIVER REGION, 1985 TO 1990

<table>
<thead>
<tr>
<th>Water Source</th>
<th>Thousands of acre-feet (TAF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Surface Water</td>
<td>4,854</td>
</tr>
<tr>
<td>CVP Water</td>
<td>4,268</td>
</tr>
<tr>
<td>SWP Water</td>
<td>1,168</td>
</tr>
<tr>
<td>Local Groundwater</td>
<td>1,803</td>
</tr>
<tr>
<td>Total Water</td>
<td>12,093</td>
</tr>
</tbody>
</table>


Agriculture’s importance as a land use is also reflected in data on the number and size of farms. According to CALFED, the number of farms in the San Joaquin River Region decreased from 28,742 in 1987 to 26,731 in 1992, partly due to the loss of farmland (439,000 acres) to industrial and urban uses, and partly due to the accumulation of farmland into fewer and larger farms. The average farm size increased from 351 to 361 acres (CALFED 1998). This resulted in an effective reduction of 4.35 percent of the total number of acres farmed.
3. Affected Environment

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3. Affected Environment

3.7 CULTURAL RESOURCES

Cultural resources are defined as prehistoric and historic archeological sites, architectural properties (e.g., buildings, bridges, and structures), and traditional properties with significance to Native Americans. This definition includes historic properties as defined by the National Historic Preservation Act (NHPA). This chapter summarizes the prehistoric and historic resources which may exist in the project area within the San Joaquin River Region and in the downstream Sacramento-San Joaquin Delta. The ethnography of the native people in each region is described in each of the sections.

Prehistoric resource locations can often be predicted by environmental variables, such as water, food, and shelter, because prehistoric occupation and use of the surrounding environment was based primarily on subsistence needs. The prehistoric period in the project area and vicinity is generally agreed upon to begin with the Clovis Period. This period, which extended back more than 11,000 years before present (BP) is represented by the distinctive fluted spear points, called Clovis Points. The points were found on shores of extinct lakes in the San Joaquin Valley, indicating that the native population was composed primarily of hunters. Bones of extinct animals, such as mammoth, sloths, and camels, are found on the same surface as the Clovis Points.

Approximately 8,000 years BP the native populations had switched from hunting to seed gathering, evidenced by food grinding implements. Cultural patterns have become better defined in the last 3,000 years. As populations expanded and specialized adaptations to local resources were developed, the archeological record becomes more complex. Many sites in this period contain mortars and pestles, or are associated with bedrock mortars, which implies that acorns were used extensively. In addition, the range of subsistence resources that were used increased and exchange systems expanded. Well-made artifacts, such as charm stones and beads, indicate that this period demonstrated social stratification and craft specialization (USBR 1997d).

Many above ground historical sites have been identified in the project area. To predict the locations of some historical sites, an understanding of the national, regional, and local historical themes that have influenced historical settlement in California is needed.

Initial Euroamerican incursions began with the Spanish missionaries and soldiers who entered California from the south in 1769. This period is characterized by the establishment of missions and military presidios, the development of large tracts of land owned by the missions, and subjugation of the local native population for labor. With Mexico’s independence from Spain in 1822, the mission period in California began to end. Large tracts of land were divided by government grants into large ranchos, often tens of thousands of acres or more. These large tracts often maintained large herds of cattle and horses, with agricultural development limited to small garden plots and vegetable-growing operations. In addition to the Spanish explorers and settlers, Russians and American explorers made forays into the region.

With the discovery of gold in the mid-1800s and the ensuing gold rush, development and improvement of a transportation system became a necessity in the region. Between 1850 and 1880, California saw the development of hundreds of primary wagon routes, the evolution of steamboat travel along major rivers, and the completion of numerous railroads. Logging in California paralleled the settlement as the new arrivals needed building materials for homes, businesses, and industries.

As settlements grew, agricultural enterprises became more common. Dry-farming practices predominated during the early years until the 1880s when large-scale irrigation systems were developed. The basis for the irrigation systems were the hydraulic mining conveyances. New crops were added to the grains obtained from dry-farming, such as vegetables, fruits, and nuts. The improvements to the transportation systems allowed the distribution of these new crops to the new settlements.

3.7.1 San Joaquin River Region
3. Affected Environment

The San Joaquin River Region includes Fresno, Mariposa, San Joaquin, and Stanislaus counties, and parts of Calaveras, Merced, Madera, and Tuolumne counties. Agricultural developments in the region have destroyed many archeological sites. Remnants of sites do occur, but they have been highly disturbed.

3.7.1.1 Prehistoric Resources

Although early Holocene (10,000 to 12,000 years BP) people probably inhabited or passed through the west side of the San Joaquin River Basin region, few indications of their activities have been discovered, probably due to deep burial beneath accumulated silt. Evidence of prehistoric occupation of the Sierra Nevada foothills on the east side of the San Joaquin River goes back 9,500 years BP. Recent excavations have revealed details of occupation in the area since approximately 3300 B.C.

The chronological sequence derived from the excavation of San Luis Reservoir best describes the west side of the region, while the excavation of Buchanon Reservoir in Madera County describes the east side. Table 3.7-1 shows the chronology derived from the excavation sites on both sides of the San Joaquin River Region.

The majority of discovered prehistoric sites in the San Joaquin River Region are less than 500 years old. The high Sierra Nevada mountain area is typified by seasonal camps characterized by lithic scatters and few bedrock mortars. The valley/foothill transitional zone often includes sites with midden deposits, structural remains, and numerous bedrock mortars (USBR 1997)).
3. Affected Environment

Table 3.7-1: PREHISTORIC RESOURCE CHRONOLOGY OF THE SAN JOAQUIN RIVER REGION

<table>
<thead>
<tr>
<th>Period</th>
<th>Dates</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positas Complex</td>
<td>3300 to 2600 B.C.</td>
<td>Small shaped mortars, cylindrical pestles, milling stones, perforated flat cobbles, and spire-topped olive snail (Olivella spp.) beads</td>
</tr>
<tr>
<td>Pacheco Complex</td>
<td>2600 B.C. to A.D. 300</td>
<td>Foliate bifaces, rectangular shell ornaments, thick rectangular Olivella beads in the early phase and spire-ground Olivella beads, perforated canine teeth, bone awls, whistles, grass saws, large stemmed and side-notched points, milling stones, mortars, and pestles in the later phase</td>
</tr>
<tr>
<td>Gonzaga Complex</td>
<td>A.D. 300 to 1000</td>
<td>Extended and flexed burials, bowl mortars, shaped pestles, squared and tapered-stem points, few bone awls, distinctive shell ornaments, and thin rectangular, split-punched, and oval Olivella beads</td>
</tr>
<tr>
<td>Panoche Complex</td>
<td>A.D. 1500 to 1850</td>
<td>Large circular structures (pits), flexed burials and primary and secondary cremations, varied mortars and pestles, bone awls, whistles, small side-notched points, clamshell disk beads, and other types of beads</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Period</th>
<th>Dates</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chowchilla Phase</td>
<td>300 BC to AD 550</td>
<td>Fish spears, large projectile points, milling stones, various shell beads and ornaments, atlatl darts, and extended and semi-extended burials with large quantities of grave goods</td>
</tr>
<tr>
<td>Raymond Phase</td>
<td>AD 300 to 1500</td>
<td>Milling stones, core tools, relative lack of Olivella beads, absence of abalone (Haliotis spp.) shell ornaments, small- to medium-sized projectile points, bedrock mortars, unshaped pestles, and flexed burials with few grave goods</td>
</tr>
<tr>
<td>Madera Phase</td>
<td>AD 1500 to 1850</td>
<td>Steatite disc beads and other steatite objects, small points, bedrock mortars, cobble pestles, various types of Olivella beads, imported brownware pottery, and flexed burials and cremations with a large quantity of artifacts</td>
</tr>
</tbody>
</table>


Table 3.7-2 lists the prehistoric sites by county in the entire San Joaquin River Region and shows approximately what percentage of the county has been surveyed for cultural resources. In addition, information about the locations of the majority of prehistoric resources is included.
## 3. Affected Environment

### Table 3.7-2: PREHISTORIC SITES BY COUNTY IN THE SAN JOAQUIN RIVER REGION

<table>
<thead>
<tr>
<th>County</th>
<th>Total No. Recorded Sites</th>
<th>No. of Prehistoric Sites</th>
<th>Percentage of County Land Surveyed</th>
<th>Areas of High Density</th>
<th>Overall Amount of Significant Disturbance in the County</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calaveras</td>
<td>1,527</td>
<td>929</td>
<td>10-15</td>
<td>Stanislaus, N Fork Stanislaus, and Mokelumne rivers; creeks, ridge flats</td>
<td>Low</td>
</tr>
<tr>
<td>Fresno</td>
<td>2,891</td>
<td>2,603</td>
<td>5</td>
<td>San Joaquin, Kings, and S Fork Kings rivers; Fancher, White, Panoche, and Dinkey creeks; near Shaver, Huntington, and Millerton lakes, creeks, meadows, ridge flats</td>
<td>Low</td>
</tr>
<tr>
<td>Madera</td>
<td>2,074</td>
<td>2,043</td>
<td>1-2</td>
<td>Fresno, San Joaquin, and Chowchilla rivers; Willow Slough; near Millerton and Bass lakes; Crane Valley; near Devils Postpile National Monument; creeks, meadows, ridge flats</td>
<td>Low</td>
</tr>
<tr>
<td>Mariposa</td>
<td>1,264</td>
<td>856</td>
<td>5</td>
<td>Merced River; along creeks; in Yosemite National Park</td>
<td>Low</td>
</tr>
<tr>
<td>Merced</td>
<td>341</td>
<td>316</td>
<td>2</td>
<td>unknown</td>
<td>Low</td>
</tr>
<tr>
<td>San Joaquin</td>
<td>249</td>
<td>189</td>
<td>5</td>
<td>San Joaquin and Mokelumne rivers</td>
<td>Low to Moderate</td>
</tr>
<tr>
<td>Stanislaus</td>
<td>350</td>
<td>280</td>
<td>3</td>
<td>Stanislaus, Tuolumne, and San Joaquin rivers; along smaller creeks</td>
<td>Low</td>
</tr>
<tr>
<td>Tuolumne</td>
<td>3,540</td>
<td>unknown</td>
<td>10</td>
<td>Stanislaus and Tuolumne rivers; along creeks, ridge flats</td>
<td>Low</td>
</tr>
</tbody>
</table>

3. Affected Environment

3.7.1.2 Historic Resources

Historically, the west side of the San Joaquin River Region was characterized by agricultural settlement. Historic resources include homesteads, economic/industrial facilities, commercial establishments, and government facilities. Due to their establishment during the agricultural development of the valley, numerous rural communities may contain sites and structures of historical significance (CALFED 1998).

The east side of the San Joaquin River Region was characterized by agricultural settlement as well but was also influenced by mining activities. Mining activities were related to the gold rush of the mid-1800s and the subsequent mining activities since the discovery of gold in the Sierra Nevada foothills. The economy of the east side has been based on mining, agriculture, and commercial services since the late 1800s. Historic resources related to the settlement of the east side include mining-related structures and features, railroad grades and associated features, dams and culverts, roads, refuse deposits, and architectural structures (CALFED 1998).

Table 3.7-3 shows the number of resources listed in the NRHP, California Historic Landmarks, California Inventory of Historic Resources, and California Points of Historical Interest by county in the San Joaquin River Region.

Table 3.7-3: HISTORIC RESOURCES BY COUNTY IN THE SAN JOAQUIN RIVER REGION

<table>
<thead>
<tr>
<th>County</th>
<th>No. of Properties in the National Register of Historic Places</th>
<th>No. of California Historic Landmarks</th>
<th>No. of Sites in California Inventory of Historic Resources</th>
<th>No. of California Points of Historical Interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calaveras</td>
<td>13</td>
<td>42</td>
<td>56</td>
<td>4</td>
</tr>
<tr>
<td>Fresno (eastern portion)</td>
<td>32</td>
<td>7</td>
<td>33</td>
<td>12</td>
</tr>
<tr>
<td>Fresno (western portion)</td>
<td>2</td>
<td>1</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Madera</td>
<td>1</td>
<td>0</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Mariposa</td>
<td>29</td>
<td>8</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Merced</td>
<td>12</td>
<td>5</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>San Joaquin</td>
<td>31</td>
<td>23</td>
<td>28</td>
<td>8</td>
</tr>
<tr>
<td>Stanislaus</td>
<td>17</td>
<td>5</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>Tuolumne</td>
<td>19</td>
<td>20</td>
<td>79</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>156</td>
<td>111</td>
<td>255</td>
<td>50</td>
</tr>
</tbody>
</table>


3.7.1.3 Ethnography
3. Affected Environment

The San Joaquin River Region was inhabited primarily by the Yokuts, Miwok, and Monache Native American cultural groups. The Yokuts culture consists of three primary divisions: the southern San Joaquin Valley Yokuts, the northern San Joaquin Valley Yokuts, and the Foothill Yokuts. In general the Yokuts were seasonally mobile hunter-gatherers with semi-permanent villages. They traveled to temporary camps to exploit the food resources in other environmental zones. The Southern Valley groups relied more heavily on fish, waterfowl, tule roots, seeds, mussels, turtles, shellfish, and rabbits. The Northern Valley Yokuts relied heavily on acorns, along with salmon and other fish. The Foothill Yokuts' primary foods were deer, acorns, pine nuts, and other foothill zone foods.

The Miwok cultures include three primary divisions: the Coast Miwok, the Lake Miwok, and the Eastern Miwok. The Eastern Miwok included five separate groups (Bay, Plains, Northern Sierra, Central Sierra, and Southern Sierra) that ranged over the area from Walnut Creek and the Delta, the lower Mokelumne and Cosumnes rivers and the Sacramento River from Rio Vista to Freeport, the foothill and mountain areas of the upper Mokelumne and Calaveras river drainages, the upper Stanislaus and Tuolumne river drainages and the upper Merced and Chowchilla river drainages, respectively. In general, the Miwok were seasonally mobile hunter-gatherers with semi-permanent villages. Acorns were the staple food among all the groups. Other food sources included buckeye, seeds, bulbs, pine nuts, deer, elk, rabbits, squirrels, fowl, salmon and other fish, bear, and insects.

The Monache, or Western Mono, consist of six separate groups. At least two of the Monache groups appear to be transitional between the Western Mono and Yokut and were bilingual. In general, the Monache lived on the west slopes of the Sierra Nevada, between 3,000 and 7,000 feet elevation. They ranged over a much wider area, including the eastern slopes of the Sierra. Monache groups were seasonally mobile hunter-gatherers. Acorns were their dietary staple and were collected in large quantities and stored for the winter in elevated granaries in the villages. The Monache also ate deer, bear, rodents, birds, insects, manzanita berries, seeds, honey, and fish.

Prior to Euroamerican contact, it is believed that the areas of the Monache and Yokuts were among the most heavily populated areas in California. It has been estimated that up to approximately 180 individuals per square mile may have inhabited this area. It is estimated that by 1910 only 6 to 9 percent of this number survived (USBR 1997j).

3.7.2 Sacramento-San Joaquin Delta

The majority of the Sacramento-San Joaquin Delta has not been surveyed for cultural resources. Most of the early archeological work in the region focused on prominent prehistoric mounds, during which time additional prehistoric sites were identified. Historic sites have been documented primarily during the past 20 to 30 years.

The cultural resource information for the Sacramento-San Joaquin Delta is not broken out as a separate region because the prehistoric and historic information is generally available by county. The resources for this region are summarized below.

3.7.2.1 Prehistoric Resources

Prehistoric sites which have been identified within the Sacramento-San Joaquin Delta include village sites, temporary campsites, milling-related activity sites, and lithic scatters. The prehistoric sites are not evenly distributed across the Delta Region, however. Although channel deposits, floodplains, and basins make up approximately 40 percent of the total acreage within the region, nearly 80 percent of the prehistoric sites are located within these landforms. Those landforms identified as mucks, organic soils, fans, basins, and terraces make up 25 percent of the delta region but contain less than 5 percent of the prehistoric sites. No prehistoric sites have been recorded in peat or peaty mucks. Former tidal wetlands may be sensitive for prehistoric resources where they contain sand dunes and mounds that have been occupied in prehistoric times.
3. Affected Environment

The landscape of the Sacramento-San Joaquin Delta is radically different today than it was prior to farmland reclamation. Reconstructed watercourses, areas subject to tidal influence, and other surface geology features were used as a basis for generating a predictive model of prehistoric settlement patterns in the south Delta region. Further mapping of extinct watercourses can assist in defining areas of prehistoric site sensitivity (USBR 1997j).

Excavators working in the Stockton area from 1893 to the early 1930s provided the groundwork for the three-phase chronological sequence of the prehistoric period, which was the first system used for central California. The three cultural levels were identified as early, intermediate, and recent and were based on artifacts and burial orientation and condition. Subsequent archeological research has refined this taxonomic system to where it is now based on cultural patterns which may extend across one or more regions, characterized by particular skills, particular economic modes, and by particular mortuary and ceremonial practices.

Little is known of human occupation of the lower Sacramento Valley prior to 4500 BP. Because of rapid alluvial and colluvial deposition in the valley over the past 10,000 years, ancient cultural deposits have been deeply buried in many areas. The earliest evidence of widespread occupation of the Sacramento-San Joaquin Delta region comes from several sites assigned to the Windmiller Pattern. The next phase was the Berkeley Pattern, followed by the Augustine Pattern. Table 3.7-4 details the three periods.

Table 3.7-4: PREHISTORIC RESOURCE CHRONOLOGY OF THE SACRAMENTO-SAN JOAQUIN DELTA

<table>
<thead>
<tr>
<th>Period</th>
<th>Dates</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windmiller Pattern (formerly Early Horizon)</td>
<td>4500 to 2500 BC</td>
<td>Sites on low rises or knolls in floodplains of major creeks or rivers; abundant grave goods and bodies in ventral position; large projectile points, clay net sinkers, bone fish hooks and spears, and abundant faunal remains; charm stones, quartz crystals, bone awls and needles, <em>Haliotis</em> and <em>Olivella</em> shell beads and ornaments</td>
</tr>
<tr>
<td>Berkeley Pattern (formerly Middle Horizon)</td>
<td>2500 to 1500 BC</td>
<td>Deep midden deposits; abundance of milling slabs, mortars, and pestles; distinct projectile points and faunal remains; quartz crystals, charm stones, projectile point styles, shell beads, ornaments, bone tools; steatite beads, tubes and ear ornaments, slate pendants, flexed burials with variable orientation or cremations and fewer grave goods</td>
</tr>
<tr>
<td>Augustine Pattern (formerly Late Horizon)</td>
<td>1500 to 100 BC</td>
<td>Intensified hunting, fishing, and gathering; large, dense populations, highly developed trade networks; elaborate ceremonial and mortuary practices; social stratification; shaped mortars and pestles, bone awls for basketry, bone whistles and stone pipes, clay effigies, bow and arrows, pottery; flexed burials with variable orientation and generally lacked grave goods</td>
</tr>
</tbody>
</table>
Due to the long history of agricultural use, it is unlikely that intact surface or shallow subsurface deposits exist. Subsurface deposits may exist below the plow zone or capped beneath pavement or structures. Surface deposits may exist in areas relatively unaffected by development or agriculture (CALFED 1998).

3.7.2.2 Historic Resources

Potential historic resources in the Sacramento-San Joaquin Delta are largely related to agriculture. Other resources are also present, including farmsteads, labor camps, landings for the shipment of agricultural produce, canneries, pumping stations, siphons, canals, drains, unpaved roads, bridges, and ferry crossings. Labor camps generally consist of at least one wooden bunkhouse or boarding house, a dining hall, a cookhouse, a washroom, and associated buildings. Landings are not elaborate and may consist of a few pilings.

At least 171 sites within the Sacramento-San Joaquin Delta have been listed in the NRHP as individual properties or as districts. Six sites in the region have also been listed as California Historical Landmarks and four are listed as California Points of Historical Interest. Forty known historic sites coincide with prehistoric sites.

Due to the extensive use of the land in historic times, architectural resources are likely to occur throughout the region. However, much of the region is still used for agricultural purposes, and the ground surface is regularly plowed, raked, or tilled (CALFED 1998).

3.7.2.3 Ethnography

The ethnography of the Sacramento-San Joaquin Delta included the Northern Valley Yokuts and Bay Miwoks, which are described above in Section 3.7.1.3, and the Patwin, described here. Most of the western side of the Sacramento Valley north of Suisun Bay was inhabited by Wintun-speaking people at the time of the first Euroamerican contact. The southernmost membership of this population was the Patwin, which held an extensive region west of the Sacramento River from the town of Princeton in the north to Benicia in the south.

Despite their extensive territorial range, relatively little in known of the Patwin culture. The information that does exist about the southern half of the Patwin people has been extrapolated largely from the Patwin peoples to the north. Patwin settlements tended to be located on high ground, along the Sacramento River or tributary streams, such as Cache, Putah, and Ulatis creeks, and in numerous valleys nestled along the eastern side of the Coast Range. Several major settlements, such as the villages of Aguasto and Suisun, were located near the marshy environment of the San Pablo and Suisun bays. The extensive plains to the north and northeast were used primarily for temporary camps, because there was little available firewood and in spring and summer these areas were insect-infested and contained only small quantities of easily obtained food.

Several of the major settlements were very populous and may have contained more than 1,000 people. However, temporary settlements and camps varied in size. Typically, the Patwin settlements ranged from only several residential structures to permanently occupied villages with numerous circular pit houses.

The Sacramento-San Joaquin Delta provided many resources, including an abundant fishery, a wide variety of plant foods, and plenty of game, including tule elk, antelope, and waterfowl. The seasonal availability of these food resources determined the gathering schedule for the Patwins.

The growth of the missions in California significantly impacted the Patwins. Missions Delores, San Jose, and later Sonoma all had potential recruits from the Patwin population. Residents of the village of Aguasots were taken to Mission Delores as early as 1800. The introduction of measles and smallpox significantly reduced the
number of Patwins, and the further onslaught of Euroamericans and the gold rush of 1849 decided the fate of the Patwin culture. Early ethnographic surveys of the state in 1871-1872 stated that the Patwin culture no longer existed (USBR 1997j).
3. Affected Environment

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3. Affected Environment

3.8 RECREATION

Lakes and rivers have always been a primary focus for outdoor recreation activities in California. Recreational opportunities in the Central Valley have been shaped by the construction of large reservoirs and the alteration of major rivers in addition to the opportunities provided at natural water bodies, streams, and rivers. Many outdoor recreation activities are water dependent or water enhanced. Such activities include boating, fishing, swimming, camping, picnicking, hunting, and wildlife observation. Recreation facilities, such as beaches, boat ramps, trails, restrooms, access roads, picnic areas, and camping facilities, add to the quality of the recreation experience.

The way that a reservoir is operated and water levels are managed directly affects the quality and economic value of recreational activities. Changes in a reservoir’s water levels, due to drought or excessive demands, can reduce recreational opportunities and the associated benefits. Receding water levels and reduced water surface area make boat ramps less accessible and leave recreation facilities farther from the shorelines. However, decreased recreation benefits at drawn-down reservoirs may be offset to some extent by increases in river recreation benefits downstream from the affected reservoirs. Whether the reservoir is operated as a water supply or a hydroelectric generating facility can affect recreational opportunities. Hydroelectric generating facilities can have varying impacts on both reservoir and river recreation depending on whether the operation is constant or subject to peaking.

Rivers also provide recreation opportunities, such as boating, fishing, swimming, and white-water sports. Many rivers are unimpaired by water impoundment facilities and provide seasonal recreation opportunities. Other streams, with flows controlled by reservoir releases, offer opportunities to enhance downstream flows that can benefit recreation values. Streams that would run only intermittently, for example, can have year-round flows following reservoir construction and operation. This kind of conversion can develop new fisheries, add to recreational-area attractiveness, and enhance wildlife habitat.

Many wildlife refuges in California have benefitted from the existence of imported water. Seasonal wetland habitat at refuges and at private hunting clubs is integral to the maintenance of waterfowl populations along the Pacific Flyway. Historically, recreation values associated with such wildlife have focused primarily on hunting, but more recently, bird watching has become increasingly popular as a recreation opportunity.

Descriptions of the environmental setting for recreation opportunities at both reservoirs and rivers follow. The primary region that would be affected by the proposed project and other alternative is the San Joaquin River Basin; the Sacramento-San Joaquin Delta could be affected indirectly.
3. Affected Environment

3.8.1 San Joaquin River Basin

Reservoirs with recreation use in the project area and vicinity are described in Table 3.8-1 and in the paragraphs below.

Table 3.8-1: RESERVOIRS WITH RECREATION USE

<table>
<thead>
<tr>
<th></th>
<th>New Melones Reservoir (CVP)</th>
<th>New Don Pedro Reservoir (MID/TID)</th>
<th>Lake McClure (Merced ID)</th>
<th>San Luis Reservoir (CVP/SWP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Storage (AF)</td>
<td>2,420,000</td>
<td>2,030,000</td>
<td>1,024,600</td>
<td>2,039,000</td>
</tr>
<tr>
<td>Maximum Pool Elevation (Ft above msl)</td>
<td>1,088</td>
<td>830</td>
<td>867</td>
<td>544</td>
</tr>
<tr>
<td>Maximum Surface Area (Acres)</td>
<td>3,600</td>
<td>13,000</td>
<td>7,100</td>
<td>12,700</td>
</tr>
</tbody>
</table>

3.8.1.1 Reservoirs

Recreation opportunities have been shaped substantially by the construction of reservoirs on the San Joaquin River and its tributaries. The reservoirs include San Luis Reservoir, New Melones Reservoir, Lake McClure, and New Don Pedro Reservoir.

San Luis Reservoir

The San Luis Reservoir State Recreation Area (SRA), owned by Reclamation and operated by the Department of Parks and Recreation (DPR), covers approximately 12,700 surface acres when full. San Luis Reservoir has approximately 65 miles of shoreline and a maximum pool elevation of 544 feet above msl (SWCRB 1997). The capacity of San Luis Reservoir is 2,039,000 acre-feet. It is not directly affected by the proposed project but is described here because it is located in the vicinity of the project area and provides recreation opportunities.

Water dependent opportunities at San Luis Reservoir include boating, waterskiing, and fishing. Boat access is provided in the southeastern portion of the reservoir at the Basalt area by a two-lane concrete boat ramp and boarding dock, and at the northwestern Dinosaur Point use area with a four-lane concrete boat ramp and boarding dock. There are no designated swimming areas at the reservoir. Water enhanced opportunities include picnicking, camping, hunting, and trail use activities. There are no designated lakeside beach areas at the reservoir.
Both boat and shore fishing occur at San Luis Reservoir with striped bass the primary game species. Fishing is usually of high quality from February through summer, with striped bass fishing best during winter and spring. San Luis Reservoir also supports black bass and catfish. Migratory waterfowl hunting is permitted on most of the reservoir approximately 300 feet from established reservoir and recreation facilities. Hunting for deer and wild pig is also allowed on the northwestern reservoir shoreline.

Use at San Luis Reservoir was an estimated 210,000 12-hour recreation visitor days (RVDs) in 1992. Recreation activities and number of users varies with the season, with approximately 77 percent of annual use between April and September. Most visitors come from the Bay/Delta region, followed by the San Joaquin Valley (USBR 1997h).

Recreation use is optimized at San Luis Reservoir at a maximum pool elevation of 544 feet above msl. Use of the Basalt area boat ramp becomes inconvenient at approximately 340 feet above msl but can be used on a limited basis. The boat ramp at Dinosaur Point can be used at the minimum reservoir pool but is difficult to access below 360 feet above msl. Swimming is not affected by the water level fluctuations because there are no designated swimming areas.

New Melones Reservoir

New Melones Reservoir is owned and operated by Reclamation and covers approximately 3,600 surface acres when full, has approximately 105 miles of shoreline, and a maximum pool elevation of 1,088 feet above msl (SWRCB 1997). The capacity of New Melones Reservoir is 2,420,000 acre-feet.

Water dependent opportunities at New Melones Reservoir include boating, waterskiing, swimming, and fishing. Boat access is provided on the north and east shores of the reservoir. There are three boat ramps (seven-lane) used for high, medium, and low reservoir levels at Glory Hole recreation area in the northwestern portion of the reservoir. In addition to the ramps, there is a concession-operated marina with berthing slips and three courtesy docks. The Tuttletown recreation area on the eastern shore features three seven-lane boat ramps used for variable reservoir levels and three courtesy docks. The Mark Twain, Parrot’s Ferry, Camp Nine, and Old Town recreation areas are undeveloped and offer minimal facilities.

A developed beach area provides swimming opportunities at the Glory Hole recreation area. The designated beach and swimming area at Angels Arm recreation area is closed. Boating and waterskiing are popular throughout the main reservoir area.

Water-enhanced activities include picnicking and camping. Camping facilities are available at the Glory Hole and Tuttletown recreation areas.
3. Affected Environment

Use at New Melones Reservoir totaled approximately 498,000 12-hour RVDs in 1992. The majority of the use is related to water-dependent activities, such as boating, waterskiing, and fishing. Camping is the most popular water-enhanced activity. Annual recreation use at New Melones Reservoir occurs mainly from April to late September. An estimated 95 percent of the visitors come from local counties in the San Joaquin Valley (USBR 1997h).

The optimal reservoir level for recreation use is at an elevation of approximately 950 to 980 feet above msl. All of the boat ramps except one at Glory Hole are inoperable at reservoir levels of 950 feet above msl. There is one boat ramp at Glory Hole which was designed to access the reservoir at elevations as low as 860 feet above msl. The marina at Glory Hole can be moved at different lake levels, but the marina closes when the elevation reaches 880 feet above msl. Other ramps at Mark Twain, Parrot’s Ferry, and Old Town undeveloped recreation areas are old roads that can be used on a limited basis to an elevation of 850 feet above msl.

New Don Pedro Reservoir

New Don Pedro Reservoir is owned by MID and TID. Recreational activities are managed by the Lake Don Pedro Recreation Agency (USBR 1997h). New Don Pedro Reservoir covers approximately 13,000 surface acres when full, has approximately 160 miles of shoreline, and a maximum pool elevation of 830 feet above msl (SWRCB 1997). The capacity of New Don Pedro Reservoir is 2,030,000 acre-feet (TID 1998).

Water dependent opportunities at New Don Pedro Reservoir include boating, swimming, waterskiing, jet skiing, windsurfing, sailing, houseboating, fishing, and boat-in camping. There are boat launch facilities at Fleming Meadows recreation area on the southern shoreline, Blue Oaks recreation area on the southwestern shoreline, and Moccasin Point recreation area on the northeastern arm of Moccasin Bay. In addition, there are two full service marinas with docks, boat slips, mooring areas and provisions located at Fleming Meadows and Moccasin Point recreation areas. In addition, there are 257 privately-owned house boats and 20 rental house boats based on New Don Pedro Reservoir under permit (Cornell 1997).

Boating and waterskiing occur throughout the reservoir. Swimming occurs mainly at the Fleming Meadows swimming lagoon, which is a 2-acre pool separated from the main reservoir. The lagoon has a maximum depth of 6 feet, picnic facilities, and a sandy beach area. Shore and boat fishing is mainly for bass, trout, salmon, crappie, bluegill, and catfish.

Water-enhanced activities include picnicking, camping, and sightseeing. There are a total of 550 camping sites at Fleming Meadows, Blue Oaks, and Moccasin Point recreation areas.
3. Affected Environment

Use at New Don Pedro Reservoir totaled approximately 280,000 RVDs in 1992. The majority of the use is related to water-dependent activities, such as boating, waterskiing, and fishing. Camping is the most popular water-enhanced activity. Recreation use occurs mainly from May through September (84 percent) with some use from November to February (4 percent). The majority of visitors (38 percent) come from Santa Clara, Alameda, and San Joaquin counties, with other visitors (27 percent) coming locally from Stanislaus and Tuolumne counties (USBR 1997h).

Historical data shows a strong correlation between water levels measured in feet above msl and recreation use measured in visitor days at New Don Pedro Reservoir. The peak recreation period during the year is from May through August, and June 30 was selected as representative for the season for correlating trends. For the period 1975 through 1996, the mean reservoir elevation on June 30 annually was approximately 780 feet above msl. When the reservoir level exceeds the mean level, recreation use in visitor days exceeds the average for the 1975-1996 period, which is 368,900 RVDs (Cornell 1997).

The maximum reservoir level for recreation use is at an elevation of 830 feet above msl. The Fleming Meadows boat ramp ceases operation when the elevation drops to 600 feet above msl. Between 710 and 600 feet above msl, five ramps become unusable. The Moccasin Point boat ramp cannot be used below an elevation of 722 feet above msl, and the Blue Oaks ramp cannot be used at 726 feet above msl. The Fleming Meadows and Moccasin Point marina operations are limited at 600 and 630 feet above msl, respectively (SWRCB 1997).

In addition to losing boat ramp operations at lower reservoir levels, other changes occur which affect recreation use. Lower levels reduce the aesthetic appeal of the reservoir surroundings, may cause conflicts between water users as surface area of the reservoir declines, reduce the shoreline accessibility due to steeper banks, and expose hazards. An economic consideration related to recreation use of New Don Pedro Reservoir is the increased cost of maintenance of the hazard warning devices with lowered reservoir levels (Cornell 1997).

Lake McClure

Lake McClure is owned and operated by the Merced ID. Lake McClure covers approximately 7,100 surface acres when full, has approximately 80 miles of shoreline, and a maximum pool elevation of 867 feet above msl (SWRCB 1997). The capacity of Lake McClure is 1,024,600 acre-feet (http://www.mercedid.org/irrifac.htm).

Water dependent opportunities at Lake McClure include boating, sailing, waterskiing, jet skiing, swimming, and fishing. Boat access is provided at ramps located around the shoreline. There are three boat launch lanes at McClure Point, two boat ramps with a total of five lanes at Barrett Cove, a two-lane boat ramp at Horseshoe Bend, and a one-lane boat ramp at Bagby recreation area.
3. Affected Environment

There are swimming lagoons at McClure Point, Barrett Cove, and Horseshoe Bend and marinas at McClure Point and Barrett Cove. Rainbow trout fishing occurs either on the shoreline or in boats and is enhanced by year-round fish planting. Bass fishing has also improved since the Florida largemouth bass was introduced. There are also black bass and bluegill in Lake McClure.

Water-enhanced activities include picnicking and camping. Camping facilities are available at McClure Point, Barrett Cove, Horseshoe Bend, and Bagby recreation areas.

Use at Lake McClure totaled approximately 606,000 12-hour RVDs in 1992. Day use activities accounted for most of the visitor days. Annual recreation use occurs largely between May and September. Most of the visitors originate from the following counties, listed from highest to least attendance: Santa Clara, Stanislaus, San Joaquin, Merced, Mariposa, Sacramento, Fresno, Madera, Tuolumne, and Calaveras (USBR 1997h).

Lake McClure boat ramps cease operation between 590 and 793 feet above msl. The ramp at Bagby is the first to close when the reservoir reaches an elevation of 793 feet above msl, followed by Horseshoe Bend at 758 feet above msl, McClure Point at 650 feet above msl, southern Barrett Cove ramp at 630 feet above msl, and northern Barrett Cove and Piney Creek, both at 590 feet above msl (SWRCB 1997).

3.8.1.2 Rivers

Construction and operation of the dams and reservoirs have substantially affected instream recreation uses below these structures. Sport fisheries in rivers below major lakes and reservoirs have declined. The rivers in the San Joaquin River Basin include the San Joaquin, Merced, Tuolumne, and Stanislaus rivers.

San Joaquin River

The San Joaquin River runs more than 250 miles from Millerton Lake to the Sacramento-San Joaquin Delta (Fults 1998, personal communication). Although there are no major public recreation features along this stretch, public access is available at several road and highway crossings. The river borders the San Luis National Wildlife Refuge and crosses the Fremont Ford State Recreation Area in Merced County. Stanislaus County recreation facilities include the Las Palmas fishing access site, Laird County Park, and numerous public access points. Recreation facilities in San Joaquin County include Durham Ferry SRA, Mossdale Landing County Park, Dos Reis County Park, and numerous public road crossings. Stockton has three recreational facilities on the Stockton Deep Water Channel, and the Buckley Cove Marina is located on the San Joaquin River east of Stockton.
3. Affected Environment

Summer flows in the San Joaquin River below Millerton Lake average from 480 cfs in critically dry years to over 2,600 cfs in wet years (using Reclamation’s model). Water dependent activities include fishing and boating. Fish species in this stretch of the San Joaquin River include catfish and smallmouth bass. Water enhanced activities include a minor amount of picnicking.

Recreation use estimates for the entire lower San Joaquin River are not available from a single source because the use is dispersed across 250 miles and five counties. Based on information from recreation sites on the river, boating and fishing activities on the river are estimated to total 157,000 6-hour RVDs. Most of the use is assumed to come from the local counties (USBR 1997h).

Stanislaus River

The Stanislaus River runs 60 miles from New Melones Reservoir to its confluence with the San Joaquin River and crosses primarily private agricultural and grazing lands in Tuolumne, Stanislaus, and San Joaquin counties. There are a number of developed and undeveloped public parks along the lower Stanislaus River, including Caswell Memorial State Park, located approximately three miles upstream from the Stanislaus/San Joaquin confluence. There is also public access to the river at numerous road crossings. Below Goodwin Dam is access for a whitewater boating run that is rated advanced for the four-mile stretch from the Dam to Knights Ferry (SWRCB 1997).

Summer flows in the Stanislaus River below New Melones Reservoir average from 400 cfs in critically dry years to over 800 cfs in wet years (using Reclamation’s model). Water dependent activities include fishing, swimming, and whitewater boating. Fish species in this stretch of the Stanislaus River include catfish, crappie, largemouth bass, and smallmouth bass. Water enhanced activities include picnicking and camping.

In 1992 the Corps of Engineers estimated that the use of the lower Stanislaus River below Goodwin Dam at 122,000 6-hour RVDs. Use of the recreational facilities on or near the Stanislaus River has increased substantially since 1980 because of increased park development along the river. Most of the parks attract local residents, but Caswell Memorial State Park is capable of attracting nonlocal visitors (USBR 1997h).

Tuolumne River

The Tuolumne River, from New Don Pedro Reservoir to its confluence with the San Joaquin River, is approximately 52 miles long. This reach traverses mainly private open space and grazing lands, City of Modesto property, and several public parks. Major recreational facilities include the La Grange County Regional Park on Yosemite Boulevard near La Grange, Turlock Lake SRA located on Lake Road between Turlock Lake and the river, Fox Grove Regional County Park near the Greer
3. Affected Environment

Road/Albers Road crossing, two golf courses adjacent to the river near the SR 99 crossing, and the Shiloh fishing access site at the Shiloh Road crossing upstream of the confluence (SWRCB 1997).

Summer flows in the Tuolumne River below New Don Pedro Reservoir average from 120 cfs in critically dry years to over 1,300 cfs in wet years (using Reclamation’s model). Water dependent activities include fishing, swimming, and rafting. The primary game fish in this stretch of the Tuolumne River is the chinook salmon. Water enhanced activities include picnicking and camping. Water-related recreation activities and wildlife viewing accounted for an estimated 150,000 6-hour RVDs in 1992. Most of the use is assumed to come from Stanislaus County (USBR 1997h).

Merced River

The reach of the Merced River below McSwain Dam is 50 miles long to its confluence with the San Joaquin River and crosses private agricultural and grazing land in Merced County. Major public recreation facilities include Henderson County Park on Merced Falls Road east of Snelling, McConnell SRA northeast of Livingston on SR 99, Hagaman County Park at the SR 165 river crossing, and George J. Hatfield SRA on Kelley Road near the San Joaquin River confluence. The county parks are primarily day-use facilities, while the State recreation areas provide both day-use and camping units (SWRCB 1997).

Summer flows in the Merced River below McSwain Dam average from 130 cfs in critically dry years to over 900 cfs in wet years (using Reclamation’s model). Water dependent activities include some canoeing and rafting in the lower portion of the river. There is no swimming or other water contact activities allowed at either county park because there are no lifeguards. No boat ramps are provided at the county parks because the river is shallow due to the upstream diversions. Fish species in this stretch of the Merced River include catfish and smallmouth bass. Water enhanced activities include picnicking, camping, and softball.

Because recreation is dispersed along the 50-mile stretch of the Merced River, no formal recreation surveys have been conducted. Based on information from recreation sites on the river, water-related recreation activity on the river is estimated to total 73,000 6-hour RVDs. Most of the use is assumed to come from Merced County (USBR 1997h).

3.8.1.3 Conveyance Facilities

Fishing is popular along many of the canals in the area. Public access is provided on the California Aqueduct and the Delta-Mendota Canal.
3. Affected Environment

California Aqueduct

The California Aqueduct is owned and operated by DWR. Fishing access is provided along much of the California Aqueduct. Most of the portion of the aqueduct that passes through the San Joaquin River region has walk-in access for fishing. There are 12 fishing access sites which provide parking and toilet facilities. In addition, there are 170 miles of bikeways along the aqueduct.

Several fish species exist in the aqueduct, including striped bass, largemouth bass, catfish, crappie, green sunfish, bluegill, and starry flounder. An estimated 61,000 visitor days were reported at the aqueduct for fishing purposes in 1991.

Delta-Mendota Canal

The Delta-Mendota Canal is owned by Reclamation and operated by the Fresno and Stanislaus County Parks and Recreation Department. Fishing access to the Delta-Mendota Canal is provided at Delta-Mendota Canal Site 2A in Stanislaus County and Delta-Mendota Canal Site 5 in Fresno County. There are parking areas and restrooms at both the Canal Site 2A and Canal Site 5, but there are no picnicking or camping facilities.

Fishing access to the Delta-Mendota Canal is limited to the developed access points. Fish species include both striped bass and catfish. An estimated 23,000 visitor days were recorded for the two fishing sites in 1992. The more popular site was Canal Site 5, which accounted for approximately 99 percent of the use in 1991. Most of the visitors to the canal originate in the local area (USBR 1997h).

3.8.1.4 Wildlife Refuges

Wildlife refuges in the San Joaquin River region include the San Luis and Merced National Wildlife Refuges (owned and operated by the U.S. Fish and Wildlife Service) and Los Banos Wildlife Management Area (owned and operated by the California Department of Fish and Game). Most recreation activities associated with wildlife refuges is associated with the presence of waterfowl and upland game birds.

All activities associated with wildlife refuges are water-enhanced. Activities include hunting, hiking, and wildlife observation. Hunting of ducks, geese, and pheasants are permitted between October in January in portions of each refuge. Fishing is permitted at San Luis National Wildlife Refuge only. Both national wildlife refuges provide self-guided tours, and camping is permitted at the staging areas during hunting season. Camping is not permitted at Los Banos Wildlife Management Area.
3. Affected Environment

In 1992, combined recreation use at the refuges totaled approximately 56,000 5-hour RVDs. The most popular activities have been nonconsumptive uses, such as wildlife viewing. An estimated 15 percent of the visitors to the refuges originate in the local area.

3.8.1.5 Private Hunting Clubs

There are approximately 176 private hunting clubs in the San Joaquin River Basin. These private clubs provide opportunities for hunting ducks, geese, and pheasants and encompass approximately 96,800 acres. Waterfowl hunting activity was estimated at 241,000 hunter days in 1992.

3.8.2 Sacramento-San Joaquin Delta

The Delta environment has been extensively altered over the past 125 years by construction of levees, land reclamation, and development. The Delta remains, however, a valuable and unique recreational asset due to the natural and aesthetic values still present. Waterfowl and wildlife are still abundant, sport fishing is still popular, and the vegetation and beaches lining the channels and islands are still attractive (SWRCB 1995b).

Water dependent activities in the Delta include motor boating, fishing, swimming, waterskiing, and sailing with motor boating and fishing leading in popularity. There are approximately 20 public and more than 100 commercial recreational facilities in the Delta that provide rentals, services, camping guest docks, fuel, supplies, and food. Sport fishing in the Delta occurs year-round and may take place on private vessels or from shore. Popular sport fishing species include striped bass, white sturgeon, salmon, American shad, catfish, and largemouth bass (SWRCB 1997).

Recent trends in the striped bass fishery indicate a substantial decline in harvest rates between 1983 and 1990. Although exact sport catch data for white sturgeon are not available, the estimated catch rate for sturgeon has increased 40 percent over the last two decades. Fishing for sturgeon has become more popular, especially with the decline in other game fish, such as striped bass. Few salmon are harvested in the sport fishery in the Bay/Delta Region. Angler effort was estimated at 0.8 percent of total sport fishing effort for the period between July 1990 and June 1991 when an estimated 34 fish were caught. The estimated effort was 4.9 percent of total sport fishing effort for the period between July 1991 and June 1992 when an estimated 1,860 salmon were caught. A comparison of recent catch data and data collected in the 1970s suggests that the American shad sport fishery in the Bay/Delta Region has remained stable (USBR 1997h).

Water enhanced activities in the Delta include overnight camping, picnicking, photography, bicycling, hunting, and wildlife observation. There are numerous private waterfowl and pheasant hunting clubs in the Delta region.
Overall recreation use in the Bay/Delta region has increased substantially since 1963 when it was estimated at approximately 2.4 million visitor days. By 1987, annual recreation use had reached an estimated 7 million visitor days (USBR 1997h). Visitor use in the Delta was estimated by DWR to be 12 million visitor days in 1993 (SWRCB 1997). The most important activity in the region is boating (not including fishing), followed by fishing, relaxing, sightseeing, and camping. An estimated 77 percent of recreationists in the Bay/Delta region originate from the local area (USBR 1997h).
3. Affected Environment

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3.9 ENERGY RESOURCES

Energy resources in the project area consist of hydroelectric power generation. Hydroelectric power generation plants provide approximately 24 percent of California’s electrical generation capacity. The Central Valley Project hydropower system provides a significant portion of the available energy to the San Joaquin Valley. The CVP system of power plants and pumping plants has an installed capacity of 749,000 kilowatts. Most of the power that is generated from the CVP system is used to operate CVP pumping plants or is sold to public agencies.

The major storage reservoirs that supply water for hydroelectric power generation located in the project area are New Melones, Tulloch, New Don Pedro, and Lake McClure. Hydroelectric power generation facilities located downstream of these reservoirs include the New Melones and Tulloch projects on the Stanislaus River, the New Don Pedro Project located on the Tuolumne River, and the Exchequer, McSwain, and Merced Falls projects located on the Merced River.

3.9.1 New Melones and Tulloch Projects

The New Melones Project is located in Calaveras and Tuolumne counties on the Stanislaus River. It is part of the CVP hydropower system that is owned and operated by Reclamation. Project facilities include: New Melones Reservoir, New Melones Dam and powerhouse. The Tulloch Project is located in Calaveras and Tuolumne counties on the Stanislaus River downstream of the New Melones Project, and it is owned and operated by OID and SSJID. Project facilities include: Tulloch Reservoir and powerhouse. Table 3.9-1 describes the project facilities associated with the New Melones and Tulloch projects.

<table>
<thead>
<tr>
<th>Reservoir/Powerhouse</th>
<th>Total Storage Capacity (1,000 ac-ft)</th>
<th>Hydropower capacity (MW)</th>
<th>Estimated Average Annual Generation (1,000 KWH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Melones Reservoir and Powerhouse</td>
<td>2,420.0</td>
<td>300</td>
<td>385,000</td>
</tr>
<tr>
<td>Tulloch Reservoir and Powerhouse</td>
<td>56.0</td>
<td>17</td>
<td>93,000</td>
</tr>
</tbody>
</table>


3.9.2 New Don Pedro Project

The New Don Pedro Project (NDPP) is located at the western edge of Tuolumne County on the Tuolumne River. It is owned and operated jointly by MID and TID. The NDPP consists of the New Don Pedro Dam, Don Pedro Reservoir, and the New Don Pedro Powerhouse (FERC 1996). MID
3. Affected Environment

and TID own 31.54 percent and 68.46 percent respectively of the New Don Pedro hydroelectric plant. This equates to approximately 63 MW and 136.2 MW of the power produced. In addition to providing water, flood control, and recreational opportunities, the NDPP system produces hydropower. There are four dams and associated powerhouses in the system, described in Table 3.9-2.

Table 3.9-2: HYDROELECTRIC POWER FACILITIES LOCATED ON THE TUOLUMNE RIVER

<table>
<thead>
<tr>
<th>Reservoir/Powerhouse</th>
<th>Total Storage Capacity (1,000 ac-ft)</th>
<th>Hydropower capacity (MW)</th>
<th>Estimated Average Generation (1,000 Kilowatt hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Don Pedro Reservoir and Powerhouse (TID and MID)</td>
<td>2,030.0</td>
<td>199.2</td>
<td>618,400</td>
</tr>
<tr>
<td>La Grange Reservoir and Auxiliary Powerhouse (TID)</td>
<td>0.5</td>
<td>4.0</td>
<td>18,000</td>
</tr>
<tr>
<td>Turlock Lake and Powerhouse (TID)</td>
<td>48.0</td>
<td>3.3</td>
<td>not available</td>
</tr>
<tr>
<td>Modesto Reservoir and Powerhouse (MID)</td>
<td>28.0</td>
<td>1.1</td>
<td>not available</td>
</tr>
</tbody>
</table>


Reservoir operations at NDPP are controlled by various agreements between CCSF, MID and TID, the COE, and CDFG as well as FERC license articles. The NDPP has a minimum flow requirements schedule below New Don Pedro Dam in order to protect fishery resources.

3.9.3 Exchequer, McSwain, and Merced Falls Projects

The Exchequer, McSwain, and Merced Falls projects (Table 3.9-3) are located downstream of Lake McClure on the Merced River in Mariposa County. The Exchequer and McSwain project are owned and operated by Merced ID. The Merced Falls project is owned by PG&E. Both the Exchequer and McSwain projects include storage facilities, but the Merced Falls project does not.

Table 3.9-3: HYDROELECTRIC POWER FACILITIES LOCATED ON THE MERCED RIVER

<table>
<thead>
<tr>
<th>Reservoir/Powerhouse</th>
<th>Total Storage Capacity (1,000 ac-ft)</th>
<th>Hydropower capacity (MW)</th>
<th>Estimated Average Generation (1,000 Kilowatt hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake McClure and Exchequer Powerhouse</td>
<td>1,024.6</td>
<td>80.1</td>
<td>316,000</td>
</tr>
<tr>
<td>Lake McSwain and McSwain Powerhouse</td>
<td>9.2</td>
<td>9.0</td>
<td>45,000</td>
</tr>
<tr>
<td>Merced Falls  Powerhouse</td>
<td>none</td>
<td>3.4</td>
<td>19,100</td>
</tr>
</tbody>
</table>

3. Affected Environment

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4. ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

This chapter evaluates the environmental consequences of the no action, proposed action, and alternative action for each resource area and concern described in Chapter 3, Affected Environment. The proposed action of meeting flow objectives for the San Joaquin River system through the implementation of the San Joaquin River Agreement (SJRA alternative) is compared with the No Action alternative. Finally, the alternative action of the Water Right Priority System is discussed in comparison with no action. The terms “effects” and “impacts” are synonymous.

4.1 INTRODUCTION

4.1.1 Scope of Analysis

Chapter 3 described the environmental setting for the following environmental resources and concerns that were determined to be potentially affected by the alternatives:

- Surface Water
- Groundwater
- Terrestrial Resources (Vegetation and Wildlife)
- Aquatic Resources
- Land Use
- Cultural Resources
- Recreation
- Energy Resources
- Indian Trust Assets
- Environmental Justice

These resources are described in this action-specific or project EIS/EIR based on a 1998 Environmental Assessment/Initial Study (EA/IS) for a one-year water acquisition by the Bureau of Reclamation (Reclamation) from the San Joaquin River Group Authority’s (Authority’s) willing sellers (USBR 1997c). The 1998 EA/IS concluded that these concerns were appropriate for an in depth evaluation of additional stream flows in the San Joaquin River measured at Vernalis. The public scoping process for this focused EIS/EIR confirmed that resource issues were limited to these ten that meet NEPA and CEQA requirements (see Section 5.1). As a result, impacts on resources such as climate and air quality, soils and geology, noise, aesthetics, transportation/circulation, growth inducement, and public services are not evaluated based on a high probability of no impact. These resource areas are unlikely to be affected by an instream flow project that does not involve the construction of major new facilities. Should any of the willing sellers construct new canals or other facilities to store or convey water, these projects would be subject to independent NEPA/CEQA analyses.
4. Environmental Consequences and Mitigation Measures

4.1.2 Determination of Impact and Mitigation

The environmental consequences of the alternatives are classified into the following impact categories:

- **Significant.** Significant adverse environmental impacts are those that can be clearly identified as significant based on the criteria identified for each resource area. There is no mitigation available to reduce the impact to less than significant.

- **Potentially Significant.** Adverse impacts have been identified that have the potential to be significant. In the absence of sufficient information to determine that the potential impact is less than significant, the impact is treated as significant. Also, if the potentially significant impact cannot be mitigated to a less-than-significant level, then it is considered significant.

- **Less-Than-Significant.** This type of adverse impact is determined to be small or insignificant based on the criteria identified for each resource area. This type of environmental effect is usually short term or measurably small. It may or may not contribute to a cumulative impact over the long term.

- **No Impact.** Using the criteria for determining significance of impact, this category means that no adverse impact can be identified. There is no adverse physical or social change that can be determined based on available information.

- **Beneficial.** The environmental consequences are positive or otherwise beneficial to the resource. A beneficial impact may be further described as a significant beneficial impact when the magnitude of the positive effect is large.

This classification system is based on criteria contained in the CEQA Guidelines (OPR 1995) and others explained in the first section under each resource category. Both qualitative and quantitative thresholds of significance are used, depending on the resource and the availability of measurable standards.

Adverse and beneficial impacts can be direct (primary), indirect (secondary), short-term, long-term, and/or cumulative. Cumulative impacts are those that are not significant when considered alone but when combined with other similar actions may have a cumulative effect that is significant. Cumulative as well as unavoidable impacts, irreversible commitments of resources, and the relationship between short-term uses and long-term productivity are described in Chapter 4 in summary sections following the impact evaluations for each resource area.

Mitigation measures to reduce significant adverse impacts to a less-than-significant level are specific, feasible actions that will improve or mollify adverse conditions. A mitigation measure is feasible if
4. Environmental Consequences and Mitigation Measures

it can be accomplished in a successful manner within a reasonable period of time, taking into consideration economic, environmental, legal, social, and technological factors.

According to Section 15370 of the CEQA EIR Guidelines, the term “mitigation” includes:

- Avoiding the impact altogether by not taking a certain action or parts of an action.
- Minimizing impacts by limiting the degree of magnitude of the action and its implementation.
- Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment.
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
- Compensating for the impacts by replacing or providing substitute resources or environments.

Impacts that are less than significant or not significant (no impact) do not require mitigation. Impacts that are potentially significant or significant that can be mitigated, and the feasible mitigation measures, are described in Appendix G, Mitigation Monitoring Program.

4.1.3 Water Uses Potentially Affected

The subsequent analyses of adverse impacts of the proposed action consider the water uses that would be potentially affected by the proposed action to implement the flows contained in the SJRA. The SJRA provides for a redirection of up to 137,500 acre-feet of water annually from existing uses to instream flows for fish and related environmental benefits (110,000 acre-feet for spring and 12,500 acre-feet for fall and 15,000 acre-feet available at any time during the year). This potential redirection is shown in Table 4.1-1 with the amounts shown as a range of outcomes. The subsequent analyses of impacts to surface water, groundwater, and land use/agriculture rely on this distribution of affected uses.
### 4. Environmental Consequences and Mitigation Measures

**Table 4.1-1: WATER USES POTENTIALLY AFFECTED BY PROPOSED PROJECT (TAF)**

<table>
<thead>
<tr>
<th>Water Uses</th>
<th>Exchange Contractors</th>
<th>OID&lt;sup&gt;1&lt;/sup&gt;</th>
<th>SSJID</th>
<th>MID</th>
<th>TID</th>
<th>Merced ID&lt;sup&gt;2&lt;/sup&gt;</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation</td>
<td>0</td>
<td>0-26</td>
<td>0-11</td>
<td>0</td>
<td>0</td>
<td>0-67.5&lt;sup&gt;3&lt;/sup&gt;</td>
<td>104.5</td>
</tr>
<tr>
<td>Municipal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Carryover Storage/Conservation&lt;sup&gt;4&lt;/sup&gt;</td>
<td>0</td>
<td>0-26</td>
<td>0-11</td>
<td>0-11</td>
<td>0-11</td>
<td>0-67.5&lt;sup&gt;3&lt;/sup&gt;</td>
<td>126.5</td>
</tr>
<tr>
<td>Surface Runoff</td>
<td>0-11</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0-11</td>
</tr>
<tr>
<td>Return Flows</td>
<td>0-11</td>
<td>0-15</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0-26</td>
</tr>
<tr>
<td>Groundwater Recharge</td>
<td>0</td>
<td>0-15</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0-82.5</td>
</tr>
</tbody>
</table>

| Range of Total Available Water    | 0-11.0               | 0-26.0          | 0-11.0| 0-11.0| 0-11.0| 0-67.5<sup>6</sup> | 0-137.5|

<sup>1</sup>Water includes 15,000 acre-feet for release at any time during the year. The additional water is to be used for ramping around the spring or October pulse flows or at other times to support spawning, to control water temperature, or to meet other needs consistent with the New Melones Interim Plan of Operation. See Section 2.1.3.3.

<sup>2</sup>Water includes 12,500 acre-feet for delivery in October for fall attraction flow.

<sup>3</sup>Potential impact in only the most severe drought years. Reduced deliveries may occur in nine out of 71 years, based on historical hydrology. The proposed conjunctive use project is expected to offset water supply impacts.

<sup>4</sup>OID and SSJID have a conservation account that is tightly regulated on when water can be used.

<sup>5</sup>During some years, the maximum annual quantity may come from storage releases and, therefore, result in a reduction in carryover storage.

<sup>6</sup>Merced ID is to implement a conjunctive use project to provide dry year supplies and sustain groundwater levels to 1992 levels.

#### 4.1.4 Model Results Used in Analyses

The impact analysis of the proposed action is based upon the Hydrologic Analysis–San Joaquin River Agreement (Appendix A) specifically conducted for this EIR/EIS. This study utilized several operation simulation models developed by Reclamation: Projects Simulation Model (PROSIM) representing CVP/SWP operations and West Side deliveries; San Joaquin Area Simulation Model (SANJASM) representing Merced and Tuolumne operations, West Side streams, West Side return flows, flow above the Stanislaus, and water quality above the Stanislaus; and, the Stanislaus Operations Model (STANMODAM) which is a spreadsheet model representing Stanislaus operations under assumptions of Reclamation’s Interim Plan of Operation for New Melones, and Vernalis flow and water quality. To evaluate the effects of the proposed action across a range of hydrologic events, a long-term 71-year (1922 through 1992) hydrological sequence was simulated. Within that period of record various combinations of hydrologic events occurred ranging from periods of extended drought to floods. The SJRA is a twelve-year proposed action, and it is not possible to predict the hydrologic conditions which will occur over the proposed life of the project, 1999-2010. However, by analyzing a long term record containing a historical sequence of water year types, it is possible to illustrate how the proposed action would perform over numerous different sequences of hydrologic conditions.
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A No Action alternative was also analyzed to produce a basis for comparing the effects of implementing the proposed action (SJRA). The full set of detailed assumptions of the No Action setting are provided in Appendix A. The major assumptions are:

- New Melones Reservoir is operated consistent with the 1997 Interim Plan of Operation.
- The Merced and Tuolumne River reservoir systems are modeled to operate to meet diversion demands and minimum instream flow requirements.
- Implementation of the SWRCB’s 1995 WQCP is accomplished through operations of the SWP and CVP.
- Delta smelt and winter run chinook salmon Biological Opinions constraining operations of the SWP and CVP.

These No Action (base case) model settings result in San Joaquin River flow conditions at Vernalis that define the “existing flow” and operational conditions for the SJRA.

The impacts of implementing the Water Right Priority System alternative were determined by analyzing the SWRCB Draft EIR/EIS (1998). The Board utilized the Department of Water Resources Project Simulation Model (DWRSIM) to determine the operational changes required in the San Joaquin Basin to meet the Vernalis flow objectives of the 1995 WQCP. Similar to the above analysis, the SWRCB used an historic hydrology (1922 through 1994) to characterize the impacts across a range of hydrologic conditions. The base case utilized to determine the magnitude and direction of change upon implementation of their alternatives was different than the base case used for analysis of the proposed project (SJRA). The SWRCB assumed, as a no action alternative, that the regulatory environment would revert back to a condition where the SWP and CVP would be solely responsible for meeting pre-Bay/Delta Plan flow objectives (required by D-1485 and D-1422), that is, no implementation of either the New Melones Interim Plan of Operation for achieving the Vernalis flow or the export reduction standards required by the 1995 WQCP to protect fishery and water quality beneficial uses. The SWRCB, however, did simulate an alternative (Alternative 2) in which they assumed that the SWP and the CVP would be solely responsible for meeting the flow and export requirements called for in the 1995 WQCP. In using the SWRCB analysis of the impacts associated with implementing the Water Right Priority System, Alternative 2 was used as the best approximation of “no action” or base line condition.
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   4.1 .................................................................................................................. INTRODUCTION 1
   4.1.1 ............................................................................................................... Scope of Analysis 1
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   4.1.3 ............................................................................................................... Water Uses Potentially Affected 3
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4.10 INDIAN TRUST ASSETS

The affected environment section for Indian Trust Assets was divided into the San Joaquin River Region and Sacramento-San Joaquin Delta in order to facilitate description of the assets of the project area and vicinity. This impact section focuses specifically on these two areas in order to determine whether or not there are any existing Indian Trust Assets (ITAs) that could potentially be impacted by the proposed action.

It is Reclamation’s policy to protect ITAs from adverse impacts of its programs and activities whenever possible. Types of actions which could affect ITAs include an interference with the exercise of a reserved water right, degradation of water quality where there is a water right, impacts to fish and wildlife where there is a hunting or fishing right, or noise near a land asset where it adversely impacts uses of the reserved land. (USBR 1997d)

4.10.1 San Joaquin River Region

Approximately 11 reservations or rancherias are located in the counties that make up this region. In addition, there are also an unknown number of public domain allotments within the region.

Actions evaluated in this EIS/EIR include the management of water resources. It is unknown if there are any ITAs that would be directly affected by the proposed action or alternative action, but it is expected that there would not be any adverse impacts to ITAs in the San Joaquin River Region. Increased or decreased flows would be within the normal floodplain of the affected rivers and would not negatively affect any ITAs that may be located adjacent to rivers.

4.10.2 Sacramento-San Joaquin Delta

There are no reservations or rancherias located in the Sacramento-San Joaquin Delta. There would be no impacts to ITAs in this region as a result of the proposed action or alternative action.

4.10.3 Impact Summary and Mitigation

4.10.3.1 Reservoirs

Proposed Action

- There are no adverse impacts to Indian Trust Assets at any of the reservoirs. No mitigation is necessary.
4. Environmental Consequences and Mitigation Measures

Alternative Action

• There are no adverse impacts to Indian Trust Assets at any of the reservoirs. No mitigation is necessary.

4.10.3.2 Rivers

Proposed Action

• There are no adverse impacts to Indian Trust Assets at any of the rivers. No mitigation is necessary.

Alternative Action

• There are no adverse impacts to Indian Trust Assets at any of the rivers. No mitigation is necessary.
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4.11 ENVIRONMENTAL JUSTICE

This section addresses the concern of whether any group of people, including racial, ethnic, or socioeconomic group, would bear a disproportionate share of adverse environmental effects from implementation of the alternatives. Consideration of environmental justice is a federal requirement based on a Presidential Executive Order 12898; there is no corresponding requirement in CEQA.

4.11.1 Key Impact Issues and Evaluation Criteria

To address environmental justice concerns, the following issues are evaluated:

- Are affected resources are used by a minority or low-income community?
- Are there minority or low-income communities disproportionately subject to environmental or human health impacts?
- Do the resources used for the project support subsistence living?

4.11.2 Environmental Consequences

The San Joaquin River Area contains high percentages of Hispanics and persons/families living below the poverty level. Unemployment is significantly higher in the project area and vicinity than in other regions of the State. Consequently, there is the potential for low-income and minority groups to be disproportionately affected. Since there are no human health impacts from any of the project alternatives (including the No Action alternative), any issues related to environmental justice are focused on environmental impacts on natural resources and potential socioeconomic impacts. There would be no discernable impact to employment from either the proposed or alternative actions, so there is no socioeconomic impact on minority or low-income groups. The principal resources used by low-income and Hispanic groups in the project area are aquatic and recreation resources.

4.11.2.1 Aquatic Resources

No Action

Existing minority and low income groups use project area rivers and reservoirs for recreational fishing. The use is not at a subsistence level where fishers rely on fish and other animals caught in the wild as a major food source. Subsistence use of the renewable natural resources is common among Native Americans. Fishing to supplement normal food sources is expected to continue.
4. Environmental Consequences and Mitigation Measures

Proposed Action

Since implementation of the project alternatives would provide water to enhance aquatic resources (fish), this enhancement to fisheries would provide benefit to minority and low income groups who fish for recreational purposes to supplement their food sources. This beneficial impact however would not disproportionately affect low-income and minority population groups, since the benefit would be available to all fishers.

Alternative Action

Additional flows for the San Joaquin River system, regardless of the source of supplemental water, would provide positive impacts to benefit fisheries. This beneficial impact is not expected to disproportionately affect low-income and minority population groups, since the benefit would be available to all fishers.

4.11.2.2 Recreation Resources

No Action

Existing minority and low income groups in the project area use the area rivers and reservoirs for recreation. This use is expected to continue over the 1999-2010 period. It is not known whether these groups use these resources disproportionately to the overall population.

Proposed Action

The proposed action would result in water releases for stream flow enhancement for fish. These releases would concurrently provide enhanced recreation opportunities. Consequently, there would be a positive effect on low-income and minority populations’ use of the project area rivers. Concerning recreation use at the reservoirs, the low-income and minority populations would benefit from increased reservoir levels at New Melones. Since the proposed action would have no impact at New Don Pedro Reservoir and Lake McClure, there would be no change to recreationists including these two groups.

Alternative Action

The Water Right Priority System alternative has an adverse impact to beach use and boating at New Don Pedro Reservoir during critical water years. Low-income and minority groups would be adversely affected but not disproportionately to other user groups. Concerning river flows, there are no significant adverse impacts to recreationists on the Stanislaus, Tuolumne, and Merced rivers from use of the alternative action. Potentially significant adverse impacts occur on the San Joaquin River
4. Environmental Consequences and Mitigation Measures

during all years except for critical years where the impact is less than significant. These impacts would not occur disproportionately to low-income and Hispanic groups.

4.11.3 Impact Summary and Mitigation of Impacts

4.11.3.1 Aquatic Resources

Proposed Action

• Beneficial impacts to fisheries would not affect environmental justice. No mitigation is required.

Alternative Action

• Beneficial impacts to fisheries would not affect environmental justice. No mitigation is required.

4.11.3.2 Recreation Resources

Proposed Action

• Beneficial impacts to recreation in rivers and reservoirs would not affect environmental justice. No mitigation is required.

Alternative Action

• Adverse impacts to recreation at New Don Pedro Reservoir during critical water years would not affect environmental justice. No mitigation is required.

• No impacts to recreation would occur on the Stanislaus, Tuolumne, and Merced rivers; and there is no impact to environmental justice. No mitigation is required.

• Potentially significant impacts in all water years and less-than-significant impacts to recreationists on the San Joaquin River during critical years would not result in environmental justice impacts. No mitigation is required.
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4.12 CUMULATIVE EFFECTS

Cumulative effects are defined as the combined impact upon the environment which results from the summation of all the incremental effects of the proposed project plus other past, present, and reasonably foreseeable future actions undertaken by the same or other agencies or persons (USBR 1997d). Cumulative impacts can result from individually minor but collectively significant actions taking place over the life of the project. This section identifies a list of related projects (including plans and programs), summarizes the environmental effects of these related projects, qualitatively analyzes the cumulative impacts of the proposed project (in the context of the related projects), and recommends mitigation measures for any significant cumulative impacts.

4.12.1 Actions Included in the Cumulative Impacts Analysis

Actions that may contribute to cumulative effects include the following programs which are described in the following sections.

- State Water Resources Control Board Bay/Delta Process
- Central Valley Project Improvement Act (especially Section 3406(b)(2))
- Interim South Delta Program
- CALFED Bay-Delta Program
- New Melones Long-Term Plan of Operation
- SSJID South County Water Supply Project
- OID/SSJID Water Transfer Project to SEWD

4.12.1.1 State Water Resources Control Board Bay/Delta Process

In 1995, the State Water Resources Control Board (SWRCB) adopted a water quality control plan for the San Francisco Bay/Sacramento-San Joaquin Rivers Delta Estuary (1995 WQCP). The plan identifies municipal and industrial, agriculture, and fish and wildlife beneficial uses and specifies objectives to protect these uses. The objectives consist of numeric objectives for flow, numeric objectives for water quality constituents (salinity and dissolved oxygen), numeric operational constraints, and two narrative objectives for the protection of salmon and brackish tidal marshes in Suisun Marsh. The objectives in the 1995 WQCP are currently implemented through Biological Opinions issued by the U.S. Fish and Wildlife Service (Service) and the National Marine Fisheries
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Service (NMFS) for protection of Delta smelt and winter-run chinook salmon, respectively, and through SWRCB water right decision 1485 (D-1485). Under the Biological Opinions, D-1485, and the interim order, responsibility for meeting most of the objectives is assigned to the State Water Project (SWP), operated by the California Department of Water Resources (DWR), and to the federal Central Valley Project (CVP), operated by the U.S. Bureau of Reclamation (Reclamation). The SWRCB program is an adjudicatory action designed to implement the 1995 WQCP by determining and allocating responsibility for achieving the 1995 WQCP objectives to water right holders (SWRCB 1998).

4.12.1.2 Central Valley Project Improvement Act (Bureau of Reclamation)

On October 30, 1992, the President signed into law the Reclamation Projects Authorization and Adjustment Act of 1992 (Public Law 102-575) that included Title XXXIV, the Central Valley Project Improvement Act (CVPIA). This act amended previous authorizations of the California Central Valley Project (CVP) to include fish and wildlife protection, restoration, and mitigation as project purposes having equal priority with irrigation and domestic uses, and fish and wildlife enhancement as a project purpose equal to power generation. The CVPIA identifies a number of specific measures to meet these new purposes and directs the Secretary of the Interior (Secretary) to operate the CVP consistent with these purposes, to meet the Federal trust responsibilities to protect the fishery resources of affected federally recognized Indian tribes, and to meet all requirements of Federal and California law and to achieve a reasonable balance among competing demands for use of CVP water (USBR 1997d).

The CVPIA mandates changes in the management of the CVP, particularly operation of the CVP to dedicate and manage 800,000 acre-feet of CVP yield for the protection, restoration, and enhancement of fish and wildlife (Section 3406(b)(2)). On November 20, 1997, Interior published its “Final Administrative Proposal on the Management of Section 3406(b)(2) Water” (USBR 1997n). This paper presents how Interior intends to comply with the statutory mandate to dedicate and manage the water dedicated pursuant to Section 3406(b)(2) of the CVPIA. It designates a set of fish, wildlife, and habitat restoration measures that will be implemented over a 5-year (or greater) period. These measures could result in water delivery impacts of 800,000 acre-feet of CVP yield. Actions included in the “(b)(2) water” management program include VAMP and ramping of San Joaquin River flows (after the 31-day pulse flow period). Interior determined that NEPA was not required for the
4. Environmental Consequences and Mitigation Measures

Implementation of Section 3406(b)(2) actions, and this EIS/EIR is addressing only the program to acquire water that would be needed to meet the San Joaquin River flow objectives of VAMP and other needs of the San Joaquin River system. Subsequent litigation on the NEPA exemption for “(b)(2) water” confirmed Interior’s position. The CVPIA program also includes water acquisitions actions designed to meet instream target flows (Section 3406 (b)(3)) for the benefit of fish and wildlife.

Physical measures to restore fish and habitat include: establishment of fish screening programs; development and implementation of measures on the Sacramento River to minimize fish passage problems; expansion of the U.S. Fish and Wildlife Service’s existing hatchery facility; development and implementation of a continuing program to restore and replenish lost spawning gravel; development and implementation of a program that provides for modified operations or new and improved control structures at the Delta Cross Channel and Georgiana Slough; and design and construction of new fish protection structures at selected agricultural pumping facilities (CALFED 1998).

4.12.1.3 Interim South Delta Program (California Department of Water Resources/Bureau of Reclamation)

The objectives of the Interim South Delta Program (ISDP) are to improve water levels and circulation in South Delta channels for local agricultural diversions, improve South Delta hydraulic conditions to increase diversions into Clifton Court Forebay to optimize the frequency of full pumping capacity at the Harvey O. Banks Pumping Plant, and improve fishery conditions for salmon migrating along the San Joaquin River (CALFED 1998).

The preferred alternative for the ISDP is comprised of selected channel dredging of a 4.9-mile reach of Old River from the northwest corner of the Clifton Court Forebay to North Victoria Canal; construction and operation of a new intake gate at Clifton Court Forebay; and construction and operation of three radial gate flow control structures and one radial gate fish control structure in the south Delta, to increase water supply availability for local diverters and improve local fishery conditions. In addition, DWR is seeking a permit from the U.S. Army Corps of Engineers to divert up to 20,430 acre-feet of water per day on a monthly averaged basis from the Delta into Clifton Court Forebay. Collectively, these actions are intended to enhance the management of south Delta water resources to benefit local diverters, Delta fisheries and State Water Project water supply (CALFED 1998).

A Draft EIS/EIR and 404(b)(1) Analysis for ISDP was released for public review and comment in July 1996. The draft documents identified both beneficial and adverse impacts associated with the implementation of ISDP.
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Potential adverse impacts upon aquatic resources include loss of habitat due to dredging of Old River; loss of habitat due to the construction of the proposed facilities; negative flows in channels leading to the South Delta due to the operation of the barriers; and increased straying, predation, and entrainment losses due to high SWP export pumping during the fall, winter, and early spring. Concurrently the project could benefit San Joaquin River fall-run chinook because the spring and fall fish control structure at the Head of Old River would reduce entrainment/predation loss of San Joaquin River salmon smolts at the Tracy and Harvey O. Banks Pumping Plants and improve dissolved oxygen levels in the San Joaquin River (CALFED 1998).

Water quality could be substantially improved in two ways and potentially degraded in one way. First, increased pumping would allow reductions in exports during critical seasons. This change in operation could lead to fewer conflicts among beneficial use of Delta waters. Secondly, the installation of barriers could improve water levels and circulation in the South Delta, and thereby enhance agricultural and municipal uses of the water. However, the operation of the barriers also could degrade water quality by rerouting relatively saline waters of the San Joaquin River away from the South Delta pumping plants, and towards the central Delta (CALFED 1998).

4.12.1.4 CALFED Bay-Delta Program

The CALFED Program began in June of 1995 to address the complex issues that surround the management of the Delta. The CALFED Program is a cooperative, interagency effort involving 15 state and federal agencies with management and regulatory responsibilities in the Bay-Delta. The purpose of the CALFED Program is to develop and implement a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta system (CALFED 1998).

To achieve the programs purpose, CALFED concurrently addresses problems of the Bay-Delta system within four critical resource categories: ecosystem quality, water quality, water supply reliability, and levee system integrity. Important physical, ecological, and socioeconomic linkages exist between the problems and possible solutions in each of these categories. In addition to these four, core-element, categories, the CALFED program is evaluating water storage and conveyance alternatives (CALFED 1998).

New storage is being considered to provide opportunities for enhanced timing and flow management to more effectively and efficiently satisfy urban, agricultural, and environmental beneficial users. Options under consideration include enlarging existing storage facilities, developing new off-stream and on-stream storage reservoirs, and groundwater storage. Conveyance options, intended to convey water from north of the Delta to south of the Delta, are also part of the program alternatives. The various conveyance components range from modifications to existing facilities in the south
Delta, to improvements of existing Delta channels, to the construction of an isolated transfer facility (CALFED 1998).

The Draft Programmatic EIS/EIR for the Bay-Delta Program was released for public comment in March 1998. A final document is expected to be completed in mid 1999.

4.12.1.5 New Melones Long-Term Plan of Operation

Reclamation is committed to completing the New Melones Long-Term Operation Plan with the participation of a wide range of stakeholders in the Stanislaus River Basin. The long term operations of the Stanislaus River will be affected by several pending actions including the SJRA. The stakeholders input combined with resolution of pending actions and planning studies will result in a revision of the 1997 Interim Plan of Operation to produce the long-term plan.

The Interim Operation Plan for New Melones Dam and Reservoir (USBR 1997) will expire October 1, 1998. Based on the general consensus of stakeholders in June 1998, Reclamation will continue to operate under the interim plan through October 1, 1999. Beginning in April 1999, Reclamation will sponsor discussions to consider the Interim Operation Plan for the years 2000 and 2001. (Ploss 1998, e-mail communication)

4.12.1.6 SSJID South County Surface Water Supply Project

The SSJID South County Surface Water Supply project as currently proposed consists of the construction of a water treatment plant to treat water currently held by SSJID under its pre-1914 water rights for use in the Southern San Joaquin County communities of Manteca, Escalon, Lathrop, and Tracy. The project would proceed in two stages. First, SSJID would construct a water treatment plant and associated conveyance facilities with a capacity of up to 30,000 acre-feet annually. The second stage would consist of expanding both the treatment plant and conveyance facilities as needed to a capacity of up to 50,000 acre-feet annually.

An initial study for the SSJID South County Surface Water Supply Project was released in February, 1998. The initial study concluded that an EIR would need to be prepared. SSJID is currently in the process of developing an EIR, and anticipates releasing a draft EIR in early 1999.

4.12.1.7 OID/SSJID Water Transfer Project to SEWD

The OID/SSJID Water Transfer Project to SEWD as currently proposed would transfer up to 30,000 acre-feet of surface water annually over a ten-year period from OID and SSJID through existing conveyance facilities to the SEWD, the City of Stockton, and the Lincoln Village and Colonial Heights Maintenance District. The transferred water would be used by SEWD primarily for direct
municipal and industrial use by the City of Stockton, California Water Service company, and the Lincoln Village and Colonial Heights Maintenance District in order to reduce groundwater pumping and enhance recovery of the Eastern San Joaquin Groundwater Basin.

A Draft Initial Study and Proposed Negative Declaration for the project was released in December, 1997. After reviewing the comments received on that document, OID and SSJID determined that a focused EIR was necessary to address some of the potential environmental impacts of the project. OID and SSJID anticipate that a DEIR for the project will be released in early 1999.

### 4.12.2 Cumulative Impact Analysis

The following is an analysis of projects discussed in Section 4.12.1 and their potential cumulative impacts. The analysis is qualitative in nature. Impacts were based on identified resources potentially affected by each project extracted from the CALFED Bay-Delta Draft Programmatic EIS/EIR (1998). The CALFED analysis based their determination upon available environmental documents/studies or knowledge of the generally expected kinds of effects of similar projects (CALFED 1998). Because of the preliminary phase of most of the projects (environmental reviews have not been initiated, drafted, or finalized), comparable environmental information for identifying cumulative impacts was not available. Table 4.12-1 summarizes the effects of all actions including the SJRA proposed action.
### Table 4.12-1: SUMMARY OF CUMULATIVE IMPACTS

<table>
<thead>
<tr>
<th>Region</th>
<th>Actions Involved</th>
<th>Potential Cumulative Impacts from All Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delta Region</td>
<td>• SWRCB Bay/Delta Process</td>
<td>• Beneficial and detrimental impacts to fisheries and Delta species listed as threatened or endangered</td>
</tr>
<tr>
<td></td>
<td>• Interim South Delta Program</td>
<td>• Beneficial and detrimental impact to water quality and supply availability</td>
</tr>
<tr>
<td></td>
<td>• Central Valley Project Improvement Act</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• CALFED Bay-Delta Program</td>
<td></td>
</tr>
<tr>
<td>Sacramento River Region</td>
<td>• SWRCB Bay/Delta Process</td>
<td>• Beneficial impacts to fisheries and water quality</td>
</tr>
<tr>
<td></td>
<td>• Central Valley Project Improvement Act</td>
<td>• Adverse impact to water supply availability</td>
</tr>
<tr>
<td></td>
<td>• CALFED Bay-Delta Program</td>
<td>• Beneficial and/or adverse impacts to recreation</td>
</tr>
<tr>
<td>San Joaquin River Region</td>
<td>• SWRCB Bay/Delta Process</td>
<td>• Beneficial impacts to water supply reliability and the protection of water rights</td>
</tr>
<tr>
<td></td>
<td>• Central Valley Project Improvement Act</td>
<td>• Beneficial and detrimental impact to water quality</td>
</tr>
<tr>
<td></td>
<td>• CALFED Bay-Delta Program</td>
<td>• Beneficial impact to riparian vegetation, special-status and other wildlife species</td>
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<td></td>
<td>• Interim South Delta Program</td>
<td>• Long-term beneficial impacts to fisheries</td>
</tr>
<tr>
<td></td>
<td>• New Melones long-term plan of operation</td>
<td>• Adverse impacts to agricultural production</td>
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<tr>
<td></td>
<td>• SSJID South County Water Supply Project</td>
<td>• Adverse impacts to groundwater</td>
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<tr>
<td></td>
<td>• OID/SSJID Water Transfer to SEWD</td>
<td></td>
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<tr>
<td>SWP and CVP Service Areas</td>
<td>• All Projects Analyzed</td>
<td>• Adverse impacts to water supply availability and quality</td>
</tr>
</tbody>
</table>

Notes: * All actions include the specific programs mentioned and the SJRA proposed action. Actions have both negative and positive effects as indicated. The summary does not attempt to arrive at a net effect. See subsections of Section 4.12.2 for discussion of individual impacts.

The analysis above represents an approach that combines large projects/plans/programs and two specific recent projects in the OID/SSJID service areas in Stanislaus County. The SJRA proposed action is one component in the larger plans underway by the CALFED Bay-Delta Program and in the implementation of long-term water contracts under the CVPIA. The NEPA/CEQA documents prepared for these regional projects provide detailed analysis of collectively significant projects occurring over the 12-year time frame of the proposed action. Further detailed information on cumulative impacts is provided in the Draft PEIS on the CVPIA (USBR 1997d-n), and this information is herein incorporated by reference.
4. Environmental Consequences and Mitigation Measures

4.12.2.1 Delta Region

The SWRCB Bay/Delta Process would result in beneficial cumulative water quality and fishery impacts within the Delta. The proposed (SJRA) project and alternative (SWRCB Water Right Priority System) actions contribute beneficially to the attainment of most SWRCB Bay/Delta Process objectives for protection of beneficial uses.

Interior’s CVPIA Administrative Proposal for management of (b)(2) water (USBR 1997n) includes Appendix B, Summary of Simulated CVP and SWP Delivery Impacts by Year Type. The impact varies based on hydrologic conditions with the greatest impacts occurring in dry years. Up to 800,000 acre-feet of CVP yield will be dedicated to actions that would benefit fish and wildlife and their habitats which include the Delta ecosystem.

One of the purposes of the (b)(2) water is to assist the State in its efforts to protect the waters of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. Delta actions in the Administrative Proposal include the following: VAMP, Head of Old River barrier/fish control structure, additional X2 protection, maintain Sacramento River flow, ramping of San Joaquin River flows, closure of Delta cross-channel gates based on spring-run chinook salmon protection plan, July flows and exports, and evaluate effects of exports on smolt survival in December-January. Measures to accomplish the actions to benefit Delta and upstream fish and wildlife are: increased Delta export, upstream purchases, joint point of diversion, export deliveries, land retirement, and water reserve account.

VAMP includes flow and export rate manipulation and installation of a barrier at the head of Old River. See Table 2.1-3 for target flows and export rates.

The Interim South Delta Program (ISDP) would have both beneficial and adverse cumulative impacts. Potential adverse impacts include the loss of aquatic resource habitat due to dredging and construction of intake and control structures; increases in reverse flow in some channels under low flow conditions due to the operations of barriers; and increased straying, predation, and entrainment losses due to high export pumping during the fall, winter, and early spring (CALFED 1998).

The ISDP includes the installation and monitoring of temporary flow and fish control structures for potential effects on threatened and endangered species, including a fish control structure at the Head of Old River near Mossdale during the April through June period to protect San Joaquin River salmon migrating through the Delta. A fall flow control structure would also be installed at the Head of Old River to improve dissolved oxygen levels in the San Joaquin River between the Head of Old River and Medford Island to aid salmon migration in the San Joaquin River. Other temporary flow control structures are proposed to reduce dissolved oxygen problems, to avoid salt buildup in south Delta channels, and to lower the salt load in the Delta-Mendota Canal (USFWS 1996b). In particular, the
4. Environmental Consequences and Mitigation Measures

operation of the fish and flow control structures in coordination with the export facilities determines the magnitude of impact to endangered species such as the delta smelt. The beneficial fishery impacts of high spring flows from the San Joaquin (due to project implemented pulse flows) could be offset by adverse impacts to delta smelt from the other projects. Mortalities of delta smelt, entrained into the SWP/CVP export facilities, could be high if the fish control structure at the Head of Old River (which protects emigrating chinook salmon) results in large reverse flows in the southern and central Delta. This hydrologic condition could result in more delta smelt being exposed to entrainment losses as the export facilities zone of influence extends northward. Currently, this condition of protecting delta smelt versus chinook salmon is managed by making the fish control structure at the Head of Old River “operable”; i.e., capable of allowing some flow through the structure to offset reverse flows created in the southern Delta by SWP/CVP exports. The relationship between export levels, operation of the Old River fish control structure, coordination with spring pulse flows in the San Joaquin River, and protection of delta smelt and chinook salmon is currently undergoing intensive study by DWR. At this time, however, adverse impacts to delta smelt could occur in the south Delta depending upon the operational conditions existing at the time of major project actions (e.g., release of spring pulse flows). These cumulative impacts can range from less than significant to significant based on the abundance and distribution of delta smelt, the ratio of flow in the San Joaquin River to SWP/CVP export, and the operation of the Old River fish control structure.

The fish control structure included in VAMP is the ISDP fish control structure described above. The Service issued a Formal Endangered Species Consultation and Conference on the Proposed South Delta Temporary Barrier Project for 1996 through 2000 (USFWS 1996b). They concluded that “the proposed continuation of the Temporary Barriers Project will likely adversely affect delta smelt and Sacramento splittail, and adversely modify or destroy delta smelt critical habitat, both directly and indirectly.” However, the Service also concluded that the temporary installation of the rock barriers are not likely to jeopardize the continued existence of the delta smelt and the proposed Sacramento splittail, or result in the destruction or adverse modification of critical habitat for delta smelt because the impacts are temporary in nature, there are several protective measures in place to reduce the effects of the project, and there will be overall integration of this project with CVP/SWP operations and the Operations Group (USFWS 1996b). Although the temporary fish control structure would not be in place for the full period of VAMP implementation, its continuation or replacement for VAMP would occur under the ISDP.

Beneficial cumulative water quality impacts of the Interim South Delta Program are also expected. Increased pumping would allow reductions in exports during critical seasons when pulse flows from the San Joaquin River were being released. This change in operation could lead to fewer conflicts among beneficial uses of Delta waters. In addition, the installation of fish and flow control structures could improve water levels and circulation in the south Delta, and thereby enhance agricultural and municipal uses of the water. However, the operation of either the Grant Line or Head of Old River
4. Environmental Consequences and Mitigation Measures

barriers could degrade water quality by rerouting relatively saline waters of the San Joaquin River away from the south Delta pumping plant, and toward the central Delta. This degradation of water quality could be exacerbated during the summer as flows from the San Joaquin River drop.

The CVP/SWP project operations may adversely affect fish production and survival in Delta waterways when combined with potential impacts associated with the CALFED or other options to increase storage within the Delta (e.g., Delta Wetlands Project). Potential effects would depend largely on the volume of water released, and the operation of the downstream releases. However, proposed new storage sites and modifications to existing sites associated with the projects within the Sacramento River Region could potentially benefit fisheries resources in the Delta by dampening the water-level fluctuations and improving water quality by increasing the concentration of dissolved oxygen. In-Delta storage projects (CALFED or Delta Wetlands Project) could potentially add adverse effects to Delta water quality and circulation by the discharge of lower quality or potentially contaminated water to receiving waters. All four of the Delta Region actions (Table 4.12-1) could benefit water availability and Delta exports.

4.12.2.2 Sacramento River Region

The conditions for water quality and fisheries in the Sacramento River Region would generally improve with implementation of any of the actions involved (SWRCB, CVPIA, CALFED). This results from increased flows and non-flow actions (CVPIA, CALFED) such as fish screens and fish passage improvements, habitat restoration, improved water quality, and predator control.

Upon implementation of the San Joaquin River Agreement, the Sacramento River flows would likely (1) decrease or remain constant during the pulse flow and (2) increase or remain constant depending on the hydrologic conditions and applicable outflow objectives as SJRA project area reservoirs refill. Outflow can be increased through a reduction of export rates as well as through increased river flows. Depending on the operation of storage reservoirs, which would provide this additional water for flows, recreation could be adversely affected by water levels and discharge/recharge cycles. Non project water users in the Sacramento Valley would not be affected. New storage capacity (under CALFED or CVPIA) would benefit recreation in the long term and have a cumulative beneficial impact on direct recreation activities and indirect activities by increasing water recreation opportunities within the region.

4.12.2.3 San Joaquin River Region

Implementation of the preferred alternative (SJRA) would positively impact the SWRCB Bay/Delta Process. A negotiated settlement would avoid potentially contentious and protracted proceedings to protect Delta beneficial uses. The SJRA action would benefit water supply reliability to meet the objectives of the SWRCB Bay/Delta Process. This would also have beneficial impacts to the
4. Environmental Consequences and Mitigation Measures

protection of water rights in the region since willing sellers, rather than water right modifications, would be used to meet SWRCB Vernalis flow objectives.

Special-status and other wildlife species in the San Joaquin River Region would benefit from the CVPIA project due to land falling and retirement, riparian restoration, increased spring flows, and refuge water supply increases for wetland habitat. The CVPIA land retirement program in the San Joaquin River Region, however, would impact agricultural land use by reducing the amount of available farmland. Reductions in delivery, related to water storage short-falls, could add incrementally to the loss of agricultural production in the Region. Use of groundwater to offset these surface water delivery shortages would have potentially adverse impacts to groundwater resources in an area already characterized by overdraft problems.

As explained in Section 4.12.2.1, the Administrative Proposal for management of (b)(2) water includes much of the proposed action: VAMP 31-day spring pulse flow (up to 110,000 acre-feet) and ramping flows around the pulse flow. The October flow would be in addition to the (b)(2) action and represents an additional benefit.

Fisheries resources would obtain long-term benefits from the CVPIA and CALFED actions by improved conditions along the lower San Joaquin River with respect to temperatures, improved habitat, reduced losses to diversion, and improved fish movement. These benefits would be incrementally increased by the actions proposed in the current project (SJRA), since they involve increased flows to enhance movement of salmon in the basin.

The Interim South Delta Project would have a beneficial cumulative impact on the San Joaquin River fall-run chinook salmon because the spring and fall barriers at the Head of Old River would reduce entrainment/predation loss of San Joaquin River salmon smolts at the Tracy and Harvey O. Banks pumping plant and improve dissolved oxygen levels in the San Joaquin River.

The SSJID South County Water Supply Project and the OID/SSJID Water Transfer Project to SEWD would shift water use away from irrigation use to municipal and industrial uses in San Joaquin County. Such a transfer has the potential for adverse environmental impacts on the Stanislaus River through reduced flows, but because it is anticipated that the water for both projects would be made available largely through conservation and improved conjunctive use of water, these impacts would likely be insignificant. The projects may result in additional groundwater use within OID and SSJID, with possible adverse environmental impacts; but they would likely result in lower groundwater use in the areas receiving the water, thereby reducing groundwater depletion, subsidence, and saltwater intrusion into the aquifers of San Joaquin County, which would be a beneficial environmental impact.
4. Environmental Consequences and Mitigation Measures

4.12.2.4 SWP and CVP Service Areas

A cumulative impact of all the projects analyzed which change operations or add substantially to upstream storage, is the potential to contribute to adverse cumulative water supply availability and water quality impacts within the SWP and CVP Service Areas. When combined with higher instream flow requirements and increased consumptive water use demands placed on water within the SWP and CVP service areas, the cumulative impacts on water supply availability may be significant. Mitigation of these impacts would include the (1) use of water transfers to redistribute water efficiently and as needed, and (2) development of additional water storage facilities. These facilities would primarily be conjunctive use projects that would store surface water in underground aquifers for later withdrawal and use. Potential water quality cumulative impacts would be adverse but not significant (CALFED 1998).
4. Environmental Consequences and Mitigation Measures

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4. Environmental Consequences and Mitigation Measures

4.13 RELATIONSHIP BETWEEN SHORT-TERM USES AND MAINTENANCE OF LONG-TERM PRODUCTIVITY

This section provides a summary of the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity of the affected resources for the proposed action (SJRA) and the alternative action (Water Right Priority System), 1999-2010. There are no short-term construction impacts associated with the releases of water for stream flow enhancement. In summary, the long-term benefits of increased productivity of the San Joaquin River ecosystem and reliability in water supplies outweigh short-term adverse effects on individual resources listed below.

4.13.1 Proposed Action

Surface Water

Most impacts to water deliveries, water storage, and water quality are associated with specific hydrologic conditions, and these conditions vary throughout the period. Potentially significant impacts are short-term impacts (1 to 5 years) related to dry hydrologic events. Over the long-term, the twelve-year period 1999-2010, the probability is low that an extended adverse impact would occur, i.e., a long-term drought. Water supply reliability would be enhanced with the proposed action over the long term. Rather than relying on short-term individual water acquisitions, Reclamation and the Authority would plan their water operations with greater performance reliability.

Groundwater

Groundwater impacts to the Merced Groundwater Basin and to the OID and Exchange Contractors service areas are short term because they are related to dry hydrologic events when the full amount of water would most likely not be required. Over the long term, conjunctive use programs and natural groundwater recharge during wet years would minimize the long-term impact on groundwater overdrafting, water level, water quality, and subsidence problems.

Terrestrial Resources

The pulse flows are to occur in most years, so the impacts to vegetation and wildlife are annual events that would benefit the long-term productivity of the riparian ecosystems as long as the releases are timed to include ramping flows.

Aquatic Resources
4. Environmental Consequences and Mitigation Measures

The pulse flows would occur in most years, so the impacts to aquatic resources are long-term rather than short-term, and most impacts are beneficial. Ramping flows would ensure that juvenile salmon and salmon redds are not adversely affected.

**Land Use**

Short-term impacts are associated with dry hydrologic events that could result in the use of groundwater to offset reductions in irrigation deliveries or reductions in crop production. Over the long term, agricultural production would not be affected. Short-term reductions in employment and income would not significantly affect the regional economy over the long term.

**Cultural Resources**

Exposure of resources to recreational users would occur in the short term due to specific hydrologic events. This impact could affect maintenance of the integrity of the resources over the long term if several dry years occurred over the life of the proposed project, 1999-2010.

**Recreation**

There are no short-term or long-term impacts to recreation on the rivers or at the reservoirs.

**Energy Resources**

Impacts to hydropower generation during peak power production months would occur in the short term at Lake McClure/Merced River, depending on dry hydrologic events. Over the long term, productivity would not be significantly affected. Also, there would be some energy use associated with short-term pumping of groundwater, primarily during dry hydrologic events.

**Indian Trust Assets**

There are no identified Indian Trust Assets in the project area, so there are no short-term impacts to the detriment of long-term protection of these assets for Native Americans.

**Environmental Justice**

There are no environmental justice impacts associated with use of the reservoirs or the rivers in either the short- or long-terms.

4.13.2 Alternative Action
4. Environmental Consequences and Mitigation Measures

Impacts in the short-term are similar to the proposed action and described above (Section 4.13.1). Since the specific water right holders and their geographic locations and service areas are not identified, it is possible that the following resources would be affected differently in either the short- or long-terms.

**Surface Water**

Implementation of the alternative action is accomplished by “taking” (via SWRCB administrative action) the water associated with the rights of junior appropriators as required to achieve the 1995 WQCP objectives. The amount of water required, and therefore the number of junior water right holders affected, varies each year depending upon the water year type (wet, above normal, etc.). Junior appropriators, high on the list (i.e., first to lose their water), could experience long-term significant losses of water deliveries and productivity as their water supply is continually called upon to meet fish attraction and pulse flow needs (except under wet conditions when supply exceeds all the demands). In addition, since it would be impossible to predict (with any degree of certainty) the type of water year in advance, long-term water supply reliability would be sacrificed to meet short-term (annual) needs. This could have significant consequences to productivity, as decision making under this uncertainty would preclude conventional planning and reliability of resources.

**Groundwater**

Other water right holders may rely more heavily on groundwater supplies to provide sufficient releases into the San Joaquin River system. Short-term use of substantial amounts of groundwater could affect the long-term productivity of the affected groundwater basins and the resultant problems of overdrafting, water levels, water quality, and subsidence.

**Land Use**

If any of the water right holders rely on water planned for municipal use, then deliveries to municipal water users would be affected in the short-term, based on hydrologic conditions. Short-term reductions in water deliveries would adversely affect the long-term reliability of water supplies for municipal users which could affect population growth and the regional economy.

**Recreation**

Long-term impacts to boating occur on the San Joaquin River. In the short term, critically dry years, impacts occur to recreationists at New Don Pedro Reservoir.
4. Environmental Consequences and Mitigation Measures

4.13 RELATIONSHIP BETWEEN SHORT-TERM USES AND MAINTENANCE OF LONG-TERM PRODUCTIVITY

4.13.1 Proposed Action

4.13.2 Alternative Action
4. Environmental Consequences and Mitigation Measures

4.14 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF NATURAL RESOURCES

Irreversible impacts are those which cause either directly or indirectly the use of natural resources so that they cannot be restored or returned to their original condition. For both the proposed action and the alternative action, these potential irreversible impacts are associated with consumption of resources: surface water, groundwater, land, and energy. Use of surface and groundwater may be mitigated, depending on the extent to which mitigation can be implemented. Changes in agricultural production could involve the potential loss of agricultural land under the alternative action. Both the proposed and alternative actions result in the loss or consumption of energy resources, either through reduced energy production (hydropower) and/or through additional energy consumption to pump groundwater (directly or indirectly).
4. Environmental Consequences and Mitigation Measures

4.14 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF NATURAL RESOURCES ................................................................. 158
4. Environmental Consequences and Mitigation Measures

4.15 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts are those that cannot be mitigated. A summary of unavoidable adverse impacts for both the proposed and alternative action are as follows:

**Proposed Action**

- **Surface Water, Storage (Merced River)** - The carryover storage for Lake McClure would be reduced during below normal or dry hydrologic conditions.

- **Energy Resources** - Storage in Lake McClure would be decreased more than 10 percent during critical, dry, and below normal years during peak hydropower generation months.

**Alternative Action**

- **Surface Water, Storage (Tuolumne River)** - The carryover storage for New Don Pedro Reservoir would be reduced.

- **Surface Water, Storage (Merced River)** - The carryover storage for Lake McClure would be reduced during below normal or dry hydrologic conditions.

- **Recreation (San Joaquin River)** - Steam flows above the critical flow threshold for boating occur in all years.
4. Environmental Consequences and Mitigation Measures

4.15 UNAVOIDABLE ADVERSE IMPACTS

.......................................................... 159
4. Environmental Consequences and Mitigation Measures

4.16 GROWTH-INDUCING EFFECTS

Section 21100(b)(5) of CEQA requires that an EIR discuss the growth-inducing impacts of a proposed project. This requirement is further explained in the CEQA Guidelines Section 15126(g) which states that an EIR must address “the ways in which the proposed project could foster economic or population growth, or the construction of additional housing, either directly or indirectly in the surrounding environment.” In NEPA, growth-inducing impacts fall under the category of potential indirect effects. Indirect effects include those that occur later in time or farther away in distance, but are still reasonably foreseeable. Growth-inducing projects are those that remove obstacles to population growth or encourage and facilitate other activities that could stimulate growth later in time.

Section 4.6 discusses the effects of the proposed and alternative actions on population, population density, the regional economy and employment, and agricultural land use. Neither alternative would make additional water available to serve municipal and industrial development. Neither alternative would stimulate the economy to a significant level.
4. Environmental Consequences and Mitigation Measures

4.16 GROWTH-INDUCING EFFECTS ................................................................. 160
4. Environmental Consequences and Mitigation Measures

4.2. SURFACE WATER RESOURCES

This section evaluates the surface water/water supply impacts of the two flow alternatives for providing fishery beneficial use protection required in the 1995 WQCP (SWRCB 1995). The two alternatives, the San Joaquin River Agreement (SJRA) and the State Water Resources Control Board (SWRCB) Water Right Priority System, are described in detail in Chapter 2.

4.2.1 Key Impact Issues and Evaluation Criteria

To evaluate the effects of implementation of either alternative on water supply, two key parameters are analyzed: delivery changes and carryover storage changes. These represent the major water supply parameters affected by implementation of the project alternatives.

Key issues identified in the scoping process and considered in this analysis are:

1. Flow changes at Vernalis
2. How sales and transfers of water and changes in flow schedules affect both upstream and downstream water quality and quantity (including the Delta) in the different water year types.
3. Impacts on water supply availability from the New Melones Project.
   - The impact of SJRA on the long-term operations of New Melones Reservoir and the availability of Stanislaus River water for existing and reasonably foreseeable future in-basin needs.
   - Whether the reallocation of Stanislaus River/New Melones water adversely impacts the ability of local agencies to develop future water supplies or impairs their ability to exercise their watershed, basin, or area of origin priorities.
   - Impact on the New Melones Project’s ability to meet water quality objectives at Vernalis including the impacts associated with a different release pattern/timing of releases caused by the acquisition of water on the tributaries.

An issue raised in the public scoping but not addressed in this EIS/EIR is the effects on south Delta water quality, quantity, and flow due to changes in export pumping rates and operation of the South Delta Barrier Program. These issues (i.e., those directly related to exports and the operation of fish and flow control structures) are the subject of other independent NEPA/CEQA analyses for the Interim South Delta Program (ISDP) including the Temporary Barriers Program. The ISDP is to improve water levels and circulation in the South Delta channels and to allow full pumping capacity
4. Environmental Consequences and Mitigation Measures

at Banks Pumping Plant (DWR and USBR 1996). The issues are not within the scope of this proposed action. See Section 4.12, Cumulative Effects, especially Section 4.12.1.3 for more information on the ISDP.

4.2.2 Environmental Consequences

The water supply impact assessment of the proposed project is based upon the hydrologic analysis specifically conducted for this EIR/EIS (Section 4.1.4 and Appendix A). This analysis utilized several operation simulation models developed by Reclamation (PROSIM, SANJASM and STANMOD). A long-term, 71-year (1922 through 1992) hydrological sequence was simulated to characterize impacts over various combinations of hydrologic events, ranging from periods of extended drought to floods.

The water supply impacts of implementing the alternative action (Water Right Priority System) were determined by analyzing the SWRCB Draft EIR (1998) on the 1995 WQCP which used DWRSIM (see Section 4.1.4) to simulate project operations. Unlike the SWRCB Draft EIR analysis, however, the impact assessment conducted here utilized the SWRCB Flow Alternative 2 (rather than Flow Alternative 1) as the base case. Flow Alternative 2 simulated the conditions occurring if the SWP and the CVP were solely responsible for meeting the 1995 WQCP flow and water quality objectives at Vernalis. This represents the closest approximation to the “existing flow and operational conditions” that could be obtained from the SWRCB Draft EIR (1998) analysis.

4.2.2.1 Water Deliveries

No Action

Water deliveries under the No Action alternative would be similar to existing conditions. The San Joaquin River Group willing sellers would continue to operate under present contractual arrangements. The SWP and CVP would be responsible for meeting the Vernalis flow standards stated in the 1995 WQCP. The 1997 New Melones Interim Plan of Operation would continue for the 12-year life of the project.

Proposed Action

The proposed action (SJRA) specifies a protocol by which the SJRGA would provide up to 110,000 acre-feet of water for a pulse flow in April-May, attraction flows in October, and some additional water, provided by Oakdale Irrigation District (OID), to be used at the discretion of Reclamation and the USFWS (see Section 2.1.1 or Appendix A). The need for this water, and hence the potential impact on other surface water beneficial uses, varies with water year type. Consequently, the hydrologic modeling of the SJRA implementation over the historic 71-year hydrologic record
4. Environmental Consequences and Mitigation Measures

(Appendix A) was used to characterize the magnitude of water affected by the proposed action. Tables 4.2.1 and 4.2.2 summarize the resulting water allocation for April and May, respectively. Averages for each water year type were developed for the purpose of evaluating potential impacts.

Table 4.2-1: AVERAGE ALLOCATION OF SJRA WATER (TAF) OVER THE 71-YEAR HYDROLOGIC PERIOD (1922-1992) AND ALLOCATION AS A PERCENT OF MAXIMUM SURFACE WATER AVAILABLE (APRIL RELEASE)

<table>
<thead>
<tr>
<th>Water Year Type</th>
<th>Exchange Contractors (TAF) %</th>
<th>OID/SSJID (TAF) %</th>
<th>MID/TID(^1) (TAF) %</th>
<th>Merced ID (TAF) %</th>
<th>Total (TAF) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet</td>
<td>0.00</td>
<td>0.06</td>
<td>0.01</td>
<td>1.32</td>
<td>1.37</td>
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<tr>
<td>Above Normal</td>
<td>1.81</td>
<td>3.83</td>
<td>0.6</td>
<td>14.99</td>
<td>24.26</td>
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<tr>
<td>Below Normal</td>
<td>4.86</td>
<td>10.45</td>
<td>1.7</td>
<td>29.37</td>
<td>53.96</td>
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<tr>
<td>Dry</td>
<td>6.33</td>
<td>13.99</td>
<td>2.3</td>
<td>37.78</td>
<td>69.29</td>
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<tr>
<td>Critically Dry</td>
<td>2.59</td>
<td>5.33</td>
<td>0.9</td>
<td>18.13</td>
<td>29.61</td>
</tr>
<tr>
<td>71-yr. Average</td>
<td>2.88</td>
<td>6.19</td>
<td>1.03</td>
<td>19.35</td>
<td>33.52</td>
</tr>
</tbody>
</table>

\(^1\) Maximum surface water available was unknown (see Table 3.1-1), thus average annual diversion amounts used to characterize available water.

Table 4.2-2: AVERAGE ALLOCATION OF SJRA WATER (TAF) OVER THE 71-YEAR HYDROLOGIC PERIOD (1922-1992) AND ALLOCATION AS A PERCENT OF MAXIMUM SURFACE WATER AVAILABLE (MAY RELEASE)

<table>
<thead>
<tr>
<th>Water Year Type</th>
<th>Exchange Contractors (TAF) %</th>
<th>OID/SSJID (TAF) %</th>
<th>MID/TID(^1) (TAF) %</th>
<th>Merced ID (TAF) %</th>
<th>Total (TAF) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet</td>
<td>0.38</td>
<td>0.99</td>
<td>0.2</td>
<td>5.54</td>
<td>7.49</td>
</tr>
<tr>
<td>Above Normal</td>
<td>5.56</td>
<td>12.30</td>
<td>2.1</td>
<td>32.18</td>
<td>60.21</td>
</tr>
<tr>
<td>Below Normal</td>
<td>6.57</td>
<td>13.71</td>
<td>2.3</td>
<td>38.77</td>
<td>71.56</td>
</tr>
<tr>
<td>Dry</td>
<td>5.84</td>
<td>12.92</td>
<td>2.2</td>
<td>37.66</td>
<td>67.87</td>
</tr>
<tr>
<td>Critically Dry</td>
<td>2.86</td>
<td>6.93</td>
<td>1.2</td>
<td>20.92</td>
<td>36.04</td>
</tr>
<tr>
<td>71-yr. Average</td>
<td>3.84</td>
<td>8.64</td>
<td>1.4</td>
<td>25.18</td>
<td>44.86</td>
</tr>
</tbody>
</table>

\(^1\) Maximum surface water available was unknown (Table 3.1-1), thus average annual diversion amounts used to characterize available water.
4. Environmental Consequences and Mitigation Measures

Tables 4.2-1 and 4.2-2 document that the average water allocation across all year types and willing sellers ranges from 33,530 acre-feet to 44,860 acre-feet or between 1.1 to 1.5 percent of the total water available from these sellers (based on surface water use provided in Table 3.1-1). The greatest potential adverse impact occurs during below normal and dry years with Merced Irrigation District exhibiting the largest potential change in water supply. Depending upon the water year type and the month in which the fish water release occurs (April or May), Merced ID provides an average of 4.2 percent to 5.6 percent of their total water supplies to the proposed action. This constitutes a potentially significant negative impact on water deliveries which is above the 71-year average.

Table 4.1-1 (see Section 4.1.3) presents the water uses (deliveries) potentially affected by implementation of the preferred alternative. Merced ID potentially provides up to 67,500 acre-feet of water to meet the proposed action needs (October attraction flows and April/May pulse flow). Table 4.2-3 shows the number of times, in a 71-year hydrologic sequence, that the full allocation from each willing seller would be required. There are from 6 to 8 occurrences of this allocation event in the simulated record (8 - 11 percent of the years). In most instances, these full allocations occur during below normal or dry hydrologic conditions when irrigation demand would also be high. Based on the afore stated assumptions, in years of full allocations and in certain sequential hydrologic conditions, Merced ID would potentially experience significant reductions in irrigation deliveries when and if these conditions occurred within the 12-year life of the proposed project.

Table 4.2.3: NUMBER OF OCCURRENCES OF FULL ALLOCATIONS (110 TAF) NEEDED TO MEET SJRA FLOW OBLIGATIONS OVER THE 71-YEAR HYDROLOGIC PERIOD (1922-1992)

<table>
<thead>
<tr>
<th>Water Year Type</th>
<th>April Pulse Flow Release (number of times 110 TAF cap reached)</th>
<th>May Pulse Flow Release (number of times 110 TAF cap reached)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Above Normal</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Below Normal</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Dry</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Critically Dry</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>6</td>
<td>8</td>
</tr>
</tbody>
</table>

The other willing sellers (Exchange Contractors, OID/SSJID, MID/TID) are not as greatly affected. Based on the long term average allocations of 2,880 acre-feet (for the Exchange Contractors) to 6,190 acre-feet for OID/SSJID (Tables 4.2-1 and 4.2-2), these represent only 1 percent or less of their available water supplies and, on average, are less-than-significant impacts to the deliveries of
surface water within their service areas. When periods of full allocation are considered (Table 4.2-3), it is possible for the Exchange Contractors, OID/SSJID, and MID/TID to provide 1.3 percent, 6.2 percent, and 2.6 percent respectively of their total supplies (see Tables 2.1-3 and 3.1-1) to meet their obligations under the Agreement. This is considered a less-than-significant impact when there are full allocations. OID, however, has committed to provide up to 26,000 acre-feet of water independent of water year type. As a result, there is a potentially significant adverse impact to OID’s water deliveries during critically dry years (when allocations are reduced under the 1988 stipulation and agreement with Reclamation). Because some of the 26,000 acre-feet may come from groundwater (conjunctive use), tailwater recovery, or conservation (Table 2.1-3) during critically dry years, the impact to water deliveries in critically dry years can be mitigated to less-than-significant levels.

**Alternative Action**

To evaluate impacts resulting from implementation of the alternative action (SWRCB Water Right Priority System), data from the *Draft Environmental Impact Report for the Implementation of the 1995 Bay/Delta Water Quality Control Plan* (SWRCB 1998) were used. In particular, the State showed 73-year period (1922-1994) and critical period (May 1928-October 1934) annual average water delivery changes for each alternative analyzed (Table V-1 and Table V-2). The SWRCB Alternative 2, where the SWP and CVP were entirely responsible for meeting the 1995 WQCP Vernalis flow objectives, is similar to the base case used in the analysis of the above described preferred alternative (SJRA). It is therefore reasonable to compare the delivery changes of the SWRCB Alternative 2 with the SWRCB Water Right Priority System alternative (SWRCB Alternative 3) to determine the impacts of implementing the alternative action.

The total average annual change in deliveries resulting from implementing the Water Right Priority System is a minus 31,000 acre-feet (the difference between -367,000 thousand acre-feet for Alternative 3 and -336,000 thousand acre-feet for Alternative 2 in Table V-1, SWRCB 1995). For the San Joaquin River Basin, the surface water delivery change is -62,000 acre-feet (Table VI-75, SWRCB 1995). This average annual reduction is distributed across a completely different array of water users (up to 38) than is the proposed action (which uses six specific willing sellers). This reduction is a potentially significant negative impact, since many junior water appropriators would have to completely curtail their diversions in order to achieve the 1995 WQCP Vernalis flow objectives. Similarly, in critically dry years, implementation of the SWRCB Water Right Priority System would result in 12,000 acre-feet of delivery reduction from junior appropriators. This is also considered a potentially significant adverse impact since the delivery change is imposed without regard to the consequences or willing ability of the appropriator(s) to provide the water. The SWRCB analysis does not provide any information on the total water supplies available to the junior appropriators affected by this alternative. Therefore, an objective determination of the magnitude of impact is not possible, and the effect is considered a potentially significant adverse impact.
4. Environmental Consequences and Mitigation Measures

4.2.2.2 Carryover Storage in San Joaquin Basin Reservoirs

Carryover storage is the amount of water retained in a reservoir at the end of September of each water year. Carryover storage helps meet future demand in the event that the next year is dry. The amount of water dedicated to carryover storage is balanced against the amount needed to meet immediate delivery needs, hydropower generation needs, and instream flow requirements of a project, according to operation rules that differ for each reservoir (SWRCB 1998).

To determine the impacts of implementing the project alternatives on carryover storage, average September end-of-month storage volumes for each flow alternative are compared to those of the base case. Reservoirs in this analysis include New Melones Reservoir, New Don Pedro Reservoir and Lake McClure.

No Action

Average carryover storage in the reservoirs of the San Joaquin River Basin under the No Action alternative are shown in Tables 4.2-4 and 4.2-5. The SWP and CVP would be responsible for meeting the Vernalis flow standards stated in the 1995 WQCP. The New Melones Interim Operation Plan would continue for the 12-year life of the project. These No Action storage levels reflect any existing operational constraints (e.g., flood control, FERC license agreements, etc.) which affect the volume of water in the reservoir or determine a minimum carryover storage.

Table 4.2-4: AVERAGE END-OF-YEAR STORAGE (TAF) IN PROJECT RESERVOIRS FOR NO ACTION - APRIL *

<table>
<thead>
<tr>
<th>Water Year Type</th>
<th>New Melones Reservoir (TAF)</th>
<th>New Don Pedro Reservoir (TAF)</th>
<th>Lake McClure (TAF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet</td>
<td>1831</td>
<td>1703</td>
<td>749</td>
</tr>
<tr>
<td>Above Normal</td>
<td>1330</td>
<td>1445</td>
<td>659</td>
</tr>
<tr>
<td>Below Normal</td>
<td>1251</td>
<td>1260</td>
<td>501</td>
</tr>
<tr>
<td>Dry</td>
<td>1144</td>
<td>1218</td>
<td>400</td>
</tr>
<tr>
<td>Critically Dry</td>
<td>746</td>
<td>864</td>
<td>317</td>
</tr>
<tr>
<td>71-yr. Average</td>
<td>1299</td>
<td>1325</td>
<td>544</td>
</tr>
</tbody>
</table>

* “April Pulse” releases are included in the No Action alternative from the Stanislaus and Tuolumne rivers.
Table 4.2-5: AVERAGE END-OF-YEAR STORAGE (TAF) IN PROJECT RESERVOIRS FOR THE NO ACTION - MAY

<table>
<thead>
<tr>
<th>Water Year Type</th>
<th>New Melones Reservoir (TAF)</th>
<th>New Don Pedro Reservoir (TAF)</th>
<th>Lake McClure (TAF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet</td>
<td>1831</td>
<td>1697</td>
<td>749</td>
</tr>
<tr>
<td>Above Normal</td>
<td>1331</td>
<td>1426</td>
<td>659</td>
</tr>
<tr>
<td>Below Normal</td>
<td>1251</td>
<td>1241</td>
<td>501</td>
</tr>
<tr>
<td>Dry</td>
<td>1145</td>
<td>1204</td>
<td>400</td>
</tr>
<tr>
<td>Critically Dry</td>
<td>754</td>
<td>856</td>
<td>317</td>
</tr>
<tr>
<td>71-yr. Average</td>
<td>1300</td>
<td>1312</td>
<td>544</td>
</tr>
</tbody>
</table>

Proposed Action

Implementation of the preferred alternative, the flows in the San Joaquin River Agreement, affects carryover storage in the reservoirs within the project area. These changes have been summarized, by water year type for the New Melones, New Don Pedro, and Lake McClure reservoirs (Tables 4.2-6 through 4.2-8).

The changes in carryover storage in New Melones Reservoir resulting from implementation of the proposed action are shown in Table 4.2-6. This Stanislaus River reservoir experiences an average increase in storage over the 71 years of the hydrologic sequence of 53,000 to 59,000 acre-feet (8 to 9 percent increase over the base case). Change in end-of-year storage varies by water year type, with the greatest change (77,000 to 72,000 acre-feet) occurring in critically dry water years (a 24 to 21 percent increase over No Action alternative depending upon which month the pulse flow is released). Under the proposed action, this significant beneficial impact to carryover storage during critically dry years is the direct result of using project water obtained from willing sellers, rather than having Reclamation provide requisite flows via releases from their facility. In addition, the May 1997 New Melones Interim Plan of Operation, and its stakeholder refinement during 1998, will result in an operation plan to be determined by U.S. Department of Interior.
4. Environmental Consequences and Mitigation Measures

Table 4.2-6: NEW MELONES RESERVOIR-STANISLAUS RIVER AVERAGE CHANGE IN END-OF-YEAR STORAGE (TAF) UPON IMPLEMENTATION OF THE PROPOSED ACTION (SJRA)

<table>
<thead>
<tr>
<th>Water Year Type</th>
<th>Average Change in Storage (TAF) (April Release)</th>
<th>Percent Change (April Release)</th>
<th>Average Change in Storage (TAF) (May Release)</th>
<th>Percent Change (May Release)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet</td>
<td>47</td>
<td>3</td>
<td>42</td>
<td>2</td>
</tr>
<tr>
<td>Above Normal</td>
<td>66</td>
<td>6</td>
<td>55</td>
<td>5</td>
</tr>
<tr>
<td>Below Normal</td>
<td>57</td>
<td>5</td>
<td>52</td>
<td>5</td>
</tr>
<tr>
<td>Dry</td>
<td>49</td>
<td>6</td>
<td>47</td>
<td>5</td>
</tr>
<tr>
<td>Critically Dry</td>
<td>77</td>
<td>24</td>
<td>72</td>
<td>21</td>
</tr>
<tr>
<td>71-yr. Average</td>
<td>59</td>
<td>9</td>
<td>53</td>
<td>8</td>
</tr>
</tbody>
</table>

The project can affect New Melones Reservoir operations. Up to 26,000 acre-feet per year would be made available to Reclamation by OID. As modeled, this water would be made available to Reclamation in New Melones Reservoir as a reduction in the amount of water that is diverted by OID. The current Interim Operations Plan would initially treat this water as additional carryover storage after the year has passed, and then enter that effect on storage into the next year’s allocation of water. The current rules for allocating additional storage (or inflow) at New Melones Reservoir under the Interim Operations Plan will not allocate “out” every additional acre-foot of additional storage or inflow. Thus, as modeled, a substantial portion of the OID water remains in storage, carried forward into the next year, and at times accumulating several years in a row. There is no attempt in this analysis to presume how the additional water would be allocated among Reclamation purposes, one of which is a desire for additional carryover storage.

Additionally, although not experienced in the modeling, at times there may be occasions when releases from the SJRG members under the SJRA may contribute to flows at Vernalis that would otherwise be required of Reclamation. To the extent that Reclamation can reduce its releases from New Melones Reservoir in recognition of this occurrence, water will be conserved in New Melones Reservoir for additional allocation or reserved as carryover storage.

As a result of project implementation, the New Don Pedro Reservoir would experience less-than-significant changes in carryover storage (Table 4.2-7). The average change (over the 71-year hydrology) is only a 1 percent decrease from the base line; an 11,000 acre-feet decrease in storage for a reservoir which has over 2.3 million acre-feet in capacity. Even the largest average decrease observed, 24,000 acre-feet during below normal years with a May pulse flow release, would represent only a 2 percent decrease from the base line in carryover storage. At a lake elevation of 763.7 feet
4. Environmental Consequences and Mitigation Measures

(the elevation corresponding to the average storage over the 71-year period) the largest change in storage (a 24,000 acre-feet decrease) would result in only a 2.6 foot drop from the normal water level elevation.

Table 4.2-7: NEW DON PEDRO RESERVOIR-TUOLUMNE RIVER AVERAGE CHANGE IN END-OF-YEAR STORAGE (TAF) UPON IMPLEMENTATION OF THE PROPOSED ACTION (SJRA)

<table>
<thead>
<tr>
<th>Water Year Type</th>
<th>Average Change in Storage (TAF) (April Release)</th>
<th>Percent Change (April Release)</th>
<th>Average Change in Storage (TAF) (May Release)</th>
<th>Percent Change (May Release)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet</td>
<td>0</td>
<td>0</td>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>Above Normal</td>
<td>-12</td>
<td>-1</td>
<td>-22</td>
<td>-2</td>
</tr>
<tr>
<td>Below Normal</td>
<td>-20</td>
<td>-2</td>
<td>-24</td>
<td>-2</td>
</tr>
<tr>
<td>Dry</td>
<td>-22</td>
<td>-2</td>
<td>-23</td>
<td>-2</td>
</tr>
<tr>
<td>Critically Dry</td>
<td>-10</td>
<td>-1</td>
<td>-17</td>
<td>-2</td>
</tr>
<tr>
<td>71-yr. Average</td>
<td>-11</td>
<td>-1</td>
<td>-16</td>
<td>-1</td>
</tr>
</tbody>
</table>

With implementation of the proposed action (SJRA), Lake McClure, on the Merced River, would sustain the largest drop in carryover storage (Table 4.2-8). The average decrease over the 71-year hydrologic sequence was 47,000 to 58,000 acre-feet of storage; this represents a 10 to 13 percent reduction in carryover storage. The largest decrease occurred during below normal and dry years where from 79,000 to 91,000 acre-feet were removed depending upon the release month and year type. This constitutes a potentially significant negative impact; between 17 and 23 percent reduction in carryover storage occurs compared to the No Action alternative. Lake McClure is the smallest of the reservoirs within the project area with slightly over 1.0 million acre-feet of capacity. At a lake elevation of 782.2 feet (the elevation corresponding to the average 71-year storage), the lake pool elevation would drop approximately 22.2 feet during a dry year with a May pulse flow release due to implementation of the proposed project. To look at this comparison another way, the average lake elevation in a below normal water year is 772.1 feet and in a dry year is 745.5 feet. The lake would drop approximately 23.7 feet during a below normal year and 28.5 feet during a dry year with the May pulse flow release due to the implementation of the proposed project.
Table 4.2-8: LAKE MCCLURE (NEW EXCHEQUER)-MERCED RIVER AVERAGE CHANGE IN END-OF-YEAR STORAGE (TAF) UPON IMPLEMENTATION OF THE PROPOSED ACTION (SJRA)

<table>
<thead>
<tr>
<th>Water Year Type</th>
<th>Average Change in Storage (TAF) (April Release)</th>
<th>Percent Change (April Release)</th>
<th>Average Change in Storage (TAF) (May Release)</th>
<th>Percent Change (May Release)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet</td>
<td>0</td>
<td>0</td>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>Above Normal</td>
<td>-49</td>
<td>-7</td>
<td>-73</td>
<td>-11</td>
</tr>
<tr>
<td>Below Normal</td>
<td>-79</td>
<td>-16</td>
<td>-91</td>
<td>-18</td>
</tr>
<tr>
<td>Dry</td>
<td>-84</td>
<td>-21</td>
<td>-91</td>
<td>-23</td>
</tr>
<tr>
<td>Critically Dry</td>
<td>-53</td>
<td>-17</td>
<td>-67</td>
<td>-21</td>
</tr>
<tr>
<td>71-yr. Average</td>
<td>-47</td>
<td>-10</td>
<td>-58</td>
<td>-13</td>
</tr>
</tbody>
</table>

Alternative Action

Implementation of the alternative action, the SWRCB Water Right Priority System, would have beneficial impacts to New Melones Reservoir, and potentially significant negative impacts to New Don Pedro Reservoir and Lake McClure, respectively. Table 4.2-9 shows the changes in reservoir carryover storage for the three San Joaquin Basin reservoirs within the project area. The changes are determined using the SWRCB Alternative 2 as the base case. In the San Joaquin system, New Melones would carry all the responsibility for meeting the Vernalis standards, which in effect, would be equivalent to the New Melones Interim Plan of Operation which governs current operational conditions.

Table 4.2-9: CHANGE IN RESERVOIR CARRYOVER STORAGE (TAF) RESULTING FROM IMPLEMENTATION OF THE SWRCB WATER RIGHT PRIORITY SYSTEM (FROM SWRCB 1998).

<table>
<thead>
<tr>
<th>Period</th>
<th>New Melones Reservoir (TAF)</th>
<th>New Don Pedro Reservoir (TAF)</th>
<th>Lake McClure Reservoir (TAF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>73-year Period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>219</td>
<td>-90</td>
<td>-55</td>
</tr>
<tr>
<td>Critical Period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>486</td>
<td>-325</td>
<td>-47</td>
</tr>
</tbody>
</table>

With the alternative action, New Melones Reservoir would experience a significant increase in carryover storage related to the use of other water supplies within the San Joaquin Basin. The 73-
4. Environmental Consequences and Mitigation Measures

year average increase in storage of 219,000 acre-feet is a beneficial impact of implementing this alternative. Similarly, the average increase of 486,000 acre-feet of carryover storage during the critical period (1928-1934) is also a significant beneficial impact to New Melones carryover storage.

Conversely, with the alternative action, New Don Pedro Reservoir would experience a significant negative impact to carryover storage. The average decrease of 90,000 acre-feet over the 73-year period, and 325,000 acre-feet during the critical period constitute a significant reduction in storage within this reservoir resulting directly from implementation of the Water Right Priority System allocation of flow.

With implementation of the alternative action, Lake McClure would also be subjected to a decrease in carryover storage. The 73-year period average was 55,000 acre-feet lower than the base case. The critical period average was 47,000 acre-feet lower than the base case. These reductions in carryover storage constitute a potentially significant adverse impact to this 1.1 million acre-feet reservoir as a result of implementing the alternative action (SWRCB Water Right Priority System).

4.2.2.3 Water Quality

Changes in water quality at Vernalis due to implementation of the alternatives were evaluated using the hydrologic analysis. Reclamation models predicted Total Dissolved Solids (TDS) at Vernalis for every month within the hydrologic sequence simulated (1922-1992). Comparison of the predicted TDS for each month against the 1995 WQCP objective for that month (converted from Electrical Conductivity to TDS) facilitate an assessment of whether the standard was exceeded or met. Instances when the action causes an incremental exceedence of the standard are interpreted as a negative affect; conversely, actions causing an incremental attainment of water quality values below the standard are considered to be a benefit.

No Action

The No Action alternative assumes that New Melones Reservoir is operated consistent with the Interim Operation Plan (USBR 1997c) and is solely responsible for meeting the SWRCB 1995 WQCP objectives. When there is insufficient water in New Melones Reservoir to meet all of the demands, salinity objectives cannot be met. Table 4.2-10 shows the number of times the Vernalis salinity objectives were exceeded over the 71-year hydrologic period simulated in the hydrologic analysis. This table only shows the months of exceedence; other months of the year never exhibited water quality in excess of the standards. The No Action alternative for both the April and May pulse flow release is shown, since differences in average monthly values occur depending upon the release month.
4. Environmental Consequences and Mitigation Measures

Table 4.2-10: NUMBER OF EXCEEDENCES OF 1995 BAY/DELTA WATER QUALITY OBJECTIVE AT VERNALIS OVER THE 71-YEAR HYDROLOGIC PERIOD

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No Action- April</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>22</td>
<td>28</td>
<td>11</td>
<td>85</td>
</tr>
<tr>
<td>SJRA Action- April</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>7</td>
<td>20</td>
<td>27</td>
<td>11</td>
<td>73</td>
</tr>
<tr>
<td>No Action- May</td>
<td>10</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>20</td>
<td>27</td>
<td>11</td>
<td>82</td>
</tr>
<tr>
<td>SJRA Action- May</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>19</td>
<td>27</td>
<td>11</td>
<td>59</td>
</tr>
</tbody>
</table>

Water quality exceedence based on monthly averages occurs in the fall (October and November), winter (February), and through the summer low flow period (June through July). The greatest number of months with exceedences, and the largest magnitude of exceedence, occur during the low flow summer period (Table 4.2-10). The standards during this period (June through August) are also at their lowest of the year, 455 TDS (SWRCB 1997).

Table 4.2-11 presents the average monthly values for total dissolved solids (TDS) for the No Action and SJRA alternatives for the 71-year hydrologic period by water year type. Of concern is the June through August period when the water quality standard for salinity is 455 TDS.
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**TABLE 4.2-11: AVERAGE WATER QUALITY (TDS) AT VERNALIS BY WATER YEAR TYPE**

<table>
<thead>
<tr>
<th>WATER YEAR AVERAGE - NO ACTION APRIL - WATER QUALITY (TDS) AT VERNALIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>WY Type</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>Wet</td>
</tr>
<tr>
<td>Above</td>
</tr>
<tr>
<td>Below</td>
</tr>
<tr>
<td>Dry</td>
</tr>
<tr>
<td>Critical</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WATER YEAR AVERAGE - PROPOSED ACTION APRIL - WATER QUALITY (TDS) AT VERNALIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>WY Type</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>Wet</td>
</tr>
<tr>
<td>Above</td>
</tr>
<tr>
<td>Below</td>
</tr>
<tr>
<td>Dry</td>
</tr>
<tr>
<td>Critical</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WATER YEAR AVERAGE - NO ACTION MAY - WATER QUALITY (TDS) AT VERNALIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>WY Type</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>Wet</td>
</tr>
<tr>
<td>Above</td>
</tr>
<tr>
<td>Below</td>
</tr>
<tr>
<td>Dry</td>
</tr>
<tr>
<td>Critical</td>
</tr>
</tbody>
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<tr>
<th>WATER YEAR AVERAGE - PROPOSED ACTION MAY - WATER QUALITY (TDS) AT VERNALIS</th>
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Proposed Action

Implementation of the proposed action results in an overall reduction in the number of salinity standard exceedences at Vernalis. The most significant beneficial impact occurs during the month of October where all exceedence events would be eliminated by the proposed action. There also would be some improvement in June and July, and potential improvement in November (if the pulse flow were released entirely in May) or August (if the pulse flow were released entirely in April).

The improvements in water quality at Vernalis take into consideration the increased flow of high quality water from the San Joaquin River tributaries, which occurs in October and during the spring (April/May). No improvements (as measured by numbers of exceedence) were seen from the Spring Pulse Flows, since water quality is inherently good in the basin at this time as pulse flows occur in the basin. Evaluation of the average change in TDS during the pulse flow periods revealed a measurable improvement in water quality. The average decrease in TDS was 27 mg/l and 36 mg/l for the April and May release, respectively.

While not modeled, the potential use of agricultural return flow water by OID/SSJID and by the Exchange Contractors to meet their SJRA commitments does not appear to impact overall quality of the San Joaquin River at Vernalis. This is largely due to the fact that small quantities of potentially lower quality return flow would be added to large flows from the Merced, Tuolumne, and Stanislaus rivers that are high in quality.

The improvement in water quality at Vernalis resulting from implementation of the proposed project should also maintain or improve water quality in the South Delta. The exact magnitude and distribution of this beneficial impact cannot be assessed by the monthly analysis performed herein which is based on Appendix A.

Alternative Action

The SWRCB evaluated the change in salinity as a result of implementing the suite of flow alternatives they considered in their DEIR (SWRCB 1998). Using the Board’s Flow Alternative 2 (SWP/CVP responsible for meeting 1995 WQCP objectives), a comparison was made with the predicted salinity resulting from implementing the Water Right Priority System (Flow Alternative 3). The SWRCB’s analysis simulated average end-of-month Electrical Conductivity for the 73-year hydrologic period. Their results indicated that monthly averages during the 73-year period only exceeded the salinity standard during June, July, and August.

Overall the SWRCB predicted a net improvement in water quality due to implementation of the alternative action in November, December, January, February, and March. These were times when the salinities were lower than the standard, even for the base case (Flow Alternative 2). During the remaining months of the year, the SWRCB’s analysis indicated that salinities were greater with the alternative action than with no action; the quality exceeded standards during June, July, and August. Furthermore, during these exceedence periods the implementation of the alternative action actually
increased the salinity. Since implementation of the alternative action would create further degradation in an already degraded water quality environment in the San Joaquin River at Vernalis, this is a potentially significant adverse impact.

Inspection of the SWRCB’s impact analysis (1998) leads to the qualitative conclusion that implementation of the Water Right Priority System alternative would lead to potentially significant impacts to water quality during the summer months (when quality is already exceeding standards and further degradation could potentially limit the beneficial uses of water). Some benefits to quality occur during the late fall and winter months when quality is naturally high. The significant negative impacts would need to be mitigated by releases of water from New Melones Reservoir sufficient to achieve the standards.

4.2.3 Impact Summary and Mitigation of Impacts

4.2.3.1 Water Deliveries

Proposed Action

- Implementation of the preferred alternative (SJRA) would result in potentially significant impacts to water deliveries for Merced ID during critically dry conditions and under below normal or dry hydrologic conditions only when full allocations and certain sequential hydrologic conditions occur. Under such circumstances, impacts can be mitigated by implementation of a conjunctive use program to store surface water in groundwater aquifers during times of surplus which can then be pumped to augment surface supplies during times of shortages.

- Implementation of the preferred alternative (SJRA) would result in potentially significant adverse impacts for OID water deliveries during critically dry years when the District does not receive its full allocation. OID does not have storage capacity to offset these shortages. Therefore, to reduce these potentially significant impacts to less-than-significant levels, OID through conjunctive use, reclamation, and improved efficiency, could make up for the water shortage in critically dry years.

- All other willing sellers/willing buyers water deliveries would either be unaffected by the preferred action or experience less-than-significant impacts.

Alternative Action

- Implementation of the SWRCB Water Right Priority System would have significant adverse impacts to water deliveries within the San Joaquin River Basin. Average annual deliveries would be reduced by 62,000 acre-feet and, at times, complete curtailment of diversions by junior water right appropriators. The number and composition of the affected appropriators are different than the preferred alternative and vary with water year type. It was not possible
4. Environmental Consequences and Mitigation Measures

with available information to determine if these potentially significant impacts to junior appropriators could be mitigated.

4.2.3.2 Water Storage

Proposed Action

• Implementation of the preferred alternative (SJRA) would result in beneficial impacts to carryover water storage for New Melones Reservoir. No mitigation is required.

• A less-than-significant adverse impact to carryover storage in New Don Pedro Reservoir would result. No mitigation is required.

• A potentially significant negative impact to carryover storage for Lake McClure (Merced Irrigation District) would occur during below normal or dry hydrologic conditions. These impacts are unmitagable and therefore unavoidable.

Alternative Action

• A beneficial impact (i.e., a large increase in storage) would occur to New Melones reservoir as other water supplies within the San Joaquin Basin would be used to meet the 1995 WQCP Vernalis flow objectives.

• A significant negative impact to New Don Pedro Reservoir storage would occur with implementation of the alternative action as reservoir storage would be used to meet 1995 WQCP Vernalis flow objectives. These impacts are unmitagable and therefore unavoidable.

• A potentially significant negative impact to Lake McClure storage would occur with implementation of the alternative action as reservoir storage would be used to meet 1995 WQCP Vernalis flow objectives. These impacts are unmitagable and therefore unavoidable.

4.2.3.3 Water Quality

Proposed Action

• Beneficial impacts to water quality would occur in the San Joaquin River at Vernalis during October as instances of the exceedence of standards are reduced. No mitigation is required.

• Beneficial impacts to water quality may also occur in June and July, and potentially in November or August (depending upon when the pulse flow would be released) as the number of times the salinities exceed the standards at Vernalis are reduced. No mitigation is required.

• April or May Spring Pulse flow would reduce salinities, on the average, by 27 to 36 mg/l and would be a beneficial impact. No mitigation would be required.
Alternative Action

- Implementation of the Water Right Priority System would improve water quality at Vernalis during November, December, January, February, and March and would be a beneficial impact. No mitigation would be required.

- Potentially significant adverse impacts to water quality at Vernalis would occur during the summer months (June, July, and August). Quality at Vernalis already exceeds standards during this period, and based on the SWRCB modeling assumptions, further degradation of water quality as a result of implementing the alternative action could limit beneficial uses. Mitigation of these impacts to a less-than-significant level would require additional water releases from New Melones by Reclamation.
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4.3 GROUNDWATER

This section describes changes to groundwater conditions associated with the project alternatives, as compared to the No Action alternative. Groundwater conditions for each alternative are compared to the No Action alternative, and associated impacts are reported.

In certain alternatives, specific groundwater basins within the project area may be affected by the proposed action. However, the groundwater basins within the San Joaquin River Group Authority members’ service areas are all part of the San Joaquin River Region, thus are to some extent hydraulically connected.

4.3.1 Impact Issues and Evaluation Criteria

Specific environmental impacts and concerns that were identified during the public scoping phase of this project include:

- Impacts on the Eastern San Joaquin Groundwater Basin from the acquisition of water on the San Joaquin River tributaries.
- Impacts of reductions of the use of surface water from the Stanislaus and Tuolumne Rivers in Stanislaus County on groundwater usage in Stanislaus County. Will the water acquisitions for SJRA be offset locally by increased groundwater pumping, and if so, what will be the impact on local groundwater resources?
- Extent to which San Joaquin River Agreement (SJRA) would result in additional groundwater pumping.
- Cumulative effects of the proposed project and other ongoing projects on water quality and quantity.

Groundwater impacts for each alternative are summarized as changes to groundwater overdrafting, groundwater levels, groundwater quality, subsidence, subsurface drainage, and waterlogging compared to the No Action alternative. These conditions represent the general response of the groundwater basins to potential increases in groundwater withdrawals as part of the water required for the proposed SJRA flows. Changes in groundwater storage provide a measure of associated groundwater impacts such as changes in groundwater-surface water interaction, subsidence of the ground surface, migration and upwelling of poor-quality groundwater, impairment of subsurface drainage systems in areas of poorly drained soils, and high groundwater tables adjacent to streams with known seepage-induced waterlogging problems.
Significance determinations for the impact analysis are based on the quantity of groundwater involved directly or indirectly and on the existing overdraft conditions in the basin.

### 4.3.2 Environmental Consequences

Within the San Joaquin River Region, approximately 2.6 million acre-feet of groundwater is extracted in a typical year (DWR 1998). The majority of the groundwater is pumped by a combination of private agricultural interests and municipalities. The approximate annual volume of groundwater utilized by the willing sellers at present ranges from 9,668 acre-feet by OID to 144,000 acre-feet utilized by the Exchange Contractors (Table 3.1-1). The willing sellers’ total groundwater use annually ranges from approximately 0.4 percent to 5.5 percent of the total groundwater pumped within the basin. The following sections are by basin or service area.

#### 4.3.2.1 Groundwater Overdrafting

Groundwater overdraft is defined by Department of Water Resources (DWR) as the condition of a groundwater basin where the amount of water extracted exceeds the amount of groundwater recharging the basin “over a period of time” (DWR 1980). To quantify overdraft, the period of time must be of sufficient duration to produce a record that can be used to approximate the long-term average hydrologic conditions in the basin. In the California Water Plan Update (Draft) (DWR 1998), DWR estimated the amount of groundwater overdraft in the Central Valley. In the San Joaquin River Basin, groundwater overdraft is estimated to be 240,000 acre-feet and occurs throughout the basin.

Because groundwater is typically used to replace much of the shortfall in surface water supplies, water delivery reductions resulting from the proposed alternative could increase groundwater overdraft within the various willing sellers’ groundwater basins. Water delivery reductions for the willing sellers resulting from the proposed action are reported in Table 4.1-1. For this evaluation of groundwater storage, these quantities are assumed to be the maximum increase in groundwater pumping that would result from the different alternatives. The deficiency caused by the surface water diversion can also be made up by other water management methods including, but not limited to, tailwater recovery and water conservation.

**South San Joaquin Irrigation District (SSJID) Service Area**

DWR Bulletin 118 (1996) has identified the groundwater basin underlying eastern San Joaquin County as a critically overdrafted basin. Groundwater extraction in the urban area of SSJID is estimated to exceed the safe yield of one acre-foot per acre per year, while groundwater extraction in agricultural areas is significantly below the safe yield. As a result, the average extraction rate within the SSJID is less than the estimated safe yield; and, therefore, the SSJID’s portion of the groundwater basins technically is not overdrafted (SSJID 1994).
SSJID estimates that the typical agricultural groundwater production rate in the service area is 32,400 acre-feet. Of this volume approximately 11,200 acre-feet per year is pumped by SSJID with the remainder pumped from private wells (SSJID 1993). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

**No Action.** The No Action alternative represents existing conditions plus reasonable foreseeable future conditions that would exist without the proposed action. Projected agricultural and municipal groundwater demands for the SSJID service area are 58,000 acre-feet per year. SSJID estimates their groundwater extraction rates would remain below the safe yield of one acre-foot per acre per year. Given their projected usage of groundwater, overdrafting of the SSJID groundwater basin from SSJID pumping would not increase.

**Proposed Action.** The proposed action, outlined in the San Joaquin River Agreement, provides water from the Authority for achieving the Vernalis Adaptive Management Plan (VAMP) pulse flow, up to 110,000 acre-feet (except in double-step years where it could be 160,000 acre-feet). The volume of water for all flows (excluding double-step years) is capped at 137,500 acre-feet in any year (see Table 2.1-3). Maximum annual surface water diversion for the pulse flow event from the SSJID service area is 11,000 acre-feet. Of this volume, SSJID projects that none of this water would come from groundwater. There would be no impact to the overdraft problem within eastern San Joaquin County as a result of this action.

**Alternative Action.** To evaluate impacts resulting from implementation of the alternative action (SWRCB Water Right Priority System), data from the *Draft Environmental Impact Report for the Implementation of the 1995 Bay/Delta Water Quality Control Plan* (SWRCB 1998) was used. In particular, the State showed 73-year period (1922-1994) and critical period (May 1928-October 1934) annual average water delivery changes for each alternative analyzed (Table V-1 and Table V-2). The total average annual change in deliveries resulting from implementing the Water Right Priority System is a minus 31,000 acre-feet. This average annual reduction is distributed across a completely different array of water users than is the proposed action (which uses specific willing sellers). Similarly, in critically dry years, implementation of the SWRCB Water Right Priority System would result in 12,000 acre-feet of delivery reduction from junior appropriators and would be imposed without regard to the consequences or willing ability of the appropriator(s) to provide the water. The SWRCB analysis does not provide information on the total water supplies available to the junior appropriators affected by this alternative.

If other water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped by SSJID and other water right holders to supplement reduced surface water deliveries is not known at this time.
4. Environmental Consequences and Mitigation Measures

for the SSJID area; but for the entire San Joaquin River Basin, it is up to 62,000 acre-feet (Table V1-75, SWRCB 1998). The effect is considered a potentially significant impact.

Oakdale Irrigation District (OID) Service Area

Groundwater depletion within OID is estimated to be approximately 5,100 acre-feet per year (MW April 13, 1995, Memorandum). OID estimates that the typical groundwater production rate in the service area is 55,900 acre-feet. Of this volume approximately 30,000 acre-feet per year is pumped by private irrigators with the remainder pumped from District and Reclamation wells. Annual average use from OID wells is 9,668 acre-feet (Table 3.1-1). The data shows that groundwater storage within the service area is essentially in balance, with only a slight (4,000 acre-feet per year) depletion in storage over the past 20 years (MW May 8, 1995, Memorandum). On a local level, groundwater extraction rates vary throughout the basin based on factors such as location of municipalities, depth to groundwater, and crop water needs.

No Action. Projected groundwater demands for the OID service area are 55,900 acre-feet per year. OID estimates that groundwater extraction rates within their service area would continue to slightly exceed infiltration rates. Given their projected usage of groundwater, slight overdrafting of the OID groundwater basin from pumping would continue. The groundwater budget for the OID service area suggests that current pumping rates do not appear to significantly threaten the continued long-term viability of their groundwater resources (MW 1995, Memorandum).

Proposed Action. The maximum annual surface water diversion for the flow events from the OID service area is 26,000 acre-feet. To substitute for this water, OID projects pumping between zero and 15,000 acre feet of groundwater to serve its irrigation customers using existing facilities. If the total 15,000 acre-feet is groundwater, this represents approximately 27 percent of the total groundwater pumped annually from the service area. However, groundwater levels have been historically relatively high throughout the OID service area, and the groundwater surface is hydraulically connected to the Stanislaus River water surface. The additional groundwater pumped from the service area should be recharged by inflow from the Stanislaus River. Extracting an additional 15,000 acre-feet per year of groundwater should not result in a significant negative impact to the overdraft problem within OID’s service area.

Alternative Action. If other water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped by others to supplement reduced surface water deliveries is not known at this time for the OID service area. Since an objective determination of the magnitude of impact is not possible, the effect is considered a potentially significant impact.
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Modesto Groundwater Basin

The average annual overdraft in the Modesto Basin is estimated at 15,000 acre-feet (MID 1996). DWR estimates that the typical groundwater production rate in the basin is 229,000 acre-feet per year (DWR 1998). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

No Action. Projected agricultural and municipal groundwater demands for the Modesto Irrigation District (MID) service area are summarized in Table 3.3-5. Total groundwater demand in the basin is projected to increase from 108,000 acre-feet per year in 1995 to 222,000 acre-feet per year in 2030 (MID 1996). Given the projected usage of groundwater, overdrafting of the Modesto Groundwater Basin would continue to increase if other groundwater conservation methods are not implemented.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the MID is 11,000 acre-feet. MID projects that none of this water would come from groundwater and that they would make up the diverted water by reduced carryover storage in the New Don Pedro Reservoir. There would be no impact to the overdraft problem, because no additional groundwater would be pumped either directly or indirectly to accommodate the pulse flows.

Alternative Action. The modeling studies used to calculate water deliveries for the 1995 WQCP DEIR (SWRCB 1998) assumed that water right holders in the San Joaquin Basin would pump groundwater to compensate for reductions in surface water deliveries. The 1995 WQCP DEIR projects that MID would have zero reduction in surface water deliveries as a result of implementation of the alternative action (see Table VI-75, SWRCB 1998). As a result, MID would not have to pump groundwater to make up for reductions in surface water deliveries. Therefore, this action would have no impact on groundwater overdrafting in the Modesto Groundwater Basin from MID, but water obtained from other water right holders could contribute to overdraft. In the absence of specific information on these other holders and the amounts of water involved, the impact is considered potentially significant.

Turlock Groundwater Basin

The average annual overdraft in the Turlock Basin is estimated at 70,000 to 85,000 acre-feet (TID 1997). Maximum annual surface water diversion for the pulse flow event from the Turlock Groundwater Basin is 11,000 acre-feet. TID projects that none of this water would come from groundwater. DWR estimates that the typical groundwater production rate in the basin is 452,000 acre-feet per year (DWR 1998). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).
4. Environmental Consequences and Mitigation Measures

No Action. Projected agricultural and municipal groundwater demands for the TID service area are summarized in Appendix B, Table B1-3. Total groundwater demand in the basin is projected to increase from 447,405 acre-feet per year in 1995 to 520,100 acre-feet per year in 2030 (TID 1997). Given the projected usage of groundwater, overdrafting of the Turlock Groundwater Basin would continue to increase.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the TID is 11,000 acre-feet. Of this volume, TID projects that none of this water would come from groundwater (see Table 2.1-3). TID projects that they can make up for the diverted water by incorporating conservation measures into their water plan. There would be no impact to the overdraft problem, because no additional groundwater would be pumped either directly or indirectly to accommodate the pulse flows (Godwin 1998, personal communication).

Alternative Action. The 1995 WQCP DEIR projects that TID would have zero reductions in surface water deliveries as a result of implementation of the alternative action. Therefore, TID would have no impact on groundwater overdrafting. Other water right holders could contribute to overdraft, so the impact is potentially significant.

Merced Groundwater Basin

The average annual overdraft in the Merced Groundwater Basin is estimated at 20,000 acre-feet (Merced ID 1997). DWR estimates that the typical groundwater production rate in the basin is 555,000 acre-feet per year (DWR 1998). Based on factors such as location of municipalities, depth to groundwater, and crop water needs, on a local level, groundwater extraction rates vary throughout the basin.

No Action. Projected agricultural and municipal groundwater usage for the Merced ID service area is approximately 638,000 acre-feet per year (Merced ID 1996). Of this volume, Merced ID pumps approximately 25,000–30,000 acre-feet per year (Table 2.1-3). Total agricultural groundwater demand in the basin is projected to decrease by 12 percent over the next 40 years, from 601,800 acre-feet per year in 1996 to 529,584 acre-feet per year in 2036 (Merced ID 1997). Total groundwater demand for municipal uses, in the basin, is projected to increase by approximately 33 percent by 2030, from approximately 40,000 acre-feet per year in 1996 to 121,000 acre-feet per year in 2036 (Merced ID 1997). No estimates were given for the increase in demand for industrial uses. Given the projected usage of groundwater, overdrafting of the Merced Groundwater Basin would continue to increase.

Proposed Action. Maximum annual surface water diversion for the SJRA flows from Merced ID is 67,500 acre-feet. Of this volume, Merced ID projects that the percentage of this water that may come from groundwater ranges from zero to 100 percent as an indirect impact due to the potential use of groundwater to substitute for reduced surface water delivery. No groundwater would be
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pumped directly by Merced ID to meet SJRA flows. For the worst case, this 67,500 acre-feet represents approximately 12 percent of the typical annual groundwater production rate of 555,000 acre-feet per year from the basin (DWR 1998). This amount could result in a significant impact to the overdraft problem, if other groundwater conservation measures are not implemented.

**Alternative Action.** If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The SWRCB DEIR assumes that Merced ID would have zero reductions in surface water deliveries that may have to be offset with groundwater. This action would have no impact on additional groundwater overdrafting from Merced ID. However, the SWRCB study assumes groundwater pumping values for Merced ID of 176,000 acre-feet in dry years and 269,000 acre-feet in critical years. As shown on Table 3.1-1, the average annual Merced ID groundwater use is in the range of 25,000 to 30,000 acre-feet, with a maximum historical use of 167,000 acre-feet in 1977. The surface water supply is supplemented by an unreasonably high groundwater supply in dry and critical water years. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not known at this time. Therefore, since an objective determination of the magnitude of impact is not possible from material provided in the DEIR, the effect is considered a potentially significant impact.

**Exchange Contractors Water Authority Service Area**

Data regarding the average annual overdraft in the area serviced by the San Joaquin River Exchange Contractors Water Authority (Exchange Contractors) are not available. DWR does not provide an estimate of the typical groundwater production rates in the service area; however, they provide an estimate for the Delta Mendota Basin which includes the Exchange Contractors service area. DWR estimated the groundwater production rate for the Delta Mendota Basin is 511,000 acre-feet per year (DWR 1998). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

**No Action.** The total average annual volume of groundwater pumped by users in the Exchange Contractors service area is estimated at approximately 100,000 acre-feet. Total groundwater demand in the basin, including private water users, has fluctuated from a low of 196,167 acre-feet in 1995 to a high of 390,000 acre-feet in 1994. The average annual volume of groundwater pumped during the five year period from 1991 through 1995 is 265,000 acre-feet (SJRECWA 1997). The projected overdraft for the service area is not reported.

**Proposed Action.** Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors service area is 11,000 acre-feet (see Table 2.1-3). Of this volume, the Exchange Contractors project that the water that may come from groundwater ranges from zero to 11,000 acre-feet. For the worst case, this represents approximately 7.6 percent of the typical annual groundwater production rate of 144,000 acre-feet per year pumped by the Exchange Contractors.
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The 11,000 acre-feet is 2.2 percent of the Delta Medota Basin production of 511,000 acre-feet. Based on this worst case scenario, if the total amount comes from groundwater storage, groundwater overdraft in the Exchange Contractors groundwater basin could increase by a small amount. This would result in a less-than-significant impact to the basinwide overdraft problem.

**Alternative Action.** The 1995 WQCP DEIR projects that the Exchange Contractors would experience approximately 5,000 acre-feet increase in surface water deliveries (as the difference between Alternative 2 and Alternative 3). The groundwater overdraft in the Exchange Contractors service area would not increase. This would result in no impact to the basinwide overdraft problem from the Exchange Contractors. However, the volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not quantifiable; so the impact is potentially significant.

### 4.3.2.2 Water Levels

Changes in water level are the result of many factors including surface water and groundwater use, irrigation technologies, changes in crop mix and streamflow. Declining water levels can result in additional power consumption as a result of having to lift the water a longer distance as well as upwelling of saline water which reduces water quality.

**South San Joaquin Irrigation District (SSJID) Service Area**

Semi-annual monitoring of groundwater levels throughout San Joaquin County, including SSJID have been conducted since the fall of 1997. Measurements of the water levels are collected during the spring and fall of each year. The spring measurements reflect natural recharge that occurred during the wet season, while the fall measurements indicate the impact of groundwater pumping during the summer months.

Within the District, groundwater movement is generally from the southeast to the northwest. Since 1964, groundwater levels within the District have declined between 20 and 30 feet, with about 10 feet of this decline occurring between 1987 and 1993, as a result of the extended dry conditions at this time (SSJID 1994). The majority of this decline has occurred in the central and eastern areas of the District as a possible result of a large cone of depression located east of Stockton.

Water levels will continue to decline within the SSJID service area as a result of the overdrafting that is occurring within the eastern area of the county (Brown and Caldwell 1985). The rate of groundwater decline will vary throughout the area depending on conditions including groundwater extraction rates, underflow to groundwater depressions located outside SSJID, and recharge from sources including, irrigation seepage, precipitation, groundwater inflow and artificial recharge.
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SSJID estimates that the typical agricultural groundwater production rate in the service area is 32,400 acre-feet. Of this volume approximately 11,200 acre-feet per year is pumped by SSJID with the remainder pumped from private wells (SSJID 1993). On a local level, groundwater extraction rates vary throughout the basin (based on factors such, location of municipalities, depth to groundwater, and crop water needs).

No Action. SSJID estimates their groundwater extraction rates would remain below the safe yield of one acre-foot per acre per year. Given their projected usage of groundwater, water levels within the SSJID groundwater basin should not decline. However, as a result of the overdrafting in urban areas located within and adjacent to the SSJID service area, water levels would probably continue to decline if other conservation methods are not implemented in the SSJID service area.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the service area is 11,000 acre-feet (see Table 2.1-3). Of this volume, SSJID projects that none of this water would come from groundwater. This action would have no negative impact on water levels within the service area.

Alternative Action. If SSJID is required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries in the SSJID service area is not known at this time. Therefore, while an objective determination of the magnitude of impact is not possible, the effect is considered potentially significant.

Oakdale Irrigation District (OID) Service Area

OID has been monitoring water levels within seven wells. An analysis of water levels for spring and fall of 1992 showed that water levels ranged from more than 100 feet above mean sea level in the northern part of the service area to less than 50 feet above mean sea level in the northwest portion of the service area, indicating that groundwater generally flows from east to west. Groundwater levels decline by approximately five feet from spring to fall and appear to be a seasonal variation.

No Action. OID estimates that groundwater storage within the service area is essentially in balance, with only a slight (4,000 acre-feet per year) depletion in storage over the past 20 years (MW May 8, 1995, Memorandum). Given projected usage of groundwater, water levels within the OID groundwater basin should not decline.

Proposed Action. OID projects that groundwater pumping to supplement instream flows could range from zero to 15,000 acre-feet per year. OID conducted an analysis in 1995 of hydrologic impacts likely to be associated with potential water transfers from their service area (MW April 13, 1995, Memorandum). The analysis simulated three levels of water level transfers from the
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portion of the OID north of the Stanislaus River: 10,000 acre-feet per year, 20,000 acre-feet per year, and 30,000 acre-feet per year over a period of 70 years. The results of the simulation showed that groundwater levels would decline between two and four feet over the 70 year period for 10,000 and 20,000 acre-feet per year diversions. Conditions in the portion of the OID service area south of the Stanislaus River are considered a mirror image of northern area conditions, and similar water level declines would be expected (MW April 13, 1995, Memorandum). These results indicate that use of 15,000 acre-feet per year for the proposed action would have no significant impacts to groundwater water levels within the OID service area.

Alternative Action. If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries is not known at this time. An objective determination of the magnitude of impact is not possible, so the effect on groundwater levels is considered a potentially significant impact.

Modesto Groundwater Basin

Long term water level monitoring conducted by DWR indicates that the Modesto Groundwater Basin has experienced groundwater declines of 15.3 feet from the period 1970-1990 (HCI 1992). This decline represents depletion of storage of 404,000 acre-feet. The average annual water budget for 1952-1991 indicates an average annual overdraft in the basin of 2,300 acre-feet per year (MID 1996). The overdraft is indicated by water level declines of approximately 0.5 feet per year (HCI 1993).

Water levels will probably continue to decline within the MID service area as a result of the overdrafting. The rate of groundwater decline will vary throughout the area depending on conditions including groundwater extraction rates, underflow to groundwater depressions located outside MID, and recharge from sources including, irrigation seepage, precipitation, groundwater inflow and artificial recharge.

DWR estimates that the typical groundwater production rate in the basin is 229,000 acre-feet per year (DWR 1998). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

No Action. The data presented in MID’s Groundwater Management Plan (MID 1996) suggests that the groundwater basin would continue to be overdrafted by approximately 15,000 acre-feet per year as a result of groundwater extraction rates exceeding recharge rates. Given projected usage of groundwater, water levels are projected to continue to decline if conservation methods are not implemented in the Modesto Groundwater Basin.
4. Environmental Consequences and Mitigation Measures

**Proposed Action.** Maximum annual surface water diversion for the pulse flow event from the MID is 11,000 acre-feet (see Table 2.1-3). Of this volume, MID projects that none of this water would come directly from groundwater. This would result in no impact to declining groundwater levels in the Modesto Groundwater Basin.

**Alternative Action.** The 1995 WQCP DEIR projects that MID would have no reduction in surface water deliveries that may have to be offset by increased groundwater pumping as a result of implementing the alternative action (Table VI-75, SWRCB 1998). Therefore, this action would have no impact on water levels in the Modesto Groundwater Basin from MID but there could be impacts from other water right holders in this basin. These impacts cannot be quantified based on information in the DEIR, so the overall impact to the basin is potentially significant.

**Turlock Groundwater Basin**

Water level data shows that water levels have declined between 1971 and 1991 (TID 1997). The largest water level declines have occurred within the eastern part of the Basin, where declines are as much as 90 feet. Water levels have declined approximately five feet throughout the western part of the Basin.

These declines are largely the result of pumping in excess of recharge, resulting in annual overdrafting in the Turlock Basin at an annual estimated rate of 70,000 to 85,000 acre-feet (TID 1997). DWR estimates that the typical groundwater production rate in the basin is 452,000 acre-feet per year (DWR 1998). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

Water levels will probably continue to decline within the TID service area as a result of the overdrafting. The rate of groundwater decline will vary throughout the area depending on conditions including groundwater extraction rates, underflow to groundwater depressions located outside TID, and recharge from sources including, irrigation seepage, precipitation, groundwater inflow and artificial recharge.

**No Action.** The data presented in TID’s Groundwater Management Plan (TID 1997) suggests that the groundwater basin would continue to be overdrafted by approximately 70,000 to 85,000 acre-feet per year as a result of groundwater extraction rates exceeding recharge rates. Given the projected usage of groundwater, water levels within the Turlock Groundwater Basin are projected to continue to decline if conservation methods are not implemented.

**Proposed Action.** Maximum annual surface water diversion for the pulse flow event from the TID is 11,000 acre-feet. Of this volume, TID projects that none of this water would come from groundwater (see Table 2.1-3). This action would have no negative impact on water levels within the Turlock Groundwater Basin.
4. Environmental Consequences and Mitigation Measures

**Alternative Action.** The 1995 WQCP DEIR projects that TID would have zero reductions in surface water deliveries as a result of implementation of the alternative action (see Table VI-75, SWRCB 1998). As a result, TID would not have to pump additional groundwater to make up for reductions in surface water deliveries. The alternative action would have no impact on groundwater levels within the Turlock Groundwater Basin from TID. However, there could be impacts from other water right holders in this basin. These impacts cannot be quantified at this time, so the impact on groundwater levels is potentially significant.

**Merced Groundwater Basin**

The Merced Irrigation District monitors static and high groundwater levels on a monthly basis from a total of 196 active wells within its irrigation boundaries. In addition, Merced ID monitors shallow monitoring wells, located at the section corners, to determine localized areas of high or perched groundwater table conditions. Long term water level data indicates that the Merced Groundwater Basin has experienced groundwater level declines of up to 40 feet during the period 1960-92. This decline represents depletion of storage of 404,000 acre-feet.

These declines are largely the result of pumping in excess of recharge resulting in annual overdrafting in the Merced Groundwater Basin at a estimated rate of 20,000 acre-feet (Merced ID 1997). DWR estimates that the typical groundwater production rates in the basin is 555,000 acre-feet per year (DWR 1998). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

Water levels will probably continue to decline within the Merced ID service area as a result of the overdrafting. The rate of groundwater decline will vary throughout the area depending on conditions including groundwater extraction rates, underflow to groundwater depressions located outside Merced ID, and recharge from sources including, irrigation seepage, precipitation, groundwater inflow and artificial recharge.

**No Action.** The data presented in Merced ID’s Groundwater Management Plan (Merced ID 1997) suggests that the groundwater basin would continue to be overdrafted by approximately 20,000 acre-feet per year as a result of groundwater extraction rates exceeding recharge rates. Given their projected usage of groundwater, water levels within the Merced ID Groundwater Basin are projected to continue to decline if conservation methods are not implemented in the Basin.

**Proposed Action.** Maximum annual surface water diversion for the SJRA flows from the Merced ID ranges is 67,500 acre-feet (see Table 2.1-3). Of this volume, Merced ID projects that the percentage of this water that may come indirectly from groundwater to substitute for reductions in surface water deliveries ranges from zero to 67,500 acre-feet. Based on the worst case, if the total amount comes from groundwater storage, this would represent less than 12 percent of the total
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groundwater pumped in the basin in a typical year. This could result in a significant impact to declining groundwater levels.

**Alternative Action.** If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The 1995 WQCP DEIR projects that Merced ID would have zero reductions in surface deliveries as a result of the alternative action and would not have to pump groundwater to make up for loss in water deliveries. Consequently, the alternative action would have no impact on groundwater levels within the Merced Groundwater Basin from Merced ID. However, the SWRCB study assumes groundwater pumping values for Merced ID of 176,000 acre-feet in dry years and 269,000 acre-feet in critical years. As shown on Table 3.1-1, the average annual Merced ID groundwater use is in the range of 25,000 to 30,000 acre-feet, with a maximum historical use of 167,000 acre-feet in 1977. Nevertheless, there could be impacts from other water right holders which cannot be quantified at this time; therefore the impact is potentially significant.

**Exchange Contractors Water Authority Service Area**

Data regarding the average annual overdraft in the area serviced by the San Joaquin River Exchange Contractors Water Authority (Exchange Contractors) are not available. The *Draft Programmatic Environmental Impact Statement for the Central Valley Project Improvement Act* (USBR 1997d) reports that water level declines began occurring in the 1940s along the west side of the San Joaquin River Region, dropping more than 30 feet by 1960.

DWR does not provide an estimate of the typical groundwater production rates in the service area. However, they provide an estimate for the Delta Mendota Basin, which includes the Exchange Contractors service area, of 511,000 acre-feet per year (DWR 1998).

**No Action.** No data was available on water level fluctuations in response to overdrafting in the area.

**Proposed Action.** Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors service area is 11,000 acre-feet (see Table 2.1-3). Of this volume, the Exchange Contractors project that the amount that may come from groundwater ranges from zero to 11,000 acre-feet. This represents about two percent of the typical groundwater production rate in the Delta Mendota Basin. If the total amount comes from groundwater storage, groundwater overdraft in the Exchange Contractors groundwater basin could increase slightly, but this would result in a less-than-significant impact to the water level problem.

**Alternative Action.** If the water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. Modeling conducted to calculate water deliveries for the 1995 WQCP projects that the Exchange Contractors may have average annual reductions in
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surface water deliveries of approximately 15,000 acre-feet for Alternative 3 and 20,000 acre-feet for Alternative 2 (see Table VI-75, SWRCB 1998). The difference is 5,000 acre-feet less of a delivery reduction. The alternative action would have no impact on groundwater levels in the Exchange Contractors service area. However, impacts from other water right holders are unclear; so the impact on reduced water levels is potentially significant.

4.3.2.3 Water Quality

Groundwater quality conditions in the San Joaquin River Region vary throughout the area. Only those parameters that may be problems in the groundwater basins within the San Joaquin River Authority’s willing sellers’ service areas are discussed here. Groundwater quality for the proposed action and alternative action are compared to the No Action alternative.

South San Joaquin Irrigation District (SSJID) Service Area

With the exception of wells owned by the cities, water quality is not monitored in the District (SSJID 1994). As a result, comparatively little long-term data is available on water quality. The cities are required by the Department of Health Services to periodically sample and test wells used as a source of potable water. Water samples from city wells in Manteca, Ripon, and Escalon contain both inorganic and organic contaminants including nitrates and DBCP. Most of the impacts are restricted to shallow groundwater and are due to seepage from surface or near surface sources.

No Action. The No Action alternative represents existing conditions plus reasonable foreseeable future conditions that would exist without the proposed action. Levels of both inorganic and organic contaminants would continue to increase.

Proposed Action. SSJID predicts that none of their annual surface water diversion for the pulse flow event would come from groundwater. This action would have no impact on groundwater water quality within the Basin.

Alternative Action. If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped by junior water holders from the groundwater basin underlying the SSJID service area to supplement reduced surface water deliveries is not known at this time. Therefore, an objective determination of the magnitude of impact is not possible, the effect is considered potentially significant.

Oakdale Irrigation District (OID) Service Area

Water quality is reported to be generally acceptable for most uses within the OID service area (Black and Veatch, et. al. 1995). Problem levels of some constituents, including salinity, nitrates,
radionuclides, dibromochloropropane (DBCP) and other trace organics have been detected in groundwater within the service area. Most of the impacts are restricted to shallow groundwater and are due to seepage from surface or near surface sources.

**No Action.** OID reports that there is no evidence of any significant threat to groundwater quality such as saline intrusion in the aquifers below their service area (MW March 31, 1995, Memorandum).

**Proposed Action.** OID predicts that the amount of their annual surface water delivery for instream flows that may come from groundwater ranges from zero to 15,000 acre-feet per year. Data shows that this rate of pumpage would have only limited impacts to groundwater depletion and water levels and should have no impacts on groundwater water quality within the service area.

**Alternative Action.** If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped by junior water right holders from the groundwater basin underlying the OID service area to supplement reduced surface water deliveries is not known at this time. Therefore, an objective determination of the magnitude of impact on water quality is not possible, and the effect is considered potentially significant.

**Modesto Groundwater Basin**

Groundwater quality within the Modesto Groundwater Basin is generally acceptable for most uses. Problem levels of some constituents, including total dissolved solids (TDS), nitrates, radionuclides, DBCP and some other trace organics, have been found in the groundwater. In addition to the water constituents listed above, some localized areas within the area have been contaminated through spills or dumping of hazardous materials. The area includes two Superfund sites: the Norris plant located south and east of Riverbank, and Halford Cleaners located in the City of Modesto.

**No Action.** The No Action alternative represents existing conditions plus reasonable foreseeable future conditions that would exist without the proposed action. Groundwater quality would remain acceptable for most uses.

**Proposed Action.** Maximum annual surface water diversion for the pulse flow event from the MID is 11,000 acre-feet (see Table 2.3-1). Of this volume, MID projects that none of this water would come from groundwater. This would result in no impact to groundwater quality within the basin.

**Alternative Action.** MID is not projected to experience any surface water delivery reductions as a result of the alternative action (see Table VI-75, SWRCB 1998). As a result, additional groundwater pumping would not be required. The alternative action would have no impact on water quality in the
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Modesto Groundwater Basin from MID. However, there could be impacts from other water right holders. An objective determination of the magnitude of impact is not possible based on information in the DEIR, so the effect is considered a potentially significant impact.

Turlock Groundwater Basin

Groundwater quality within the Turlock Groundwater Basin is generally acceptable for most uses. Problem levels of some constituents, including TDS, nitrates, radionuclides, DBCP and some other trace organics have been found in the groundwater. DWR estimates that the typical groundwater production rate in the basin is 452,000 acre-feet per year (DWR 1998).

No Action. Groundwater quality would remain generally acceptable.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the TID is 11,000 acre-feet (see Table 2.3-1). TID projects that none of this water would come from groundwater. This action would have no negative impact on water quality within the Turlock Groundwater Basin.

Alternative Action. The SWRCB (1998) projects that TID would not be required to curtail any portion of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives. The alternative action would not have any impact on groundwater in the Turlock Groundwater Basin from TID. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not known at this time. An objective determination of the magnitude of impact is not possible, so the effect is considered a potentially significant impact.

Merced Groundwater Basin

There are numerous constituents detected in the Merced Groundwater Basin groundwater supply. Some constituents are naturally occurring, while others have been introduced into the groundwater from man-made sources. The constituents identified in this section either currently impact groundwater usage within the Basin, or have the potential to impact the Basin’s future groundwater usage. Groundwater quality within the Merced Groundwater Basin is generally acceptable for most uses. Problem levels of some constituents, including TDS, nitrates, radionuclides, DBCP and some other trace organics, have been found in the groundwater.

Maximum annual surface water diversion for the Spring and October flow events from the Merced ID is 67,500 acre-feet. Of this volume, Merced ID projects that the volume of water that may come indirectly from groundwater ranges from zero to 67,500 acre-feet. DWR estimates that the typical groundwater production rate in the basin is 555,000 acre-feet per year (DWR 1998).
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No Action. Existing conditions of both acceptable quality for some uses and problems with levels of some constituents would continue.

Proposed Action. Maximum annual surface water diversion for the SJRA flows from the Merced ID is 67,500 acre-feet (see Table 2.3-1). Of this volume, Merced ID projects that the amount of this water that may come indirectly from groundwater (to substitute for surface water deliveries) ranges from zero to 67,500 acre-feet. Based on the worst case, the extraction of this quantity of water from the basin may increase TDS slightly and could result in a less-than-significant impact.

Alternative Action. Projections of average annual surface water diversions required to achieve the 1995 WQCP Vernalis flow objectives show that the Merced ID reduction in surface water deliveries is zero and would not have to be supplemented by pumping groundwater (Table VI-75, SWRCB 1998). However, the SWRCB study assumes groundwater pumping values for Merced ID of 176,000 acre-feet in dry years and 269,000 acre-feet in critical years. As shown on Table 3.1-1, the average annual Merced ID groundwater use is in the range of 25,000 to 30,000 acre-feet, with a maximum historical use of 167,000 acre-feet in 1977. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not known at this time. Therefore, an objective determination of the magnitude of impact to water quality cannot be made and the effect is considered a potentially significant impact.

Exchange Contractors Water Authority Service Area

The San Joaquin River Exchange Contractors Water Authority (Exchange Contractors) report in their AB3030 plan that water quality issues within their service area occur only in urban areas. High manganese concentrations have been detected from groundwater samples collected from wells in Firebaugh and Mendota. The city of Dos Palos developed a surface water quality problem because of the poor quality of groundwater. The Exchange Contractors report that localized areas west and southwest of their boundaries contain poor quality water (SJRECWA 1997).

DWR does not provide an estimate of the typical groundwater production rates in the service area. However, they provide an estimate for the Delta Mendota Basin which includes the Exchange Contractors service area. The DWR estimated groundwater production rate for the Delta Mendota Basin is 511,000 acre-feet per year (DWR 1998).

No Action. Water quality problems may continue in the urban areas.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors service area is 11,000 acre-feet (see Table 2.3-1). The Exchange Contractors project that up to 100 percent of this water could come from groundwater. This represents approximately two percent of the total groundwater pumped, so the impact on water quality is less than significant.
Alternative Action. The 1995 WQCB DEIR projects that the Exchange Contractors may experience a 5,000 acre-feet increase in surface water deliveries. This would result in no impact to the groundwater quality. However, other water right holders could be responsible for providing water. The amount of groundwater pumping that may result from reduced surface water deliveries cannot be quantified, and the impact is considered potentially significant.

4.3.2.4 Subsidence

Subsidence occurs in the western San Joaquin Valley where land that had been used for grazing or dry farming was converted to irrigated agriculture. Subsidence in the San Joaquin Valley results from lowered groundwater elevations and the subsequent compaction of the dewatered soil interstitial spaces. A negative effect of subsidence is the permanent loss of aquifer capacity. Between 1920 and 1970, 5,200 square miles in the valley had subsided more than one foot. Land subsidence is a significant problem in the western San Joaquin Valley in the San Joaquin River Basin. The largest of the three land subsidence areas in the San Joaquin Valley is the 2,600 square mile Los Banos-Kettleman City area which extends from Merced County to Kings County and lies within both the San Joaquin and Tulare Basins. Groundwater production, prior to completion of the California Aqueduct in 1967, caused land subsidence of one foot regionally and up to 29 feet locally. In the years since 1970, the rate of subsidence has declined because surface water was imported to the areas (DWR 1998). Recent increases in subsidence are the result of increased groundwater extraction to compensate for water supply deficiencies caused by drought, Bay-Delta export restrictions, and Central Valley Project Improvement Act (CVPIA).

South San Joaquin Irrigation District (SSJID) Service Area

No Action. Ground subsidence is not a problem within the SSJID service area. Overdrafting in urban areas located within and adjacent to the SSJID service area water levels may cause localized ground subsidence and loss of groundwater storage as groundwater levels decline.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the SSJID service area is 11,000 acre-feet. Of this volume, SSJID projects that none of this water would come from groundwater. This action would have no impact on land subsidence within the Basin.

Alternative Action. If water right holders, including SSJID, are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries is not known at this time, so the effect on subsidence is potentially significant.
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Oakdale Irrigation District (OID) Service Area

No Action. Ground subsidence is not a problem within the OID service area. Overdrafting in urban areas located within and adjacent to the OID service area may cause localized ground subsidence and loss of groundwater storage as groundwater levels decline.

Proposed Action. Maximum annual water deliveries for the instream flows from the OID service area would be 26,000 acre-feet. Of this volume, OID projects that zero to 15,000 acre-feet per year of this water would come from groundwater. However, groundwater levels have been historically high throughout the OID service area, and the groundwater surface is hydraulically connected to the Stanislaus River water surface. The majority of the groundwater pumped from the service area should be recharged by inflow from the Stanislaus River. Extracting an additional 15,000 acre-feet per year of groundwater should not result in a negative impact to subsidence within OID’s service area.

Alternative Action. If water right holders including OID are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries is not known at this time, so there could be a potentially significant effect on subsidence.

Modesto Groundwater Basin

No Action. Ground subsidence is not reported to be a significant problem within the MID service area and the Modesto Groundwater Basin.

Proposed Action. MID projects that no water would come from groundwater to achieve the SJRA pulse flow. There would be no impact to subsidence in the Modesto Groundwater Basin.

Alternative Action. MID would not be required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, so the reduction in surface water deliveries would not be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not known at this time. While an objective determination of the magnitude of impact is not possible, the effect on subsidence is considered a potentially significant impact.

Turlock Groundwater Basin

No Action. Ground subsidence is not reported to be a significant problem in the Turlock Groundwater Basin.
Proposed Action. Maximum annual surface water diversion for the pulse flow event from the TID is 11,000 acre-feet (see Table 2.3-1). Of this volume, TID projects that none of this water would come from groundwater. Consequently, this action would have no negative impact on land subsidence within the Basin.

Alternative Action. TID would not be required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not known at this time. The magnitude of impact on ground subsidence cannot be quantified at this time; therefore, the effect on subsidence is considered a potentially significant impact.

Merced Groundwater Basin

No Action. Ground subsidence is not a problem within the Merced Groundwater Basin and the Merced ID service area. The groundwater basin is projected to continue to be overrafted by approximately 20,000 acre-feet per year as a result of groundwater extraction rates exceeding recharge rates. Given projected usage of groundwater, water levels within the Merced ID Groundwater Basin are projected to continue to decline, which could result in a loss of aquifer storage and local land subsidence.

Proposed Action. Maximum annual surface water diversion for the SJRA flows from the Merced ID is 67,500 acre-feet. Of this volume, Merced ID projects that the amount of this water that may come indirectly from groundwater substitution ranges from zero to 67,500 acre-feet. Based on the worst case, if the total amount comes from groundwater, groundwater overdraft in the basin, loss of groundwater storage, and land subsidence could occur and result in potentially significant impacts to the basin.

Alternative Action. Merced ID would not be required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives. However, the SWRCB study assumes groundwater pumping values for Merced ID of 176,000 acre-feet in dry years and 269,000 acre-feet in critical years. As shown on Table 3.1-1, the average annual Merced ID groundwater use is in the range of 25,000 to 30,000 acre-feet, with a maximum historical use of 167,000 acre-feet in 1977. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not quantified and may be significant. An objective determination of the magnitude of impact on land subsidence is not possible, so the effect is considered a potentially significant impact.

Exchange Contractors Water Authority Service Area

The Exchange Contractors’ Water Authority have measured land subsidence annually within their service area from 1957 to 1962. During this period, land subsidence in their service area has ranged
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from less than a foot under the San Luis Water District to over four feet near the Mendota Pool. The Exchange Contractors will continue the annual subsidence monitoring within their service area.

**No Action.** Ground subsidence is a problem with the service area. Overdrafting may cause continued ground subsidence and loss of groundwater storage as groundwater levels decline.

**Proposed Action.** Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors’ service area is 11,000 acre-feet. Of this volume, the amount of water that may come from groundwater ranges from zero to 11,000 acre-feet. The 11,000 acre-feet is approximately 2.2 percent of the Delta Mendota Basin production of 511,000 acre-feet. This additional volume of groundwater would result in a less-than-significant impact to the basin subsidence problems.

**Alternative Action.** The Exchange Contractors would not be required to curtail diversions in order to achieve the 1995 WQCP Vernalis flow objectives by comparing Alternatives 2 and 3. The reduction in surface water deliveries may be supplemented by pumping groundwater. Their impact to ground subsidence would be no impact. However, the impact from other water right holders and their possible groundwater pumping cannot be quantified and must be considered potentially significant.

4.3.2.5 Agricultural Subsurface Drainage

Inadequate drainage and accumulating salts have been persistent problems for irrigated agriculture along the west side and in parts of the east side of the San Joaquin River Region for more than a century. The most extensive drainage problems exist on the west side of the San Joaquin River and Tulare Lake Regions (USBR 1997d).

The area of subsurface drainage problems primarily extends along the western side of the San Joaquin River and Tulare Lake Regions from the Delta on the north to the Tehachapi Mountains south of Bakersfield. In some portions of the San Joaquin River Region, natural drainage conditions are inadequate to remove the quantities of deep percolation that accrue to the water table. Therefore, groundwater levels often encroach on the root zone of agricultural crops, and subsurface drainage must be supplemented by constructed facilities for irrigation to be sustained. Few wells pump from this shallow groundwater zone because of high salinity concentrations.

**South San Joaquin Irrigation District (SSJID) Service Area**

**No Action.** Agricultural subsurface drainage is not a significant problem in the San Joaquin Irrigation District service area. Agricultural subsurface drainage or the associated problems with the subsurface drainage may be a problem in isolated areas immediately adjacent to the Stanislaus and San Joaquin Rivers.
4. Environmental Consequences and Mitigation Measures

**Proposed Action.** The San Joaquin River Agreement flows would raise water levels temporarily in the San Joaquin River, which has a low potential to cause additional agricultural subsurface drainage. The 31-day pulse flows would not exceed 7,000 cfs (measured at Vernalis) and are not large enough to cause a significant impact on agricultural subsurface drainage within the SSJID service area.

**Alternative Action.** Additional flows released to implement the Water Right Priority System alternative may raise water levels in the San Joaquin River and have an impact on agricultural subsurface drainage in areas adjacent to the river. Groundwater pumped by SSJID or other water right holders to supplement reduced surface water deliveries may have the reverse effect and locally depress water levels, reducing the potential for agricultural subsurface drainage. Assuming that both processes would occur, the effect is less than significant.

**Oakdale Irrigation District (OID) Service Area**

**No Action.** Agricultural subsurface drainage is not a significant problem in the Oakdale Irrigation District service area. Agricultural subsurface drainage or the associated problems with the subsurface drainage may be a problem in isolated areas immediately adjacent to the Stanislaus River.

**Proposed Action.** The San Joaquin River Agreement flows from OID would result in minor rises in water levels in portions of the Stanislaus River which flows through OID and subsequently would raise water levels temporarily in the San Joaquin River. This potential rise is insignificant and would have a very low potential to cause additional agricultural subsurface drainage. The 31-day pulse and other flows are not large enough to cause an impact on agricultural subsurface drainage within the OID service area.

**Alternative Action.** Additional flows released to implement the Water Right Priority System alternative may raise water levels in the Stanislaus River and subsequently result in minor rises in water levels in the San Joaquin River. This rise in water levels may have a slight, but temporary, impact on agricultural subsurface drainage in areas adjacent to the rivers. Groundwater pumped by OID or other water right holders to supplement reduced surface water deliveries may have the reverse effect and locally depress water levels, reducing the potential for agricultural subsurface drainage. Assuming that both processes would occur, the effect is less than significant.

**Modesto Groundwater Basin**

Drainage wells have been employed by MID to control shallow groundwater levels in the western part of the MID service area since 1918 (MID 1996). The drainage wells pump excellent quality groundwater to maintain groundwater levels below the crop root zone. Maintaining the water table below the crop root zone also maintains the salt balance within the root zone.
4. Environmental Consequences and Mitigation Measures

The area affected by shallow groundwater and quantity of shallow groundwater pumped has declined through the years because of the increased use of groundwater in the Modesto area. The use of many of the drainage wells in areas no longer affected by shallow groundwater has been discontinued or the wells are now used as irrigation wells (MID 1996).

**No Action.** As reported by MID, agricultural subsurface drainage in the Modesto Groundwater Basin is declining as groundwater extraction has increased in the urban Modesto area. Groundwater usage in the urban Modesto area is projected to expand in response to population growth. Agricultural subsurface drainage should continue to decline in areas that are hydraulically connected to groundwater pumping near Modesto.

**Proposed Action.** The Spring pulse flow would raise water levels temporarily in the San Joaquin River which has a low potential to cause additional agricultural subsurface drainage. The 31-day pulse flow is not large enough (7,000 cfs or less at Vernalis) to have a significant impact on agricultural subsurface drainage within the MID service area.

**Alternative Action.** MID would not be required to curtail surface water deliveries. However, other water right holders could be called upon to participate in the Water Right Priority System. This action could raise water levels in the San Joaquin River and have an impact on agricultural subsurface drainage in areas adjacent to the river. The expansion of groundwater pumping in the Modesto urban area should have the reverse effect and locally depress water levels reducing potential for agricultural subsurface drainage. Assuming that both processes would occur, the effect is considered a less-than-significant impact.

**Turlock Groundwater Basin**

Several areas in the western portion of the Basin experience localized high groundwater levels. The affected area varies from year to year and over the course of an irrigation season as a result of pumping, precipitation, and applied irrigation water. If left uncontrolled, groundwater levels of less than six feet from ground level would not be uncommon, resulting in agricultural subsurface drainage and potentially adverse impacts to local crop production (TID 1997).

To minimize these potentially adverse impacts on crops, TID provides groundwater control or drainage pumping in areas where groundwater levels are within six feet of the ground surface. TID owns and operates approximately 170 drainage wells within their service area. In recent history subsurface drains have also been utilized to control groundwater levels. Water pumped for drainage is typically discharged into the District’s canal system where it is utilized, as much as possible, for irrigation (TID 1997).

**No Action.** TID reports that several areas in the western portion of the Basin experience localized high groundwater levels that are controlled by drainage pumping. Localized areas with the Turlock
4. Environmental Consequences and Mitigation Measures

Groundwater Basin should continue to experience subsurface drainage in areas where groundwater levels approach the ground surface.

**Proposed Action.** The pulse flow would raise water levels temporarily in the Tuolumne and San Joaquin Rivers which have a low potential to cause additional agricultural subsurface drainage. The 31-day pulse flow is not large enough to have an impact on agricultural subsurface drainage within the TID service area.

**Alternative Action.** While TID would not be required to curtail surface water deliveries, other water right holders could be responsible for releasing additional flows to implement the Water Right Priority System, and this action may raise water levels in the San Joaquin River and subsequently have an impact on agricultural subsurface drainage in areas adjacent to the river. Increased groundwater pumping to offset reductions in deliveries would help to depress water levels. Assuming both processes occur, the effect is expected to be less than significant.

**Merced Groundwater Basin**

The area of the Basin located generally between the cities of Atwater and Livingston, south of State Highway 99 and north of State Highway 140, has experienced localized high groundwater levels (Merced ID 1997). Groundwater levels have varied from year to year and over the course of an irrigation season as a result of pumping, precipitation, and applied irrigation water. If left uncontrolled, groundwater levels of less than six feet below the ground surface would not be uncommon, resulting in potentially adverse impacts to local crop production (Merced ID 1997).

To minimize these potentially adverse impacts, Merced ID provides groundwater control in areas where groundwater levels were within six feet of the ground surface. This condition within Merced ID has declined steadily over the last 10 years. As a result, many of the drainage wells are now used exclusively for irrigation during periods when insufficient surface water is available. Water pumped from these wells is typically discharged in to District’s water distribution system where it is utilized, as much as possible, for irrigation (Merced ID 1997).

**No Action.** Merced ID reports that an area in the northwestern portion of the basin experiences localized high groundwater levels that are controlled by drainage pumping. However, agricultural subsurface drainage in the Merced Groundwater Basin has continually declined over the past ten years. Agricultural subsurface drainage should continue to decline in areas that are overdrafted.

**Proposed Action.** The SJRA flows would raise water levels in the Merced and San Joaquin Rivers which have the potential to locally increase the occurrence of local agricultural subsurface drainage. The small increase in flows and water levels would have a less-than-significant impact on agricultural subsurface drainage within the Merced ID service area.
Alternative Action. Merced ID would not be required to release water to implement the Water Right Priority System, but other water right holders could be affected. The additional flows could raise water levels in the San Joaquin River and have an impact on agricultural subsurface drainage in areas adjacent to the river. With existing drainage control wells and potential increases in groundwater pumping to offset reductions in surface water deliveries, the overall impact to subsurface drainage would be less than significant.

Exchange Contractors Water Authority Service Area

No Action. Approximately ten percent of the Exchange Contractors Water Authority service area experiences some subsurface drainage problems. To minimize these potentially adverse impacts, the Exchange Contractors maintain a system of groundwater control wells in areas where groundwater levels may rise to within six feet of the ground surface (SJRECWA 1997).

Proposed Action. The addition of up to 11,000 acre-feet to the San Joaquin River at a rate of 7,000 cfs or less at Vernalis would not raise water levels significantly. The 31-day pulse flow period would not have an impact on agricultural subsurface drainage within the Exchange Contractors service area.

Alternative Action. Additional flows released to implement the Water Right Priority System may raise water levels in the San Joaquin River and could be large enough to have an impact on agricultural subsurface drainage in areas adjacent to the river. With problems occurring in very limited areas and existing groundwater control wells, the impact would be less than significant.

4.3.3 Impact Summary and Mitigation of Impacts

4.3.3.1 Groundwater Overdrafting

Proposed Action

- Maximum annual surface water diversion for the pulse flow event from the SSJID service area is 11,000 acre-feet. Of this volume, SSJID projects that none of this water would come from groundwater. There would be no increase in overdrafting within the SSJID service area as a result of this action. No mitigation is necessary.

- Maximum annual water diversion for instream flows event from the OID service area is 26,000 acre-feet. Of this volume, OID projects that zero to 15,000 acre-feet of this water may come from groundwater. The additional groundwater pumped from the service area should be recharged by inflow from the Stanislaus River. Extracting an additional 15,000 acre-feet per year of groundwater should not result in a significant negative impact to the overdraft problem within OID’s service area. No mitigation is necessary.
4. Environmental Consequences and Mitigation Measures

- Maximum annual surface water diversion for the pulse flow event from MID is 11,000 acre-feet. MID projects that none of this water would come from groundwater. There would be no additional overdrafting within the Modesto Groundwater Basin as a result of this action. No mitigation is necessary.

- Maximum annual surface water diversion for the pulse flow event from TID is 11,000 acre-feet. Of this volume, TID projects that none of this water would come from groundwater. There would be no impacts to the overdraft problem, because no additional groundwater would be pumped either directly or indirectly to accommodate the pulse flow.

- The maximum annual surface water diversion for the flows from the Merced ID is 67,500 acre-feet. Of this volume, Merced ID projects that the amount of this water that may come indirectly from groundwater to substitute for reduced surface water deliveries ranges from zero to 67,500 acre-feet. For the worst case, this represents approximately 12 percent of the typical annual groundwater production rate of 555,000 acre-feet per year from the Merced Groundwater Basin (DWR 1998). This could result in a significant impact to the groundwater basin. Mitigation could include implementing a conjunctive groundwater use program, implementing programs to improve conservation of surface water, restricting or limiting groundwater pumping in highly overdrafted areas, importing water to supplement the loss of groundwater, or supplementing groundwater with treated water to replace groundwater.

- Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors service area is 11,000 acre-feet. Of this volume, the Exchange Contractors project that the amount of this water that may come from groundwater ranges from zero to 11,000 acre-feet. For the worst case, this represents approximately 2.2 percent of the Delta Mendota Basin production rate of 511,000 acre-feet per year. This amount would result in a less-than-significant impact to the basinwide overdraft problem. No mitigation is necessary.

Alternative Action

- If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries is approximately 62,000 acre-feet for the San Joaquin River Basin. While an objective determination of the magnitude of impact for service areas or sub-basins is not possible, the effect is considered a potentially significant impact. Mitigation measures which could be implemented include instituting a conjunctive groundwater use program, implementing programs to improve conservation of surface water, restricting or limiting groundwater pumping in highly overdrafted areas, importing water to
supplement the loss of groundwater, or supplementing groundwater with treated water to replace groundwater. Mitigation would reduce the impacts to less than significant.

4.3.3.2 Water Levels

Proposed Action

• Maximum annual surface water diversion for the pulse flow event from the SSJID service area is 11,000 acre-feet. Of this volume, SSJID projects that none of this water would come from groundwater. This action would have no impact on water levels within the service area. No mitigation is necessary.

• Maximum annual water diversion for instream flows from the OID service area is 26,000 acre-feet. Of this volume, OID projects that zero to 15,000 acre-feet per year may come from groundwater. The additional groundwater pumped from the service area should be recharged by inflow from the Stanislaus River. Extracting an additional 15,000 acre-feet per year of groundwater should not result in a negative impact to the water levels within OID’s service area as a result of this action. No mitigation is necessary.

• Maximum annual surface water diversion for the pulse flow event from MID is 11,000 acre-feet. MID projects that none of this water would come from groundwater. This action would result in no impact to the water levels in Modesto Groundwater Basin. No mitigation is necessary.

• Maximum annual surface water diversion for the pulse flow event from TID is 11,000 acre-feet. Of this volume, TID projects that none of this water would come from groundwater. This action would have no impact on water levels within the Turlock Groundwater Basin. No mitigation is necessary.

• The maximum annual surface water diversion for the flow events from Merced ID is 67,500 acre-feet. Of this volume, Merced ID projects that the amount of this water that may come indirectly from groundwater ranges from zero to 67,500 acre-feet. For the worst case, this represents approximately 12 percent of the typical annual groundwater production rate of 555,000 acre-feet per year from the basin (DWR 1998). This could result in a significant impact to water levels within the groundwater basin. Mitigation includes implementing groundwater management programs to reduce pumpage or increase recharge. Measures could include a proposed conjunctive groundwater use program, programs to improve conservation of surface water, restrictions or limitations to groundwater pumping in highly overdrafted areas, importation of water to supplement the loss of groundwater, or supplementation of groundwater with treated water.
4. Environmental Consequences and Mitigation Measures

- Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors service area is 11,000 acre-feet. Of this volume, the amount that may come from groundwater ranges from zero to 11,000 acre-feet. This represents approximately 2 percent of the typical annual groundwater production rate of 511,000 acre-feet per year in the Delta Mendota Basin, a less-than-significant impact to groundwater levels within the Exchange Contractors service area. No mitigation is required.

Alternative Action

- If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries is approximately 62,000 acre-feet for the entire San Joaquin River Basin. Therefore, while an objective determination of the magnitude of impact for service areas or sub-basins is not possible, the effect is considered a potentially significant impact. Mitigation measures which could be implemented include instituting a conjunctive groundwater use program, implementing programs to improve conservation of surface water, restricting or limiting groundwater pumping in highly overdrafted areas, importing water to supplement the loss of groundwater, or supplementing groundwater with treated water.

4.3.3.3 Water Quality

Proposed Action

- SSJID projects that no groundwater would be pumped to provide water for achieving the VAMP pulse flow. This action would have no impact on groundwater water quality within the SSJID service area. No mitigation is required.

- OID projects that a maximum annual water diversion for the instream flows from their service area is 26,000 acre-feet. Of this volume, OID projects that the amount of this water that may come directly from groundwater ranges from zero to 15,000 acre-feet. This increase in groundwater extraction is projected to be balanced by additional inflow into the OID service area. There should be no impact to water quality as a result of this action. No mitigation is necessary.

- No groundwater would be pumped by MID from the Modesto Groundwater Basin, so there would be no impact to groundwater quality within the basin. No mitigation is required.
4. Environmental Consequences and Mitigation Measures

- TID projects that no groundwater would be pumped to provide water for achieving the SJRA pulse flow. This action would have no impact on water quality within the Turlock Groundwater Basin. No mitigation is required.

- The Merced ID projects that a maximum annual surface water diversion for the SJRA flows is 67,500 acre-feet. Of this volume, Merced ID projects that the amount of this water that may come indirectly from groundwater ranges from zero to 67,500 acre-feet. Based on the worst case, if the total amount comes from groundwater(to replace surface water reductions), this may increase TDS slightly and could result in a less-than-significant impact to groundwater quality. No mitigation is required.

- The Exchange Contractors project that the maximum annual surface water diversion for the pulse flow event from the service area is 11,000 acre feet. Of this volume, the amount of water that may come from groundwater ranges from zero to 11,000 acre feet. DWR does not provide an estimate of the typical groundwater production rates in the service area. However, they provide an estimate for the Delta Mendota Basin which includes the Exchange Contractor’s service area. The DWR estimated groundwater production rate for the Delta Mendota Basin is 511,000 acre feet per year (DWR 1998). Based on the worst case, if the total amount comes from groundwater storage, this could amount to approximately two percent of the total groundwater pumped from the basin. The impact on groundwater quality in the service area is less than significant. No mitigation is required.

Alternative Action

- If individual members of the San Joaquin River Authority and other water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries is approximately 62,000 acre-feet for the entire San Joaquin River Basin. Therefore, while an objective determination of the magnitude of impact for service areas or sub-basins is not possible, the effect is considered a potentially significant impact on groundwater quality. Mitigation measures could include limiting or restricting groundwater pumping in affected areas to improve groundwater quality, implementing a conjunctive use program, and implementing programs to improve conservation of surface water supplies to lessen future demands for groundwater.
4. Environmental Consequences and Mitigation Measures

4.3.3.4 Subsidence

Proposed Action

- SSJID projects that no water would come from groundwater for achieving the SJRA pulse flow. This action would have no impact on land subsidence within their service area. No mitigation is necessary.

- OID projects that the amount of water that may come from groundwater to achieve the instream flows ranges from zero to 15,000 acre-feet per year. However, groundwater levels have been historically high throughout the OID service area, and the groundwater surface is hydraulically connected to the Stanislaus River water surface. The majority of the groundwater pumped from the service area would be recharged by inflow from the Stanislaus River. These actions should not result in a negative impact to subsidence within OID’s service area. No mitigation measures are required.

- MID projects that no groundwater would be pumped to achieve the SJRA pulse flow. There would be no impact on subsidence in the Modesto Groundwater Basin. No mitigation is required.

- TID projects that no water would come from groundwater for achieving the SJRA pulse flow. This action would have no impact on land subsidence within the Turlock Groundwater Basin. No mitigation is required.

- The maximum annual surface water diversion for the SJRA flows from Merced ID is 67,500 acre-feet. Merced ID projects that the amount of water that may come indirectly from groundwater to substitute for reduced surface water deliveries ranges from zero to 67,500 acre-feet per year. Based on the worst case, if the total amount comes from groundwater storage, groundwater overdraft in the basin, loss of groundwater storage, and land subsidence could occur which are potentially significant impacts to the Merced Groundwater Basin. Mitigation measures include limiting groundwater pumping in highly overdrafted areas, importing water to supplement the loss of groundwater, and developing new or expanding existing groundwater recharge areas in areas with high recharge potential.

- Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors service area is 11,000 acre feet. Of this volume, the amount of this water that may come from groundwater ranges from zero to 11,000 acre feet. Based on the worst case, if the total amount comes from groundwater storage, this could amount to approximately two percent of the total groundwater pumped from the area. This is a less-than-significant impact on subsidence in the service area. No mitigation is required.
Alternative Action

- If individual members of the San Joaquin River Authority and other water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from all of these districts is approximately 62,000 acre-feet for the entire San Joaquin River Basin. Therefore, an objective determination of the magnitude of impact on land subsidence for each service area or sub-basin is not possible; the effect is considered a potentially significant impact. Mitigation measures include limiting groundwater pumping in highly overdrafted areas, importing water to supplement the loss of groundwater, and developing new or expanding existing groundwater recharge areas in areas with high recharge potential.

4.3.3.5 Agricultural Subsurface Drainage

Proposed Action

- The pulse flow may temporarily raise water levels within the San Joaquin River and its tributaries as it flows along the boundaries of the San Joaquin River Group Authority willing sellers’ service areas. However, the 31-day pulse flow period and other identified flows would have no impact on agricultural subsurface drainage within the willing sellers’ service areas. No mitigation is required.

Alternative Action

- The action would raise water levels in the San Joaquin River and affect agricultural subsurface drainage in areas adjacent to the river. Groundwater pumped to replace reductions in surface water deliveries would have a reverse effect and locally depress water levels. Assuming that both processes would occur, the effect is less than significant. No mitigation is required.
# 4. Environmental Consequences and Mitigation Measures

## 4.3 GROUNDWATER

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4.4 TERRESTRIAL RESOURCES

Terrestrial resources are divided into two sections: riparian vegetation and wildlife species.

Predicted impacts to riparian vegetation are based upon extensive riparian oriented field experience on other gravel and sand-bedded rivers in California. Specifically, considerable time has been spent studying riparian vegetation and relationships to hydrology and fluvial geomorphology on the Tuolumne River. While it is acknowledged that San Joaquin River, Merced River, and Stanislaus River terrestrial resources are inherently different than those of the Tuolumne River, due to land management practices, geology, and watershed size, after a field inspection of each river it was felt that the differences between rivers were not significant enough to warrant detailed independent comparisons of each. Instead, a prior understanding of the Tuolumne River riparian vegetation relationships to the physical environment was extrapolated to observations made on the San Joaquin River and its major tributaries (Merced and Stanislaus rivers).

Impacts to wildlife resources are based on changes in the quality of habitat as the result of loss or change of habitat. The changes in vegetation and resulting changes in terrestrial habitat are used as the measure of impacts on wildlife. The severity of impacts is determined by the magnitude of changes in quality or condition of terrestrial habitat and the potential for adversely affecting any threatened and endangered species (TES).

The habitat requirements of each TES wildlife species, as defined in the literature (CNDDB and WHR), were used to evaluate the effect of changes resulting from the proposed alternatives. It is assumed that the distribution and abundance of TES species is proportional to the amount and quality of habitat available. Assessment of impacts is based on the potential to impact TES species, their habitat, and/or their range. Although rare, threatened, and endangered plant species are known to live in the project area (Appendix D, Table D-2), field inspection within the riparian corridor has shown that no TES plant species live in the corridor and are all associated with non-riparian habitat types (Appendix D, Table D-1).

4.4.1 Key Impact Issues and Evaluation Criteria

4.4.1.1 Riparian Vegetation

Key impact issues for riparian vegetation are those that cause a positive or negative change to riparian vegetation health or survival. Where possible, impacts of stress are differentiated from impacts causing mortality to riparian vegetation.

Consistent with other sections in this chapter, impacts of the alternatives to riparian vegetation are assessed in terms of “significant impact”, “potentially significant impact”, “less than significant impact (if mitigated)”, and “no impact.” This section identifies specific impacts to riparian vegetation,
4. Environmental Consequences and Mitigation Measures

identifies specific thresholds of significance criteria for impact determination, assesses each alternative with respect to these significance criteria, and recommends measures to mitigate potential negative impacts. Conclusions relevant to CEQA and NEPA are the impacts of the two alternatives in comparison to the No Action alternative.

Potential Impact Types

Because riparian vegetation can both benefit from and be negatively impacted by the exact same process, many impacts of the alternatives can be positive, negative, or a mixture of both. For example, plant scour during excessively high flows can uproot all the riparian vegetation causing plant death. In most circumstances however, moderate amounts of plant scour result in positive impacts including preventing riparian encroachment, encouraging woody debris input and channel complexity, and cropping ecological succession so as to keep early seral stages in higher levels of productivity. In addition, riparian plants are negatively impacted by a variety of factors, including insufficient water availability during their growing season, and sand and silt deposition around the plant root collars (causing suffocation). The significance of the potential impacts not only has temporal aspects (depending on season and duration), but also magnitude/stage height aspects as well. The evaluation of the alternatives, combined with an understanding of riparian plant life history, narrowed down the range of potential impacts, as follows.

Potential positive impacts include:

- Improved natural riparian regeneration on surfaces at or near the bankfull channel/floodplain transition zones.
- Increased survival of established riparian vegetation.
- Slowing the decline in the health of relic stand riparian vegetation by increasing ground water availability.
- Improved natural riparian regeneration by timing pulse flows to coincide with seed dispersal periods of plant species whose populations are currently declining (e.g., Fremont cottonwood).
- Increased overall areal abundance in riparian vegetation in the project area.
4. Environmental Consequences and Mitigation Measures

Potential negative impacts include:

- Rapid downramping rates could cause stresses or mortality to riparian vegetation (due to desiccation or inundation). The summer Tuolumne flows, set by FERC, would always meet minimum flows, regardless of alternative.

- Increased abundance and/or areal extent of nuisance/exotic species (tree of heaven, eucalyptus, and other drought tolerant species with long lived seeds) due to flow timing not being correlated with native species seed dispersal periods.

- Encouraged growth of riparian encroachment along low flow channel margins (during dryer years) due to absence of high flows facilitates the initiation, establishment, and maturation of encroaching vegetation such as narrow-leaf willow, box elder, and white alder. This encroachment concurrently decreases riparian vegetation age and species diversity.

Perceived but not significant impacts include:

- Mortality to riparian vegetation due to recurring high flow scour events thus suppressing natural regeneration. Recommended flows, however, would not be of sufficient magnitude and frequency to cause this type of impact.

- The survival, regeneration, and bank location for each species. Due to magnitude and frequency of flows, this would change over current conditions.

Several components of the alternatives that could cause direct impacts to riparian vegetation include the magnitude of peak flows, the timing of high flows, and the ramping rates on ascending and descending limbs of high flows. Plant growth, germination, and establishment are periods during the plant’s annual life history that have sensitivity to such changes and thus could potentially be impacted by the proposed alternatives (Figure 3.4-1).

Project alternatives would have little or no affect on riparian vegetation as long as the magnitude of peak flows does not exceed bed mobility thresholds (e.g., 7,000 to 8,000 cfs on the Tuolumne River). Consequently, impacts associated with flow timing are:

- Spring (March-May): Most riparian plants begin annual growth and flower during early spring; by late spring Fremont cottonwoods are dispersing their seeds (Figure 3.4-4). Initiating riparian seedlings are susceptible to mortality caused by downramping rates that exceed their root growing capabilities. April and May pulse flows for both alternatives begin and end during Fremont cottonwood’s initiation period and would potentially impact this species. The alternatives having the most adverse impacts on riparian vegetation would occur during spring months.
4. Environmental Consequences and Mitigation Measures

- Summer (June-August): Riparian plants grow at their maximum potential during summer. Most riparian plants have finished seed dispersal, with the exception of narrowleaf willows (Figure 3.4-4). Stable summer flows experienced under No Action and the two alternative actions could potentially increase the encroachment of the invasive, narrowleaf willow. A long-term, cumulative indirect impact of low summer flows could be additional loss of riparian habitat due to enhanced encroachment by narrow-leaf willows (due to their long seed dispersal period).

- Fall (September-November): Riparian plants become dormant in the fall as valley oak, box elder, and white alder disperse seeds. Significant deviations in flows above or below the No Action alternative are not expected to have significant negative impacts.

- Winter (November-February): Riparian plants are dormant during winter. Flows of sufficient magnitude to induce bed mobility could scour establishing 1 and 2 year old plants. This could be either a positive or negative impact, depending on previous sequencing of scouring flows, however as long the magnitude of peak flows does not exceed bed mobility thresholds (e.g., 7,000 to 8,000 cfs on the Tuolumne River) no impacts are anticipated.

Many stress or mortality factors could cause negative impacts (Figure 3.4.4). By overlaying these mortality factors with life history trends, flow timing, magnitude, and ramping, impact thresholds can be developed above which significant impacts to riparian vegetation would likely occur. Stressors which could potentially create impacts (during times of year when vegetation is most susceptible) include:

- Desiccation - Decreases in soil moisture immediately adjacent to the channel caused by changes in groundwater levels resulting from rapid flow rampdown can cause water availability stress, reducing growth and potentially causing death. Several species can grow roots quickly to follow a decreasing wetted soil front, but not necessarily fast enough to prevent stress or death (Segelquist et al. 1993). This could be a primary impact on riparian vegetation.

- Inundation - Prolonged inundation during extended duration spring and summer high flows can drown vegetation. The mortality of vegetation within active channels could reduce encroachment of vegetation and enhance the deposition of fine sediments (positive impact). Conversely, inundation may prevent seed access to areas that could serve as germination sites. This could be a primary impact on riparian vegetation.

- Scour - One and two year-old riparian plants are most susceptible to scour mortality, because their roots are shallow and not well developed. Higher flows may mobilize silt, sand, and small gravel during winter peaks, scouring and killing newly established riparian vegetation.
4. Environmental Consequences and Mitigation Measures

Spring and summer flow magnitude and timing may impact mortality due to scour because flows during this window define where a given year’s cohort initiates. Low flows during the seeding period coupled with seed establishment close to the low water edge, result in the potential for scour-related mortality during upcoming winter peak increases. If flows during the seeding period are higher, then riparian establishment would be occur higher on the channel margin, thus decreasing the potential for winter scour related mortality.

- Deposition - As flows recede following high flows, sand and silts deposition occurs. Sediment deposition around the root collars of several riparian species (e.g., box elder, white alder) could suffocate vegetation if the deposits are deep enough (~ 0.5-1.0 feet deep). The significance of this secondary impact depends on the inundation impact on riparian regeneration.

Thresholds of Significance

Determining whether an alternative had a negative or positive impact on riparian vegetation depended upon how an alternative flow schedule interacted or impeded each species life history. The following thresholds of significance criteria were defined for determining potential impacts:

- Discharges during April 1-June 1 (spring) created potential impacts if:
  1. The magnitude and duration of flows are sufficient to inundate floodplains during seed dispersal period and initiation period, potentially creating a positive impact.
  2. Stage decreased at a rapid rate after May 1, primarily during flowramping, could potentially create a negative impact to germinating and establishing Fremont cottonwood seedlings.
  3. Stage increased during, or after, Fremont cottonwood seed dispersal period, drowning newly initiated plants could potentially create a negative impact.

- Discharges during June 1-Sept 30 (summer) created potential impacts if: Summer base flows were achieved by June 15 and did not have wide day to day variation over the three month period, thereby encouraging narrowleaf willow encroachment along the low water channel and potentially creating a negative impact.

- Discharges during October 1-March 31 (fall/winter) created potential impact if: Bedload mobilization thresholds were reached, discouraging narrowleaf willow encroachment, thereby potentially creating a positive impact.
4. Environmental Consequences and Mitigation Measures

4.4.1.2 Wildlife

Consistent with other sections, impacts of the three alternatives to wildlife species are assessed in terms of “significant impact”, “potentially significant impact”, “less than significant impact”, and “no impact.” This section identifies impacts to wildlife habitat, identifies specific thresholds of significance criteria for impact determination, assesses each alternative with respect to these significance criteria, and recommends measures to mitigate potential negative impacts if needed. Impacts to wildlife, to a large extent, are reflected from changes in vegetation. Therefore, impacts to wildlife are closely tied to the vegetation impacts discussed above.

Those species associated with valley riparian communities are the ones most likely to be impacted as a result of the alternatives. Positive and negative impacts discussed in the vegetation section illustrate the range of potential impacts to wildlife habitat. Changes in vegetation and associated wildlife habitat may result in a shift of species presence within the riparian system, where some areas may see a reduction in quantity of riparian habitat and others are improved in the quality. Wildlife species most likely to be affected are those that rely on riparian habitat to fulfill several critical life requisites such as primary foraging or nesting habitat. In addition, those species that use riparian corridors to move throughout the region may also be positively or negatively, impacted depending on the resulting change or alteration in riparian vegetation.

The significance criteria for evaluation of impacts to wildlife resources are:

- Temporary or permanent removal, filling, grading, or disturbance of wetlands and riparian communities;
- Substantial decrease in the area of important wildlife habitats or use areas in the San Joaquin, Merced, Stanislaus, and Tuolumne river systems;
- Substantial fragmentation or isolation of wildlife habitats or movement corridors, especially riparian and wetland habitats;
- Loss of occupied TES species habitat or direct mortality of TES species;
- Reduction in area or habitat value of critical habitat areas designated under the federal Endangered Species Act.
4. Environmental Consequences and Mitigation Measures

4.4.2 Environmental Consequences

Potential impacts for the SJRA alternative and the Water Right Priority System alternative are compared to the No Action alternative and to the existing conditions described in Section 3.4.2. Each alternative was evaluated separately, and no comparison between the SJRA alternative and the Water Right Priority System alternative was made. Using the thresholds of significance criteria requires a shorter time-step (hourly or daily) than that provided by the simulation model (monthly). Because of differences in the temporal resolution of the model compared to plant life history, the SJRA alternative thresholds of significance were evaluated using flow data for water year 1993, (a wet water year class) and water year 1994 (a below normal water year class); prior years when pulse flows occurred on the Tuolumne River. The SJRA alternative was compared to water years 1972 and 1978, years that were similar in water year class but did not have pulse flows. Potential impacts identified by this analysis on the Tuolumne River are inferred to have occurred on the other tributaries as well.

4.4.2.1 Riparian Vegetation

No Action

Due to the combination of contemporary hydrologic and geomorphic processes, human disturbance, each riparian plant’s specific physiologic tolerances, and the invasion of ruderal plants, no change to the current condition of a narrow riparian corridor with low species diversity described in Section 3.4.1 would occur. Plant communities would remain as described in the affected environment section. The threat of riparian encroachment by exotic species can increase in many of the tributaries as other channel restoration projects are implemented. Newly created alluvial surfaces that provide high quality salmonid habitat are vulnerable to riparian initiation and eventual encroachment. Preventing or avoiding narrowleaf willow encroachment is important in project areas where channel restoration has improved channel morphology (such as the Tuolumne River).

Proposed Action

The SJRA alternative simulates average monthly discharges using three models, and because of different modeling assumptions, the SJRA alternative was simulated for the months of April and May (instead of April 15- May 15).

One hydrograph for each water year class was generated for each modeled node in the project area (Figure 4.4-1 through Figure 4.4-25). The hydrographs portray the actual gaged discharges for that water year, the No Action alternative discharge simulation, the April pulse flow simulation and the May pulse flow simulation. If the flows for each alternative are equal for a given time period, the lines are superimposed and will appear as one thick line on the hydrograph. For example, on Figure 4.4-16 during the period of 1 February 1982 through 30 September 1982, all alternatives share the
same discharges for this time period. Therefore each alternative is superimposed over the others and accordingly only one line is visible. Evaluation of hydrograph components reveals that each simulated water year class has the potential to cross thresholds of significance.

Using the 1982 hydrograph on the Tuolumne River as an example (Figure 4.4-16), flows would no longer exceed bedload mobility thresholds during above normal and wet years. Increases in river stage after annual cottonwood seed dispersal (drowning seedlings), and rapid flow rampdowns (dessicating seedlings) could kill cottonwoods that germinated during pulse flows.

Due to the variability in modeled vs actual flows (10 percent to 20 percent) and the annual variability in flow magnitude (based on water year classification), the potential for impacts to riparian vegetation would vary in type and degree based on the actual timing and magnitude of flow release. Because the proposed flows were simulated by monthly timesteps, they cannot be quantitatively evaluated in terms of each threshold of significance criterion.

To assess the potential impacts associated with the proposed alternative in comparison to no action, Tuolumne River discharges during water years when pulse flows occurred were compared to years when they did not. Two locations were chosen for determining the rate of stage height change, at La Grange (modeled node LGR) and at the USGS gaging station #1129000, Modesto (Figures 4.4-26 through 4.4-29). The SJRA alternative stage height levels are shown using the annual daily average peak, pulse flow peak, and summer minimum flows in context to vegetation transects near La Grange (Figures 4.4-30 and 4.4-31) and upstream of the Modesto node at Santa Fe road, river mile 22.5 (Figures 4.4-32 and 4.4-33) on the Tuolumne River.

The evaluation of water years 1993-94 Tuolumne River pulse flows, both at La Grange and Modesto, indicate that both the No Action and the SJRA alternatives crossed thresholds of significance. Potentially negative impacts in both alternatives were mainly limited to decreases in stage height after Fremont Cottonwood seed dispersal, stage height increases after Fremont Cottonwood seed dispersal (Figures 4.4-5, 4.4-7, 4.4-8, 4.4-9, 4.4-10, 4.4-12, 4.4-14, 4.4-15, 4.4-16, 4.4-22, 4.4-23), and the elimination of bedload mobility thresholds (Figure 4.4-16, Figure 4.4-17 and Figures 4.4-26 through 4.4-29). Positive impacts in both alternatives were found associated with stage height increases and decreases during narrowleaf willow seed dispersal (Figure 4.4-26, Figure 4.4-27, Figure 4.4-29).

Specific potential impacts quantified for both the No Action and the SJRA alternative are:

- Pulse flow magnitudes are not sufficient to inundate floodplains during Fremont cottonwood seed dispersal (Figure 4.4-30 through Figure 4.4-33). For both water year classes, pulse flows reach stages that are contained within the active channel (Figure 4.4-30 through Figure 4.4-33).

- Modeled pulse flows have attenuated the annual peaks on the Tuolumne River such that bedload load mobility thresholds are not reached. When using prior water years data to
4. Environmental Consequences and Mitigation Measures

quantify potentially significant impacts, bedload mobility thresholds were not crossed even in the wet water year class (Figure 4.4-26 and Figure 4.4-27). The lack of semi-annual bed scour means that scour related mortality of prior years narrowleaf willow cohorts is not achieved in even wet water year classes. This could potentially lead to narrowleaf willow re-establishment on recently restored/constructed sites.

- Variation in summer baseflows are inadequate at La Grange during dry water years to inhibit narrowleaf willow regeneration but are adequate for wet water years (Figures 4.4-26 and 4.4-27); however, for both water year classes summer base flow variation at Modesto is sufficient to inhibit narrowleaf willow regeneration. There is no difference between the No Action alternative and the SJRA alternative for this threshold.

The proposed flows in the SJRA alternative would not impact any relic riparian vegetation; however, vegetation series that grow within the active channel (i.e., box elder, white alder, and willows) and germinating/establishing cottonwoods could potentially be impacted. Fremont cottonwood and valley oak stands that regenerated and established prior to flow regulation (relic stands) on the San Joaquin watershed would not be affected by any component of the proposed flows, as they are not currently influenced by contemporary fluvial processes that originally influenced where these plant series grew. No net loss to established box elder, and white alder cover types is anticipated, because they are infrequently inundated for any length of time greater than 1 day and currently are associated with the break in slope between the active channel and the floodplain.

In conclusion, no rare, threatened, or endangered plant species, and no relic vegetation types would be impacted (in comparison to no action); therefore, the negative impacts are not considered “significant”. The SJRA alternative also would have some beneficial impacts to riparian vegetation related to stage height increases in dry years. For the few potential negative impacts associated with the SJRA alternative, they can be mitigated using the measures identified in Section 4.4.3.1. However, these measures are not required under CEQA but rather are recommended, since the impacts are less than significant.

Alternative Action

The evaluation of the Water Right Priority System alternative did not have PROSIM, SANJASIM, and STANMOD simulated flows available. The Water Right Priority System alternative was evaluated using flows from the Draft Environmental Impact Report for implementation of the 1995 Bay/Delta Water Quality Control Plan (SWRCB 1998), based on simulations using California Department of Water Resources Simulation (DWRSIM) model. DWR simulated discharges are published as a monthly average of a 73-year period of record, and consider only a ten-year “critical” period of drought as a “worst-case scenario”.
4. Environmental Consequences and Mitigation Measures

The ten-year critical period was included because it simulates a drought when presumably pulse flow impacts on riparian vegetation would be the greatest. The evaluation of this alternative’s impacts on riparian vegetation only considers the average period of record, and the ten-year critical period. As with the SJRA, the DWR simulated flows were monthly timesteps, and in addition, were not modeled for each individual year; a 73- or ten-year average was used. Because the DWR simulated flows in monthly time steps, it was assumed that the implementation of this alternative would be similar to the SJRA alternative; therefore, the impacts associated with the Water Right Priority System alternative would be similar to the SJRA alternative and are less than significant.

4.4.2.2 Wildlife

No Action

No change to the current condition is described in Affected Environment (Section 3.4.2).

Proposed Action

As discussed in the previous section, there may be impacts to riparian vegetation with resulting impacts to wildlife habitat. Wildlife species closely integrated with the riparian community may also be impacted, although impacts specific to individuals or groups are difficult to quantify. Those TES species that are most closely linked to riparian habitat (such as Swainson’s hawk, willow flycatcher, riparian woodrat, and riparian brush rabbit) are likely to be the prime candidates for impacts. For example, loss of cottonwood forest may reduce the availability of nesting sites for Swainson’s hawk. Likewise, shifts in vegetation structure due to encroachment of non-native plants may reduce the habitat value for riparian woodrat or riparian brush rabbit. These could affect TES species because there may be a resulting decrease in the area of important wildlife habitat, and there may be further fragmentation of riparian corridors along project rivers.

The proposed action would have little or no affect on riparian vegetation as long as the magnitude of peak flows does not exceed bed mobility thresholds (e.g., 7,000-8,000 cfs on the Tuolumne River). (Flows of this magnitude would exceed the VAMP target flows and would occur under No Action). As a result, there would be no loss of habitat value for TES species, and no impact on these species.

Alternative Action

The potential impacts to wildlife associated with the alternative action are similar to those discussed for the proposed action. Impacts under this alternative are likely to be reflected in changes or shifts in quantity and quality of riparian habitat. However, these changes are difficult to quantify. Impacts would result in shifts in wildlife species abundance and distribution. These shifts would be potentially significant impacts if there is a significant loss of important wildlife habitat on riparian corridors due to higher flows from the greater volume of water required for the Water Right Priority System.
alternative. The impact on riparian habitat and species who depend on it are expected to be less than significant because a significant loss of riparian habitat is not expected.

4.4.3 Impact Summary and Mitigation of Impacts

4.4.3.1 Riparian Vegetation

Since impact evaluation was based on a surrogate model (the Tuolumne River data), mitigation measures are identified for riparian vegetation that might be impacted. Avoidance is the first step to mitigate potential impacts that could arise due to the timing of inundation, ramping rates, and bedload mobility threshold exceedence.

Impact avoidance criteria are equivalent to the thresholds of significance criteria. During the refinements in the actual operational scenarios for the proposed action, operation engineers may evaluate actual hourly and daily flow release possibilities and adjust them so they do not exceed the thresholds of significance criteria. Other impacts can be avoided as follows.

Proposed Action

• In the SJRA Alternative, the May pulse flow option is potentially the most detrimental, because in some years it could interfere with Fremont cottonwood initiation. Fremont cottonwood has been adversely impacted in the San Joaquin basin due to flow regulation, and rapid flow ramping at the end of the pulse flow would be more likely to kill seedlings that germinated during the May pulse flow period than if the pulse flow occurred in April. The modeled summer base flows reached immediately after the May pulse flow period may favor narrowleaf willow which is well known for its adverse impacts due to encroachment. Implementing the option in April, not May could mitigate these impacts. In both scenarios, summer baseflows should not exceed stage heights that were reached before May 15, because this could potentially drown Fremont cottonwood seedlings. The most likely implementation of this alternative would be for the pulse flows to begin in mid April accompanied by additional flows that would minimize rapid changes in stage (i.e., gradual flow ramping) during the receding limb. Flow ramping is part of the proposed action. If implemented to minimize large stage height change per day, impacts associated with flow ramping would be reduced. Therefore, it is recommended that a to-be-determined prescribed ramping rate be implemented in above normal and wet water year classes.

• The opportunity for riparian expansion will increase in many of the tributaries as channel restoration projects are implemented. Newly created alluvial surfaces that provide high quality salmonid habitat could be vulnerable to narrowleaf willow establishment and eventual encroachment. Preventing or avoiding narrowleaf willow encroachment will be important in project areas where channel restoration has improved channel morphology, such as the
4. Environmental Consequences and Mitigation Measures

Tuolumne River. Because of its propensity to fossilize the channel and reduce species and age diversity of riparian vegetation, narrowleaf willow dominance is undesirable. While the hydrographs of simulations of the above normal water years through the critically dry years show that the No Action and the SJRA Alternative propose stable summer base flows, on the Tuolumne River, static summer baseflows are already mandated by FERC. Where adequate soil moisture is present, stable summer flows could produce a large crop of narrowleaf willow seedlings in exposed areas. A small increase in flow in the first two weeks of August, immediately following narrowleaf willow’s seed dispersal period, would minimize riparian encroachment by inundating surfaces where narrowleaf willow germinated and produce a beneficial effect on Fremont cottonwood seedlings. Inundating narrowleaf willow in early August would enhance inundation related mortality to new cohorts. If the April option of the SJRA alternative is chosen, this early August flow release should approach the stage height level of May 15, drowning narrowleaf willow seedlings while watering Fremont cottonwood seedlings on upper bar and floodplain surfaces.

- In conclusion, no rare, threatened, or endangered plant species, and no relic vegetation types would be impacted (in comparison to no action); therefore, the negative impacts are not considered “significant”. The SJRA alternative also would have some beneficial impacts to riparian vegetation.

Alternative Action

- Impacts to Fremont cottonwood would be similar to the proposed action. Water provided for ramping flows would mitigate potential impacts to less than significant.

- The Water Right Priority System would also be based on FERC mandated flows in the Tuolumne River. Similar increases in stage (such as those recommended for the SJRA alternative) would prevent encroachment at restoration sites, and would mitigate to less than significant the effects of summer baseflows in these areas.
4. Environmental Consequences and Mitigation Measures

4.4.3.2 Wildlife

Proposed Action

- Ramping flows and the April pulse flow would result in reducing potential impacts on TES wildlife species by reducing loss of important wildlife habitat and decreasing the potential for fragmentation of riparian corridors. In addition, the FERC mandated flows on the Tuolumne (assumed in both No Action and SJRA alternatives) would reduce encroachment of exotic plant species in the project area and enhance habitat quality for endemic wildlife, including TES species. The impacts to wildlife, especially TES species, would be less than significant.

Alternative Action

- Impacts to the riparian corridor would be similar to those described in the proposed action. The alternative action would result in less-than-significant impacts to wildlife, including TES species.
4. Environmental Consequences and Mitigation Measures

4.4 TERRESTRIAL RESOURCES

4.4.1 Key Impact Issues and Evaluation Criteria

4.4.1.1 Riparian Vegetation

4.4.1.2 Wildlife

4.4.2 Environmental Consequences

4.4.2.1 Riparian Vegetation

4.4.2.2 Wildlife

4.4.3 Impact Summary and Mitigation of Impacts

4.4.3.1 Riparian Vegetation

4.4.3.2 Wildlife
4. Environmental Consequences and Mitigation Measures

4.5 AQUATIC RESOURCES

This section assesses the impacts to aquatic resources that could be affected by the proposed action and the alternative action.

4.5.1 Key Impact Issues and Evaluation Criteria

The aquatic resources within the project area have been defined in terms of existing habitats represented by unique Ecological Zones as described in Section 3.5.1. Riverine systems that provide spawning and rearing habitat, as well as passage into and out of the Delta for anadromous species of fish, form the basis for the impact analysis. Also considered are the reservoir habitats provided by the three major reservoirs in the project area. The estuarine habitats of the Delta are included only to the extent that they are impacted indirectly by the cumulative effects of the proposed project.

Indicator fish species, that occur within the project area during one or more environmentally sensitive stages of their life cycle, were chosen as important representatives of aquatic ecosystem responses to changes caused by the proposed project and its alternative. Fall-run chinook salmon were selected as the species of prime interest because water contributed by the proposed project is designated to provide protection for this species in the San Joaquin River Basin. The analysis of chinook salmon also encompasses steelhead trout, an anadromous species closely related to salmon. Other, less widely distributed species included in this analysis, are splittail and striped bass. Splittail are a native species currently proposed as a federally threatened species. Striped bass are included because of their commercial value as a game fish. The representative species selected for reservoir habitats is the largemouth bass.

The criterion used to determine the level of riverine impact associated with implementation of the project is based on average percentage changes to stream flow as compared to base conditions. Thresholds of impact significance were established as follows (see Section 4.1.2 for definitions of these categories):

- greater than +10 percent change Beneficial
- less than ±10 percent change Not significant
- between -11 and -25 percent change Less than significant
- greater than -25 percent change Potentially significant or Significant

Thresholds were derived based on the ability to accurately measure stream flow discharges to ±10 percent (USGS 1977). A change from -11 to -25 percent was considered measurable, but less than significant, because it would likely result in only minor changes in usable habitats. This is based in part on results of a study that combined weighted usable area (WUA) and stream temperatures as related to salmon habitat (EA 1993). Operational releases are not permitted to fall below established...
minimum flow requirements. For more discussion of the assessment methodology, see Appendix H, response 11 to comment 11 by NMFS.

Currently, minimum flow requirements have been established by the Federal Energy Regulatory Commission (FERC) for the Tuolumne River to protect fishery resources. For the Merced River, both the FERC license and the Davis-Grunsky contract provide minimum flow standards. Flow objectives for the Stanislaus River have been established in the New Melones Interim Plan of Operation (USBR 1997c).

The criterion for reservoir species impacts was an assessment of the percent change in water surface elevation, by water year type, of the three major reservoirs, for the months of April through July. This time period represents the optimal spawning period for largemouth bass. Water surface elevations were derived from water surface elevations vs. storage relationships for each reservoir. Average change in storage was then computed for each water year type, converted to water surface elevation, and compared to conditions. Thresholds of impact significance were established as follows:

- greater than +10 percent change Beneficial
- less than ±10 percent change Not significant
- between -11 and -20 percent change Less than significant
- greater than -20 percent change Potentially significant or Significant

Thresholds were derived based on the ability to accurately model changes in reservoir water surface elevations to ±10 percent (SWRCB 1998).

For both riverine and reservoir assessment, the no action and proposed action results from the hydrological modeling analysis (Appendix A) were used. This hydrologic analysis considered a hydrologic sequence of 71 years (1922 through 1992) and included the following range of water year types: 1) Critically Dry, 2) Dry, 3) Below Normal, 4) Above Normal, or 5) Wet. The No Action alternative represents the base case for comparing the alternatives. The 71-year period was used to evaluate the potential effects of the project over a the series of water year types, since the actual hydrology during project implementation would be unknown. Average percent changes over this 71-year hydrologic sequence were developed by water year type and used in the evaluation of the proposed project as compared with the base case.

The SWRCB (1998) results were used for an evaluation of conditions under the Water Right Priority System alternative. This analysis used a different operations model (DWRSIM) and a different base case, therefore the results were not directly comparable to those used to evaluate the proposed alternative. To evaluate the Water Right Priority System, an analysis between the SWRCB Alternative 2 (SWP/CVP used to meet the standards) and the alternative action (Alternative 3) was used to qualitatively determine impacts.
4. Environmental Consequences and Mitigation Measures

4.5.2 Environmental Consequences

The proposed project would provide additional stream flow largely in the form of October attraction flows and spring pulse flows. The project would provide water primarily through reservoir releases, bypass, and releases from storage. Reservoir storage would then be refilled during above normal and wet water year types, resulting in reduced stream flows (see Section 4.2 for discussion of water supply changes). The project would obtain up to 50 percent of its water from Lake McClure on the Merced River, with the majority of the remaining water coming from willing sellers on the Stanislaus, Tuolumne, and mainstem San Joaquin rivers.

4.5.2.1 Habitats and Ecological Zones

The Ecological Zones described in Section 3.5.1 contain complex relationships between the physical habitats and species assemblages found within them. These zones represent entire ecosystems that provide numerous and highly variable habitats for many species. No criterion exists to determine the significance of impacts across all of the habitats occurring within the zones on an ecosystem level. Consequentially, assessments of impacts within these zones are made through the use of indicator aquatic species. These species, which are dependent on a suite of aquatic habitats for reproduction, growth, and development, provide a link to the ecosystem level of biological organization.

No Action. The No Action alternative results in no changes to existing conditions. The No Action alternative includes flow releases in accordance with the various operating plans, settlement agreements, and FERC requirements now in place for the San Joaquin River Basin. Fluctuation of reservoir levels occur to the extent required to meet these flow releases. Since No Action represents the baseline, no impacts are identified for implementation of this alternative.

Proposed Action. Of the four Ecological Zones within the project area, only the San Joaquin River and East San Joaquin Basin zones are directly affected by the project. The project would provide flows in addition to those from the base case, with the Merced River experiencing the largest increases. Small reductions in flow would also occur as a result of reservoir recharge. The largest reductions in flow would occur on the Merced River in above normal and wet water year types. The proposed action would coordinate flow releases from among the three major reservoirs resulting in fluctuations of water level in the reservoirs. Because no criteria exists for assessing impacts to Ecological Zones, no determination of significance can be made.

Alternative Action. Neither the SWRCB (1998) Alternative 3 (the Water Right Priority System) nor the Alternative 2 (comparable base case), includes a discussion of Ecological Zones, or equivalent ecosystem level components. The alternative action could result in different flow regimes and reservoir levels when compared with the base case (Alternative 2). Consequently, it is not possible to evaluate impacts at the Ecological Zone level of biological organization. However, the general
changes would be similar to the proposed action in that both would provide additional flows during October and April or May, with resulting water level fluctuations occurring in major project reservoirs. No determination of significance can be made.

4.5.2.2 Factors Affecting the Distribution and Abundance of Aquatic Resources in the San Joaquin River Basin and Bay/Delta Estuary

A list of factors that affect the distribution and abundance of aquatic resources in the project area and Delta was presented in Section 3.5.2. These factors include; 1) Natural environmental variability, 2) Water development, 3) Introduced species, 4) Food supply, 5) Harvest, 6) Pollution, and 7) Reservoirs. Of these factors, only Pollution (Water Quality) and Reservoirs, are directly impacted by the project. Reservoir issues relating to selected indicator species are discussed in Section 4.5.2.3. Changes in surface water quality are discussed in Section 4.2.2.3.

No Action. The No Action alternative results in no changes to existing conditions.

Proposed Action. Implementation of the proposed action positively benefits water quality due to increased flow at Vernalis and would, therefore, not adversely affect aquatic resources.

Alternative Action. Implementation of the alternative action positively benefits water quality due to increased flows and would, therefore, not adversely affect aquatic resources.

4.5.2.3 Indicator Species

Indicator fish species provide a link between effects on individual organisms and consequences at the population, community, and aquatic ecosystem or “ecological unit” (see Section 4.5.2.1) levels of biological organization. The assessment of impacts to selected indicator species are based on the amount of change in stream flow or reservoir levels. Changes in flow (or reservoir levels) relate directly to the amount and quality of available physical habitat for various life stages of the indicator species and hence to its population distribution, numbers, and dynamics (change in distribution and numbers through time). To transform the magnitude of change in flow to impacts, threshold values were identified for not significant, less-than-significant, and potentially significant changes (see Section 4.5.2.1). Table 4.5-1A shows the average monthly percent change in flow (cfs) by water year type for specific reaches of the San Joaquin River and its tributaries. Table 4.5-1A was created
### TABLE 4.5-1A: AVERAGE PERCENT CHANGES IN CFS FOR RIVERS WITH APRIL/MAY PROJECT COMPARED WITH BASE CASE BY WATER YEAR TYPE

#### STANISLAUS RIVER – AVERAGE PERCENT CHANGE IN CFS WITH PROJECT (APRIL)

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#### TUOLUMNE RIVER – AVERAGE PERCENT CHANGE IN CFS WITH PROJECT (APRIL)

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#### TUOLUMNE RIVER – AVERAGE PERCENT CHANGE IN CFS WITH PROJECT (MAY)

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### TABLE 4.5-1A: AVERAGE PERCENT CHANGES IN CFS FOR RIVERS WITH APRIL/MAY PROJECT COMPARED WITH BASE CASE BY WATER YEAR TYPE (CONT.)

#### MERCEDE RIVER – AVERAGE PERCENT CHANGE IN CFS WITH PROJECT (APRIL)

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#### SJR below TUOLUMNE – AVERAGE PERCENT CHANGE IN CFS WITH PROJECT (APRIL)

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</table>
4. Environment Consequences and Mitigation Measures
by first calculating the percent change in flow from base conditions, represented by the No Action alternative, to the proposed action. These percentages were then averaged by water year type.

Table 4.5-1B shows the average monthly flow by water year that result from modeled flows for both the April/May base case and the April/May project. These averages are provided for information purposes only and have not been used in the determination of impacts. Note that the difference between averages will not be the same number as the average of individual differences. Consequently, one cannot take the average percentage change (in flows) given in Table 4.5-1A and apply them directly to Table 4.5-1B. Conversely, percentage change in averages calculated from Table 4.5-1B will not be the same number as those given in Table 4.5-1A.

Table 4.5–2 summarizes the average water surface elevations in project area reservoirs along with the percent monthly changes for April through July by water year type.

The effects of implementing the proposed project and its alternative are evaluated using the following indicator species: chinook salmon, steelhead trout, striped bass, splittail, and largemouth bass. Consideration is given to the specific life stages (including the egg stage) which occur within each river system. The key indicator species identified for this document is the fall-run chinook salmon.
4. Environment Consequences and Mitigation Measures

<table>
<thead>
<tr>
<th>TABLE 4.5-1B: AVERAGE MONTHLY CFS FOR RIVERS WITH AND WITHOUT APRIL/MAY PROJECT ALONG WITH BASE CASE FOR APRIL/MAY BY WATER YEAR TYPE</th>
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<td>Critical</td>
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### 4. Environment Consequences and Mitigation Measures

**TABLE 4.5-1B: AVERAGE MONTHLY CFS FOR RIVERS WITH AND WITHOUT APRIL/MAY PROJECT ALONG WITH BASE CASE FOR APRIL/MAY BY WATER YEAR TYPE (CONT.)**

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<th>March</th>
<th>April</th>
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| **TUOLUMNE RIVER – AVERAGE CFS WITHOUT PROJECT (APRIL)** | | | | | | | | | | | | | |
| Wet         |        |          |          |         |          |       |       |     |      |      |        |            |            |
| Above       | 299    | 628      | 1166     | 1634    | 2233     | 987   | 1810  | 312 | 299  | 250  | 250    | 250        | 843        |
| Below       | 284    | 492      | 415      | 681     | 712      | 409   | 1138  | 177 | 76   | 75   | 75     | 76         | 384        |
| Dry         | 347    | 476      | 265      | 265     | 668      | 265   | 752   | 158 | 67   | 66   | 66     | 67         | 289        |
| Critical    | 195    | 212      | 184      | 184     | 184      | 184   | 455   | 150 | 50   | 50   | 50     | 50         | 162        |

| **TUOLUMNE RIVER – AVERAGE CFS WITH PROJECT (MAY)** | | | | | | | | | | | | | |
| Wet         |        |          |          |         |          |       |       |     |      |      |        |            |            |
| Above       | 296    | 628      | 1100     | 1633    | 2119     | 979   | 592   | 1761| 250  | 250  | 250    | 250        | 843        |
| Below       | 284    | 430      | 415      | 661     | 712      | 388   | 352   | 1022| 76   | 75   | 75     | 76         | 381        |
| Dry         | 347    | 476      | 265      | 265     | 660      | 265   | 729   | 67  | 66   | 66   | 66     | 67         | 295        |
| Critical    | 195    | 212      | 184      | 184     | 184      | 184   | 150   | 445 | 50   | 50   | 50     | 50         | 161        |

| **TUOLUMNE RIVER – AVERAGE CFS WITHOUT PROJECT (MAY)** | | | | | | | | | | | | | |
| Wet         |        |          |          |         |          |       |       |     |      |      |        |            |            |
| Above       | 299    | 628      | 1100     | 1633    | 2119     | 979   | 592   | 1761| 250  | 250  | 250    | 250        | 843        |
| Below       | 284    | 430      | 415      | 661     | 712      | 388   | 352   | 1022| 76   | 75   | 75     | 76         | 381        |
| Dry         | 347    | 476      | 265      | 265     | 660      | 265   | 729   | 67  | 66   | 66   | 66     | 67         | 295        |
| Critical    | 195    | 212      | 184      | 184     | 184      | 184   | 150   | 445 | 50   | 50   | 50     | 50         | 161        |
### TABLE 4.5-1B: AVERAGE MONTHLY CFS FOR RIVERS WITH AND WITHOUT APRIL/MAY PROJECT ALONG WITH BASE CASE FOR APRIL/MAY BY WATER YEAR TYPE (CONT.)

#### MERCED RIVER – AVERAGE CFS WITH PROJECT (APRIL)

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#### MERCED RIVER – AVERAGE CFS WITHOUT PROJECT (APRIL)

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#### MERCED RIVER – AVERAGE CFS WITH PROJECT (MAY)

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#### MERCED RIVER – AVERAGE CFS WITHOUT PROJECT (MAY)

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### TABLE 4.5-1B: AVERAGE MONTHLY CFS FOR RIVERS WITH AND WITHOUT APRIL/MAY PROJECT ALONG WITH BASE CASE FOR APRIL/MAY BY WATER YEAR TYPE (CONT.)

#### SAN JOAQUIN RIVER at VERNALIS – AVERAGE CFS WITH PROJECT (APRIL)

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#### SAN JOAQUIN RIVER at VERNALIS – AVERAGE CFS WITHOUT PROJECT (APRIL)

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#### SAN JOAQUIN RIVER at VERNALIS – AVERAGE CFS WITH PROJECT (MAY)

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### Table 4.5-2: AVERAGE WATER SURFACE ELEVATIONS AND PERCENT CHANGES FOR RESERVOIRS WITH APRIL/MAY PROJECT COMPARED WITH BASE CASE BY WATER YEAR TYPE

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#### NEW MELONES PROPOSED ACTION – APRIL

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#### NEW MELONES PROPOSED ACTION – MAY

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### Table 4.5-2: AVERAGE WATER SURFACE ELEVATIONS AND PERCENT CHANGES FOR RESERVOIRS WITH APRIL/MAY PROJECT COMPARED WITH BASE CASE BY WATER YEAR TYPE (CONT.)

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#### NEW DON PEDRO PROPOSED ACTION – APRIL

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## 4. Environmental Consequences and Mitigation Measures

### Table 4.5-2: AVERAGE WATER SURFACE ELEVATIONS AND PERCENT CHANGES FOR RESERVOIRS WITH APRIL/MAY PROJECT COMPARED WITH BASE CASE BY WATER YEAR TYPE (CONT.)

**LAKE MCCLURE NO-ACTION – APRIL**

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<td>Wet</td>
<td>812</td>
<td>845</td>
<td>863</td>
<td>856</td>
<td>4.1</td>
<td>2.1</td>
<td>-0.9</td>
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<tr>
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<td>818</td>
<td>848</td>
<td>853</td>
<td>838</td>
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<td>-1.7</td>
</tr>
<tr>
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<td>827</td>
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<tr>
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<td>Critical</td>
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<td>766</td>
<td>749</td>
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<td>-2.3</td>
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**LAKE MCCLURE PROPOSED ACTION – APRIL**

<table>
<thead>
<tr>
<th>WY Type</th>
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<th>May</th>
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<td>845</td>
<td>863</td>
<td>856</td>
<td>4.2</td>
<td>2.1</td>
<td>-0.9</td>
</tr>
<tr>
<td>Above</td>
<td>806</td>
<td>839</td>
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<td>830</td>
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<td>-1.8</td>
</tr>
<tr>
<td>Below</td>
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<td>808</td>
<td>812</td>
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</tr>
<tr>
<td>Dry</td>
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**LAKE MCCLURE NO-ACTION – MAY**

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<th>July</th>
<th>Apr-May</th>
<th>May-Jun</th>
<th>Jun-Jul</th>
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<tbody>
<tr>
<td>Wet</td>
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<td>863</td>
<td>856</td>
<td>4.1</td>
<td>2.1</td>
<td>-0.9</td>
</tr>
<tr>
<td>Above</td>
<td>817</td>
<td>848</td>
<td>853</td>
<td>838</td>
<td>3.8</td>
<td>0.7</td>
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<tr>
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<td>827</td>
<td>809</td>
<td>2.8</td>
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<td>-3.0</td>
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<td>766</td>
<td>749</td>
<td>1.1</td>
<td>-1.0</td>
<td>-2.3</td>
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**LAKE MCCLURE PROPOSED ACTION – MAY**

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<th>WY Type</th>
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<th>Apr-May</th>
<th>May-Jun</th>
<th>Jun-Jul</th>
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<tr>
<td>Wet</td>
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<td>844</td>
<td>863</td>
<td>855</td>
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<td>-0.9</td>
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<td>846</td>
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<td>-2.4</td>
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<tr>
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<td>806</td>
<td>810</td>
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<td>2.1</td>
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<td>-2.5</td>
</tr>
<tr>
<td>Dry</td>
<td>800</td>
<td>802</td>
<td>793</td>
<td>766</td>
<td>0.3</td>
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<td>-3.4</td>
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<tr>
<td>Critical</td>
<td>749</td>
<td>754</td>
<td>746</td>
<td>727</td>
<td>0.7</td>
<td>-1.1</td>
<td>-2.6</td>
</tr>
</tbody>
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Chinook Salmon

Various life stages of fall-run chinook salmon can be present in the San Joaquin River Basin during all months of the year, although the number of individuals may vary considerably by stream and by year. Adults enter the system in October and spawn through January, with peak spawning period in November. Typically, eggs are buried in the spawning gravels for parts of November, December, and January, with occasional occurrences in October or February. Fry (very small juvenile fish) hatch starting in January, remain in the gravels for up to 30 days, and then emerge to feed and grow in shallow, slow moving water at the edge of the river. As the fry grow and develop (a process called rearing or maturation), they remain in waters which provide sufficient types and quantities of food and in waters where they can find cover from predators. At a certain stage of growth and development, they begin a process of physiological transformation to prepare for emigration out of the river to the ocean (smoltification). The majority of smolts leave the tributaries from March to the end of June. Other juveniles that remain in the tributaries and survive the summer months can become yearling smolts in the fall or winter.

Smolts can be stimulated to leave their rearing habitat by pulse flows in the spring. Pulse flows can mimic natural storm events that increase streamflow and stimulate emigration. Pulse flows usually result in increased turbidity and lower water temperatures. Both of these factors serve to reduce the impact of predation on emigrating smolts. Additionally, pulse flows may provide the necessary means to increase the survival of chinook salmon smolts by moving them out of tributaries in years when water temperature increases during the summer months result in elimination or reduction of suitable rearing habitat. The Vernalis Adaptive Management Plan is an experimental study to determine the proper level for the pulse flows.

No Action. The No Action alternative results in no changes to existing conditions. The No Action alternative includes fall attraction flow and spring pulse flow releases in accordance with the various operating plans, settlement agreements, and FERC requirements now in place for the San Joaquin River Basin and are intended to benefit adult and smolt life stages of chinook salmon. Since No Action represents the baseline, no impacts are identified for implementation of this alternative.

Proposed Action. In general, the Stanislaus, Tuolumne, and segments of the San Joaquin River (from the mouth of the Tuolumne to Vernalis) show less-than-significant changes in stream flow (Table 4.5-1A) as a result of implementing the proposed action. An exception to this general pattern occurs in October, January, and April/May. The relatively large increases in flow which occur in these reaches during October and/or April/May are viewed as beneficial impacts to fall-run chinook salmon. Increased stream flows in October benefit spawning adults migrating into the tributaries. These flows serve to attract the salmon to their natal streams. The spring pulse flow in April/May stimulates the emigration of salmon smolts out of the rivers systems toward the Delta and, eventually, the sea. The January increases occur in the Stanislaus River only and represent releases from storage of unallocated carryover for flood control purposes.
4. Environmental Consequences and Mitigation Measures

The Merced River and San Joaquin River (below the mouth of the Merced) show the same general flow patterns. However, large percentage increases in flow are observed when implementing the proposed action (Table 4.5-1A). This results from very low base case flows during October and April/May in some water year types. The large percentage increases shown for the Merced River in October for all water year types with the proposed action are due to increases in flow from base conditions of zero cfs. For example, in October during wet water year types, base flow conditions of zero cfs existed for 2 of the 17 years. In each case, these flows were increased to 203 cfs with the proposed action. Using a minimum flow of 1 cfs to allow for computation of percent increase, each of these years results in an increase of over 20,000 percent. When these values are used over the 17 wet water year types, the average percent change in flow is equal to 2,519.

The alternative to this method would have been to first calculate the average monthly flow by water year type and then determine the percent change between the No Action and proposed action alternatives. This method would have resulted in the percent change in average flow by water year type.

The selection criteria is based on the average percent change in flow between the no action and the proposed action. This is the preferred approach, since it is tightly linked to individual flow measurements and their relative accuracy. Statistically, the differences between meaningfully paired comparisons (i.e., proposed action minus no action) have a distribution similar to the original data which can be characterized by a variance and a mean. This transformation of the data (the process of calculating differences) preserves the information contained in the original data set. Consequently, the average percent change in flow is chosen as the criterion to assess impacts. This choice maintains the close, meaningful relationship between the selected assessment criteria and individual flow measurement.

Since base case flows are so low, the increased discharge into the Merced by the proposed project is considered a beneficial impact. The increases in flow in the San Joaquin River below the Merced are also considered a beneficial impact to the salmon. With no action, the Merced River has very low instream flow requirements. Since the proposed action provides most of the additional water needed to achieve the SJRA flows by releases into the Merced River, the fishery resources of this San Joaquin River tributary should benefit the most by implementation of the project. The operating conditions at the Merced River Fish Facility would not be impacted.

The Merced River also exhibits some reductions in flow associated with the proposed action (Table 4.5-1A). These occur in January through March, April (during a May release), May (during an April release), and in June. These instream flow reductions are the result of reservoir refill operations for Lake McClure and are largest in magnitude during above normal and wet water year types (maximum change of -22 percent). However, based upon the impact threshold criteria described in Section 4.5.1.2, these reductions in flow are considered to be less-than-significant impacts.

The October attraction and spring pulse flows associated with the proposed action are potentially large, rapidly increasing flows. These could create the potential for rapid increases and decreases in
4. Environmental Consequences and Mitigation Measures

river height (stage) as the flows are implemented, producing circumstances which could dewater
redds in the fall (a dewatered redd is a “nest” of salmon eggs, buried in gravel, that becomes exposed
to air when the stage of a river is sufficiently decreased), or strand salmon fry and smolts during the
spring (stranding is when fish living in shallow-water habitats near shore are trapped in dewatered
areas, or isolated in pools outside of the river channel, after a sudden decrease in the stage of a river).
Another possible impact to a redd is for it to be scoured by an increase in flow large enough to cause
movement of the gravel substrate. Scouring may result in the loss of eggs or fry developing within
the gravels. Because of the possible magnitude of these flow changes under the proposed action, this
is considered to be a potentially significant negative impact. A mitigation measure to reduce the
impact to less than significant would be to control the down ramp so as to protect redds and fish
within the system from dewatering and stranding. In coordination with U.S. Fish and Wildlife Service
(USFWS) and California Department of Fish and Game (DFG), the Operations Group should develop
and adopt a Best Management Practice (BMP) for supplying ramping guidelines (both up and down
ramp) governing the release of attraction and pulse flows to ensure and maximize the protection of
salmon. This BMP could be included in the annual operation plan. Additional water included in the
SJRA from OID not specifically directed to the pulse flows could be used for ramping.

The October attraction flows may also stimulate adult salmon to enter spawning reaches where
ambient water temperatures become too high after the attraction flow is reduced. The increased
water temperature may result in reduced fecundity of females (fecundity is a measure of viable eggs
produced by a female). The occurrence of this type of event would most likely take place in critical
years when low flow releases are scheduled during November and seasonal air temperatures are high.
The impact of the proposed actions on these events is likely to be less than significant based on low
frequency of occurrence for these events and the modeled flow predictions for November with the
proposed action that show no significant changes in flow. Existing temperature models should be
used in conjunction with habitat data to predict changes in temperature and usable habitat for various
life stages of salmon based on a comparison of proposed flows versus no action.

Existing records, data, and modeling efforts addressing water temperature issues for the Merced
River are not sufficient at this time to allow comprehensive quantitative analysis of the potential for
impacts of the proposed actions on Merced River temperatures. However, a qualitative examination
of projected changes in average monthly Lake McClure water storage levels provides a useful
approach for understanding better the potential for impacts on river temperatures.

The storage level of Lake McClure is a primary factor affecting the temperature of water released into
the Merced River at New Exchequer Dam. Along with season of the year, annual runoff pattern, and
annual air temperature variations, reservoir levels affect the temperature of water at the dam’s outlet.
The level of the reservoir affects the volume of cold water in the hypolimnion which forms in the
deepest layers of the reservoir upon thermal stratification during the late spring, summer, and
early fall months. Surface water warmed by the air and solar radiation during the spring and summer “floats” on top of the cooler, denser water of the hypolimnion. The depth of this warmer surface layer can vary but is generally between 15 and 30 feet deep in most California reservoirs. Once thermal stratification breaks down during the early fall months, the warmer surface and cooler hypolimnion waters mix and reservoir temperature becomes almost uniform throughout its depth and comes to a dynamic equilibrium with inflow and air temperatures until stratification reoccurs in spring.

Given this general relationship between a lake’s temperature profile and depth, differences in lake level can be used as a proxy indicator for potential differences in temperature at the reservoir outlet. Figures 4.5-1 through 4.5-5 provide graphical representation of the differences in average monthly lake levels between the proposed action (April and May scenarios) and the No Project alternative. They suggest that minimal effects on the temperature of water released into the Merced River may be expected. The difference between the two proposed action operations is negligible. Differences between the proposed action (April and May scenarios) and No Project alternative are small. The magnitude of these differences vary between water year type and over the course of individual water years, but are generally less than 30 feet different in depth. Such a small difference between the alternatives, relative to total depth of the reservoir at any one time, would not be expected to have much effect on release temperature when compared to the No Project Alternative, except perhaps during the early fall months in dry and critically dry water years when total storage may be limited. The extent of such an impact on water temperature in the Merced River would be dependent on the degree of cooling provided by decreasing seasonal air temperature which dominates release temperature in affecting river temperature in the lower Merced River during the fall and early winter months.

**Alternative Action.** Flows for the alternative action are based on the SWRCB (1998) models (DWRSIM) previously discussed in Section 4.1.4. The aquatic resources impact analyses of the alternative action is based on percentage differences in flow between the SWRCB Alternative 3, known as the Water Right Priority System, as compared with SWRCB Alternative 2, used as comparable to the No Action alternative. By deriving the percentage change (Table 4.5-3) between the two SWRCB alternatives, the criteria developed in Section 4.5.1 can be employed to evaluate impacts and their significance. Available SWRCB data facilitates impact assessment for the major tributaries of the San Joaquin River, but not for the mainstem San Joaquin River.

For the alternative action, impacts to fall-run chinook salmon would not be significant, based on flow changes considered to be within measurement error (± 10 percent), or measurable, but less-than-significant (between -11 percent and -25 percent) changes in flow. However, some potentially significant (greater than -25 percent) changes in flow are shown to occur in the Merced River during February and in the Stanislaus River during May (Table 4.5-3) of the SWRCB defined critically dry period (May 1923 to October 1934). The Stanislaus flow reductions may be the result of pulse flows being reduced in April/May. (Note that pulse flows modeled by SWRCB can cross months, whereas the pulse flows in the proposed action occur in either April or May). Based on available information,
Table 4.5-3: AVERAGE PERCENT CHANGE IN FLOW FOR SWRCB ALTERNATIVE 3 AS COMPARED WITH ALTERNATIVE 2 FOR MAJOR TRIBUTARIES OF THE SAN JOAQUIN RIVER OVER A 73-YEAR PERIOD AND A CRITICAL PERIOD (MAY 1928 TO OCTOBER 1934)

<table>
<thead>
<tr>
<th></th>
<th>October</th>
<th>November</th>
<th>December</th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>August</th>
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<tr>
<td>Stanislaus Flow, 73 Year</td>
<td>14.1</td>
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<td>7.5</td>
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<td>Tuolumne Flow, Critical</td>
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<td>0.0</td>
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<td>-11.4</td>
<td>-8.4</td>
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<td>-8.3</td>
<td>88.9</td>
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<td>404.3</td>
<td>139.6</td>
<td>200</td>
<td>130.1</td>
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</table>
it is not possible to determine whether mitigation would be required. The Merced flow reductions could adversely affect salmon fry at an early stage in their development when large reductions in flow would have the highest potential for stranding young fish. Possible mitigation could include adopting a BMP for ramping flow changes.

Large percentage increases in flow, that would provide potentially significant beneficial impacts occasionally occur in all rivers, mainly in the June through August period. However, no life stages of fall-run chinook salmon are known to be present in the Merced River during those months. The Merced River shows potentially beneficial increases in flow during April and May.

**Steelhead Trout**

Steelhead use the Stanislaus River in much the same way as fall-run chinook salmon, most of the impacts and model results discussed in the preceding section would apply to steelhead as well. The main differences between steelhead and fall-run chinook are: 1) adult steelhead begin their spawning migration slightly later than chinook and, therefore, stages of development for the eggs and juveniles will be approximately one month later than chinook; 2) adult steelhead will not necessarily die after spawning, resulting in some adults remaining in the rivers through June; and 3) young steelhead would likely remain in the rivers throughout their first summer.

**No Action.** The No Action alternative results in no changes to existing conditions. The No Action alternative includes flow releases for the Stanislaus River in accordance with the New Melones Interim Plan of Operation.

**Proposed Action.** The proposed action would result in aquatic resources impacts similar to those previously discussed for the fall-run chinook salmon in the Stanislaus River. No significant adverse changes would result in stream flow in the Stanislaus River as a result of implementing the proposed action. Beneficial impacts to steelhead would occur in the Stanislaus as a result of flow increases in October and April/May (Table 4.5-1A). These flow increases would provide attraction flows for immigrating adults in the fall, and pulse flows to stimulate emigration of smolts in the spring.

The same potentially significant impacts resulting from rapid changes in flow that may dewater or scour redds and strand juveniles would exist for steelhead. Mitigation would be the same as that described earlier for adopting Best Management Practices for ramping guidelines for pulse flows and including those in the annual operation plan.

Because yearling steelhead may reside in the Stanislaus during summer months, the Reclamation model for stream temperatures in the Stanislaus was used to identify any potential impacts that may occur during June through September as a result of implementing the proposed action. Output from the model showing the number of years water temperatures exceeding 68° F are predicted at the mouth of the river over a 70-year period (1922-1991) indicated that the maximum percent exceedence for the months of June through September, over all water year types, was reduced with
4. Environmental Consequences and Mitigation Measures

the proposed action (April or May) by 1.4 percent. These findings are consistent with the changes in percent flow shown in Table 4.5-1A. The impact of temperature change is less than significant.

Alternative Action. For the alternative action, impacts to steelhead would be similar to those discussed for fall-run chinook salmon with no significant, or less-than-significant impacts in the Stanislaus River during most months. Potentially significant changes in flow would occur on the Stanislaus River in May (Table 4.5-3). Based on available information, it is not possible to determine whether mitigation would be required for the Stanislaus River.

Large percentage increases in flow, showing potentially beneficial impacts, occasionally occur in the Stanislaus mainly during the summer months of June through August, during the SWRCB defined critical period.

Striped Bass

Striped bass are an introduced, anadromous species that primarily occur and spawn within the Delta and the Sacramento River Basin. Striped bass may enter the San Joaquin River Basin as adults to spawn in spring months. They typically spawn in the freshwater habitats available in the northern Delta lower reaches of the Sacramento River and the San Joaquin River below Vernalis. Striped bass eggs are buoyant and carried by the current towards the Delta. The eggs hatch within 1-2 days, and the young fry continue to be carried by currents towards the Delta.

No Action. The No Action alternative results in no changes to existing conditions. The No Action alternative includes flow releases in accordance with the various operating plans, settlement agreements, and FERC requirements now in place for the San Joaquin River Basin with no specific management of flows to benefit striped bass.

Proposed Action. The proposed action would result in increased stream flows during the spawning period in April or May that could attract spawning adults into the San Joaquin River. Beneficial impacts are expected in dry and critical water years. The potential reduction of available spawning habitat in the Merced River in above normal and wet water years would be a less than significant impact with little or no cumulative effect, due to the very low frequency of spawning in this area.

Alternative Action. The alternative action would result in increased stream flows during the spawning period only in the Merced River. In the Stanislaus and Tuolumne rivers, spawning period flow changes are mainly reductions in flow that would be less than significant, based on average percent changes of less than -25 percent and the very low frequency of spawning in these rivers.

Potentially beneficial impacts from increased flows in the summer months may occur in offsite locations (within the Delta) for maturing striped bass fry.
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Splittail

Splittail enter the San Joaquin River Basin to spawn during the winter and spring months. They require shallow, near shore areas or inundated floodplains for spawning and juvenile rearing. The young then continue to rear in these areas for a period of a few weeks up to one year (Sommer et al. 1997). They are a native species found in the lower reaches of the San Joaquin River and its major tributaries and also occur in the Delta and the Sacramento River Basin.

No Action. The No Action alternative results in no changes to existing conditions. The No Action alternative includes flow releases in accordance with the various operating plans, settlement agreements, and FERC requirements now in place for the San Joaquin River Basin with no specific management of flows to benefit splittail.

Proposed Action. The proposed action would result in beneficial impacts to splittail as a result of increased stream flows during a portion of the spawning period in April or May. Beneficial impacts are expected in dry and critical water years. The impacts of potential reduction of available spawning habitat in the Merced River in above normal and wet water years would be less than significant with little or no cumulative effect, due to the low frequency of occurrence for these events.

Alternative Action. The alternative action would result in increased stream flows during the spawning period only in the Merced River. In the Stanislaus and Tuolumne rivers, spawning period flow changes would be less-than-significant. Potentially beneficial impacts from increased flows in the summer months would occur in all rivers during the SWRCB critically dry period, benefitting maturing splittail fry.

Reservoir Species

The reservoir species selected as an indicator species for aquatic resources is the largemouth bass. Bass fishing is a very popular and economically important component of recreational use of reservoirs within the project area and throughout the state. Trophy sized largemouth bass are considered a prized gamefish. Largemouth bass spawn in April through June and eggs hatch in 5-10 days. The spawning period coincides with the period when reservoirs would be providing additional stream flows under the project. There is a possibility that reservoir levels would drop just after bass spawning and potentially impact the survival of the eggs. If reservoir levels increased after bass spawning, it would provide additional rearing habitat for the fry.

No Action. The No Action alternative results in no changes to existing conditions. The No Action alternative includes flow releases in accordance with the various operating plans, settlement agreements, and FERC requirements now in place for the San Joaquin River Basin. Fluctuation of reservoir levels occur to the extent required to meet these flow releases.

Proposed Action. The proposed project would coordinate releases from reservoirs on the three major tributaries of the San Joaquin River (New Melones, New Don Pedro, and Lake McClure). The
4. Environmental Consequences and Mitigation Measures

relatively small amount of water required for spring pulse flows would not cause excessive drawdown of any of the reservoirs under any water year types. Based on modeled reservoir storage, converted to water surface elevation, for the April through July period, averaged by water year type (Table 4.5-2), Lake McClure, which would likely have the most impact, would have average water surface elevation changes of three feet or less. Based on criteria established in Section 4.5.1, no significant impacts would result from the implementation of the project.

**Alternative Action.** The alternative action is assessed based on an analysis using SWRCB (1998) Alternative 3, the State Water Right Priority System, compared with SWRCB Alternative 2 as the base case. The assessment utilizes the SWRCB (1998) criterion of relative percentage change in Average Reservoir Habitat Index for an alternative when compared to base conditions. This criterion states that an alternative is considered significant only if the index is more than 10 percent different than the index for the base case. The three reservoirs assessed are New Melones, New Don Pedro, and Lake McClure. Results are presented below in Table 4.5-4.

**Table 4.5-4: PERCENT CHANGE IN RESERVOIR HABITAT INDEX FOR SWRCB ALTERNATIVE 3 COMPARED WITH SWRCB ALTERNATIVE 2**

<table>
<thead>
<tr>
<th>Reservoir</th>
<th>Alternative 2 Index (Base Case)</th>
<th>Alternative 3 Index (SWRP)</th>
<th>Percent Change (+/-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Melones</td>
<td>253</td>
<td>285</td>
<td>+12.6</td>
</tr>
<tr>
<td>New Don Pedro</td>
<td>358</td>
<td>339</td>
<td>-5.3</td>
</tr>
<tr>
<td>Lake McClure</td>
<td>387</td>
<td>366</td>
<td>-5.4</td>
</tr>
</tbody>
</table>

New Don Pedro and Lake McClure show changes that are not significant (less than 10 percent). New Melones shows significant beneficial impacts (greater than 10 percent) for the State Water Right Priority System alternative action (Alternative 3).

**Delta smelt and longfin smelt**

These species occur exclusively in the Delta, downstream of Vernalis. As stated in the 1995 Biological Opinion for the protection of delta smelt (USFWS 1995):

Proposed operations of the CVP and SWP provide adequate flows to transport delta smelt away from the influence of the pumps and provide productive, low-salinity rearing habitat in Suisun Bay. Flows for these purposes are needed from February to the end of June during most years. Because delta smelt are weak swimmers as larvae, they are passively transported with flows. Therefore, during the larval phases, flows of sufficient magnitude and duration are needed to transport and disperse delta smelt from the Delta to Suisun Bay. Bruce Herbold (EPA, pers. comm., 1994) has found a positive correlation between Delta outflow and delta smelt abundance as measured
4. Environmental Consequences and Mitigation Measures

by the fall midwater trawl index when X2 is between Middle Ground Shoals and Roe Island.

The operation of the Old River Barrier is based on VAMP sampling objectives. The Service issued a Formal Endangered Species Consultation and Conference on the Proposed South Delta Temporary Barrier Project for 1996 through 2000 (USFWS 1996b). They concluded that “the proposed continuation of the Temporary Barriers Project will likely adversely affect delta smelt and Sacramento splittail, and adversely modify or destroy delta smelt critical habitat, both directly and indirectly.” However, the Service also concluded that the temporary installation of the rock barriers are not likely to jeopardize the continued existence of the delta smelt and the proposed Sacramento splittail, or result in the destruction or adverse modification of critical habitat for delta smelt because the impacts are temporary in nature, there are several protective measures in place to reduce the effects of the project, and there will be overall integration of this project with CVP/SWP operations and the Operations Group (USFWS 1996b). The operational status of this fish control structure may be influenced by take limits of delta smelt at the export facilities.

No Action. The No Action alternative results in no changes to existing conditions. The No Action alternative includes flow releases in accordance with the various operating plans, settlement agreements, and FERC requirements now in place for the San Joaquin River Basin. Operations in the Delta would continue in accordance with the Delta Smelt Biological Opinion.

Proposed Action. The proposed action results in increased flow from the San Joaquin River into the Delta. The ratio of the total flows entering the Delta to the amount of flow exported, along with the operational status of the fish control structure at the head of Old River, determines the impacts to delta and longfin smelt. Since the operation of these facilities with project flows would be done in accordance with the 1995 Delta Smelt Biological Opinion and the 1996 temporary barriers consultation, less-than-significant impacts to delta smelt would result by implementing the proposed flow action.

Alternative Action. The alternative action results in increased flow from the San Joaquin River into the Delta, with no operational barrier at the head of Old River. The ratio of the total flows entering the Delta to the amount of flow exported determines the impacts to delta and longfin smelt. Since the operation of the export facilities would be done in accordance with the 1995 Delta Smelt Biological Opinion and the 1996 temporary barriers consultation, less-than-significant impacts to delta smelt would result by implementing the alternative action.
4. Environmental Consequences and Mitigation Measures

4.5.3 Impact Summary and Mitigation of Impacts

4.5.3.1 Habitats and Ecological Zones

Proposed Action

- No criteria exists for assessing impacts to Ecological Zones, no determination of significance can be made. No mitigation proposed.

Alternative Action

- Not possible to evaluate impacts at the Ecological Zone level of biological organization. No mitigation proposed.

4.5.3.2 Factors Affecting the Distribution and Abundance of Aquatic Resources in the San Joaquin River Basin and Bay/Delta Estuary

Proposed Action

- The only factor directly impacted by the project is water quality. Implementation of the proposed action positively benefits water quality and would, therefore, not adversely affect aquatic resources. No mitigation is required.

Alternative Action

- The only factor directly impacted by the project is water quality. Implementation of the alternative action positively benefits water quality and would, therefore, not adversely affect aquatic resources. No mitigation is required.

4.5.3.3 Indicator Species

Chinook Salmon

Proposed Action

- In general, the proposed action results in flow changes for the Stanislaus, Tuolumne, Merced, and San Joaquin rivers that are considered to be not measurable, or measurable with less-than-significant impacts to fall-run chinook salmon. No mitigation is required.

- During the spring (April/May) and fall (October), the proposed action results in increased flows for the Stanislaus, Tuolumne, Merced, and San Joaquin rivers that would result in beneficial impacts to emigrating salmon smolts and immigrating adults. No mitigation is required.
4. Environmental Consequences and Mitigation Measures

- The increased flows in spring and fall may also produce potentially significant impacts to juvenile salmon and salmon redds, depending on the implementation of the flows. Sudden decreases may strand juveniles, and large magnitude changes may result in dewatering or scouring of redds. Mitigation would be to implement ramping of flows to ensure that adverse impacts are avoided, and water for ramping is included in the SJRA. With mitigation, the impact is less than significant.

- Impacts to female fecundity based on high November water temperatures following October pulse flows are likely to be less than significant based on the low frequency of occurrence of the event and modeled flow predictions that show no significant changes in flow. No mitigation is required.

- Minimal effects from reduced water levels in Lake McClure and water releases into the Merced River on the temperature in the river may be expected, except in dry and critically dry water years when total storage may be limited. The degree of cooling provided by decreasing seasonal air temperature dominates release temperature, so the project impact is less than significant.

Alternative Action

- In general, the alternative action results in changes in flow for the Stanislaus, Tuolumne, Merced, and San Joaquin rivers that result in less-than-significant impacts to salmon. No mitigation is required.

- The alternative action results in flow reductions on the Merced River in February and the Stanislaus River in May during the SWRCB defined critically dry period that result in potentially significant impacts to juvenile salmon. Mitigation could include increased smolt production from the Merced River Fish Facility.

Steelhead

Proposed Action

- Steelhead are found only in the Stanislaus River and impacts are limited to the Stanislaus River. Beneficial impacts to steelhead would occur as a result of flow increases during most months, in all water year types. No mitigation is required.

Alternative Action

- The alternative action would result in less-than-significant impacts to steelhead in the Stanislaus River during most months. No mitigation is required.
4. Environmental Consequences and Mitigation Measures

- Flow reductions in the Stanislaus River shown to occur in May during the SWRCB defined critically dry period could result in potentially significant impacts to juvenile steelhead. Mitigation could include smolt production from the Merced River Fish Facility.

- Large percentage increases in flow occur occasionally during summer months in the Stanislaus River, primarily during the SWRCB defined critically dry period, and would be beneficial to over-summering juveniles. No mitigation is required.

Striped Bass

Proposed Action

- The proposed action would result in increased flows during the spawning period for striped bass and provide beneficial impacts, especially during dry and critical water year types. No mitigation is required.

- The potential reduction of available spawning in the Merced River during above normal and wet water year types as a result of reduced flows is a less-than-significant impact. No mitigation is required.

Alternative Action

- The alternative action would provide increased stream flows during the spawning period only in the Merced River, a beneficial impact. Flow reductions in the Stanislaus and Tuolumne rivers during the spawning period result in less-than-significant impacts to striped bass. No mitigation is required.

- Potentially beneficial impacts from increased flows in the summer months may occur in offsite locations (within the Delta) for maturing striped bass fry.

Splittail

Proposed Action

- The proposed action would result in increased flows during the spawning period for splittail and provide beneficial impacts, especially during dry and critical water year types. No mitigation is required.

- The potential reduction of available spawning in the Merced River during above normal and wet water year types as a result of reduced flows is a less-than-significant impact. No mitigation is required.
4. Environmental Consequences and Mitigation Measures

**Alternative Action**

- The alternative action would provide increased stream flows during the spawning period only in the Merced River, a beneficial impact. Flow reductions in the Stanislaus and Tuolumne rivers during the spawning period result in less-than-significant impacts to splittail. No mitigation is required.

- Potentially beneficial impacts to young splittail result from increased flows that occur in the summer months in all rivers during the SWRCB defined critically dry period. No mitigation is required.

**Reservoir Species**

**Proposed Action**

- No significant impacts to largemouth bass would result from the implementation of the proposed action. No mitigation is required.

**Alternative Action**

- Less-than-significant impacts to reservoir habitat for New Don Pedro and Lake McClure occur as a result of the alternative action. No mitigation is required.

- Beneficial impacts to reservoir habitat for New Melones occurs as a result of the alternative action. No mitigation is required.

**Delta smelt and longfin smelt**

**Proposed Action**

- No significant impact to delta and longfin smelt would occur during the increased spring and fall pulse flows provided by the proposed action along with compliance of the 1995 Biological Opinion for the operation of the CVP and SWP.

**Alternative Action**

- No significant impact to delta smelt would occur during the increased flows provided by the alternative action along with compliance of the 1995 Biological Opinion for the operation of the CVP and SWP.
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4. Environmental Consequences and Mitigation Measures

4.6 LAND USE

This section evaluates the impact of the proposed action and alternative on land uses and the economy in the project area and vicinity. As described in Section 3.6, agricultural land uses and the agricultural sector of the economy are important resources in the project area and vicinity.

4.6.1 Key Impact Issues and Evaluation Criteria

With respect to land use, the primary issue is the extent to which the water from the San Joaquin River Group Authority’s willing sellers (up to 137,500 acre-feet as shown in table 4.1-1) would affect agricultural land uses and, therefore, the agricultural economy in counties in the project area and vicinity. During public scoping, both San Joaquin and Stanislaus counties expressed concern over potential impacts to agricultural land uses. A related issue is whether the use of agricultural water supplies for instream flow enhancements for fish would be in conflict with public policies such as zoning and the Williamson Act which seeks to preserve agricultural lands for agricultural use. This issue of conflicts with local land use policies is addressed in Section 6.3 on local compliance requirements, while impacts to agricultural lands are evaluated here.

Evaluation criteria for determining impact thresholds of significance include the following:

- Reductions in municipal water supplies that could affect local populations;
- Permanent or long-term reduction in jobs in the agricultural sector of the economy; and/or
- Permanent or long-term reduction in agricultural acreage within the San Joaquin River area.

4.6.2 Environmental Consequences

This analysis relies on information provided by the willing sellers regarding water uses potentially affected by the proposed action. Similar information is not available for the Water Right Priority System alternative, so the analysis of this alternative is qualitative. The analysis also relies on economic information provided in Reclamation’s Draft PEIS on the CVPIA and its Technical Appendix, Volume 5 (USBR 1997d, 1997i), the CALFED Draft PEIS/EIR (1998), and the SWRCB’s Draft EIR on the 1995 Water Quality Control Plan (1998) in addition to information presented in Section 3.6.
4. Environmental Consequences and Mitigation Measures

4.6.2.1 Socioeconomic Impacts

Population

The concern is to what extent the resident population would experience any water shortages as a result of implementation of the project alternatives. Water shortages could constrain planned growth in the affected areas.

No Action. Under the No Action alternative, both CVP (New Melones Reservoir) and non-CVP (New Don Pedro Reservoir and Lake McClure) facilities would operate consistent with 1997 conditions. Over time, the expansion of urban development to accommodate population growth and the conversion of agricultural lands to residential and other uses would occur to the extent permitted by local zoning and county/city general plans.

Proposed Action. The proposed project does not rely on water supplies used to meet the needs of municipal customers of the willing sellers (shown previously, Table 4.1-1). Most of the available water for the proposed action (126,500 acre-feet out of the total of 137,500 acre-feet) comes from carryover storage in project area reservoirs and would not affect deliveries to irrigation customers. In future years, some of this “irrigation water” could be needed for municipal users; but the only district with municipal users at present is MID. MID’s maximum contribution to the pulse flows is 11,000 acre-feet or only 3 percent of its surface water supplies. Consequently, there would be no direct or indirect adverse impact on local populations, nor would local population growth be affected.

Alternative Action. The Water Right Priority System alternative requires flows for fish to come from sources with junior appropriative rights before senior appropriative right holders are affected. The list of major San Joaquin Basin water rights is contained in the SWRCB’s Draft EIR (1998, p. II-28). Water available for exports could be affected, since waters for export are junior to all in-basin water rights. However, the New Melones project is assumed to be an in-basin project. Also, San Joaquin water right holders with storage rights in New Don Pedro and Lake McClure do not have delivery reductions because, through reservoir operations, they have adequate storage to meet flow obligations plus full deliveries (SWRCB 1998, p. V-18). For those districts and water users who would be affected, the proportion who are municipal water users cannot be determined quantitatively from information presently available in the Draft EIR (SWRCB 1998). However, it is probable that there are users with junior rights who serve municipal users who would have to curtail deliveries 20 to 60 percent of the time in April-May (SWRCB 1998, Figure V-19, V-20). As a result, the impact is adverse and considered potentially significant. Increased groundwater pumping could offset reductions in surface water deliveries.
4. Environmental Consequences and Mitigation Measures

Population Density

The density of population (persons per square kilometer) would be affected if the alternatives constrained development of land for residential uses and spurred population growth as infill development on vacant parcels within the urbanized area/agency sphere of influence. Formal spheres of influence are established for cities and service districts by Local Agency Formation Commissions. These are used as urban limit lines in order to control annexations and promote the orderly expansion of urban services.

**No Action.** Under no action, current trends towards urbanization foster higher population density. However, the operation of existing water projects under the no action alternative assumptions does not encourage unplanned urban development.

**Proposed Action.** The proposed action does not affect municipal water users as explained above in Section 4.6.2.1. Consequently, there is no impact to population density.

**Alternative Action.** Based on Section 4.6.2.1 above, municipal users would likely be affected. If municipal supplies were constrained, population growth would be constrained in that new development would not be able to get water connections. However, the impact on population density would be insignificant, because densities under constrained growth would remain stable.

4.6.2.2 Regional Economy and Employment

The economic importance of agriculture to the communities of the Sacramento Valley, Delta and San Joaquin Valley is greater than just the gross value of farm products or the number of direct farm-related jobs. There are two ways in which the agricultural industry impacts local and regional economies.

- First, direct economic activity is what is required to produce and harvest a crop: several products, goods, and services. Prior to harvest this includes seed, fertilizer, water, equipment, fuel, and labor. Once the crop has been harvested, it needs to be transported, stored, processed, packaged, and marketed.

- The second way in which the agricultural industry affects the economy is through distribution of the income obtained through the initial direct economic activity. Farm and farm-related incomes may be spent on food, housing, and other consumer items. Therefore, every unit of direct economic activity results in a multiplier effect (secondary economic activity) which can range from 1.8 to 4, with a general average of 2.7.
4. Environmental Consequences and Mitigation Measures

For example, a total farm income of $8,397,000,000 for the San Joaquin River Region in 1992 is worth about $22,671,900,000 in related economic activity assuming a multiplier of 2.7. (CALFED 1998)

Reductions in water deliveries to agriculture could lead to reduced farm production which generally results in the hiring of fewer workers. The following analysis evaluates the effect of reducing water deliveries to irrigation customers on the regional economy.

No Action. With no reductions in surface water deliveries, irrigated agriculture in the willing sellers’ service areas would continue to rely primarily on surface water from carryover storage and from diversions. Changes in farm production and related economic activity would occur due to other economic factors such as the change in demand for agricultural products. The structure of the regional economy would be similar to existing conditions, 1992-1995, depending on the source of data.

Proposed Action. The proposed action relies on willing sellers; and OID, SSJID, and Merced ID together could provide up to 104,500 acre-feet of water that otherwise could be made available for irrigation uses. If deliveries are reduced, any subsequent impacts on total jobs from reduced farm production would be less than-significant, because (1) this full amount of water would be needed in only a few years (short term), and (2) the potential impact would be substantially avoided through the use of groundwater to substitute for reduced surface water supplies to irrigate agriculture.

Alternative Action. The SWRCB does not provide a detailed economic analysis of Flow Alternative 3 in the DEIR (SWRCB 1998). Potential output and income losses could be significant. However, with similar assumptions of no land fallowing and the use of groundwater to replace surface water supplies, the economic impacts would be similar to the proposed action, i.e., less than significant.

4.6.2.3 Agricultural Land Use

Agricultural land use can be described for this analysis as irrigated acreage, but it is also described by its cropping pattern (see Table 3.6-6).

No Action

For the Authority’s six willing sellers, Table 4.6-1 shows total acres and the number of irrigated acres currently within each district. Under the No Action alternative, most of the irrigated acreage would continue in agricultural use. With the overall trend in the Valley towards development of agricultural land near urban centers for residential, commercial, and industrial uses, some of this acreage could be lost to agriculture over the 1999-2010 period. The No Action alternative assumes that prime farmland including land under Williamson Act contracts would not be urbanized.
Table 4.6-1: AGRICULTURAL LAND USE IN WILLING SELLER DISTRICTS

<table>
<thead>
<tr>
<th>Willing Seller</th>
<th>Land Area (acres)</th>
<th>Irrigated Area (acres)</th>
<th>Percent Irrigated (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exchange Contractors</td>
<td>240,000</td>
<td>225,562</td>
<td>94.0</td>
</tr>
<tr>
<td>Oakdale ID</td>
<td>72,345</td>
<td>62,000</td>
<td>85.7</td>
</tr>
<tr>
<td>South San Joaquin ID</td>
<td>71,112</td>
<td>62,000</td>
<td>87.2</td>
</tr>
<tr>
<td>Modesto ID</td>
<td>108,000</td>
<td>64,000</td>
<td>59.2</td>
</tr>
<tr>
<td>Turlock ID</td>
<td>192,000</td>
<td>149,000</td>
<td>77.6</td>
</tr>
<tr>
<td>Merced ID</td>
<td>140,000</td>
<td>98,000</td>
<td>70.0</td>
</tr>
<tr>
<td><strong>Total for All Districts</strong></td>
<td><strong>823,457</strong></td>
<td><strong>660,562</strong></td>
<td><strong>80.2</strong></td>
</tr>
</tbody>
</table>

Proposed Action

The districts that would potentially reduce deliveries to irrigation customers are OID, SSJID, and Merced ID (Table 4.1-1). These districts together contain 222,000 irrigated acres, 34 percent of the total irrigated acres (660,562 acres) within the service areas of the Authority’s willing sellers.

When irrigation water is reduced, farmers have several options: (1) obtain alternative sources of supply to supplement reduced surface water allocations; (2) increase water use efficiency including the reduction in deep percolation; and (3) match land use and cropping patterns to available water supplies through a combination of fallowing and shifts in crop type (SWRCB 1998). A cropping pattern is the share of acres within a region planted to individual crops or categories of crops, including fallowed land. Cropping patterns are important to agricultural and regional economics (see Table 3.6-8). If total irrigation water supplies are reduced and groundwater substitution does not occur, farmers can change their cropping patterns by fallowing a portion of their lands receiving irrigation water, by planting crops that require less irrigation water, or by adopting conservation measures that reduce irrigation losses. All of these measures affect farm profits (USBR 1997i).

- **Option 1:** The most probable option for the San Joaquin River Area is to replace surface water deliveries with groundwater. Farmers may pump groundwater directly or purchase groundwater from other suppliers. If the 104,500 acre-feet of potential reduced water deliveries to farmers in the San Joaquin River Area are offset by groundwater supplies, then there would be no significant impact to crops produced (either cropping pattern or productivity of the land) or to the amount of irrigated acreage. The weighted average cost of groundwater ranges from $30-$80 per acre-foot in the San Joaquin River Region, while surface water’s weighted average price is $20-$85 per acre-foot (CALFED 1998). Use of groundwater or use of carryover storage would be the most likely outcomes for replacing the
irrigation water diverted into the San Joaquin River system, and the overall adverse impact to agriculture would be less than significant.

• Option 2: The Authority’s willing sellers are currently practicing water use efficiencies through the implementation of conservation measures that are responsible for providing some of the water proposed for diversion into the San Joaquin River system. Irrigation efficiencies by farmers are also being practiced. An additional measure that may be implemented over the long term is Merced ID’s conjunctive use project to store surface water in underground aquifers.

• Option 3: Changes in cropping patterns, including land fallowing, are not expected as a direct or indirect result of the curtailed water deliveries in the San Joaquin River Area. Located in Merced County, Merced ID is the largest provider of surface water under the proposed action. All of its irrigated acreage would be affected by reduced deliveries in the short term if the full allotment of 67,500 acre-feet was required. Reduced deliveries could adversely affect almond production in the short term, depending on hydrologic conditions (Van Camp 1998, personal communication). Over the long term, Merced ID’s conjunctive use project would replace the delivery shortage and mitigate a potentially significant impact to agricultural production in Merced County to a less-than-significant level.

**Alternative Action.** Agricultural land uses for the Water Right Priority System alternative are likely to be similar to the proposed action. The SWRCB’s DEIR assumed that water right holders in the San Joaquin Basin would pump groundwater if their diversions were curtailed. The above described analysis of the proposed action is based on information from the willing sellers who indicate their irrigation customers are unlikely to withdraw land from production. Rather, farmers would use groundwater to maintain crop production and minimize production losses. Other water right holders for the alternative action would likely include some farmers who would reduce production. In the absence of more definitive data, the impact is assumed to be adverse and potentially significant.

4.6.3 Impact Summary and Mitigation of Impacts

4.6.3.1 Socioeconomic Impacts

Population and Population Density

**Proposed Action**

• There is no adverse impact on local populations, and local population growth would not be affected. No mitigation is necessary.
4. Environmental Consequences and Mitigation Measures

- There is no impact to municipal users, so there is no impact to population density. No mitigation is required.

Alternative Action

- Users with junior rights who serve municipal water users would have to curtail deliveries 20 to 60 percent of the time in April-May, a potentially significant impact. Mitigation measures such as conservation and greater efficiencies may be applied to partially reduce the impact, but not sufficiently to reduce the impact to less than significant.

- The effect on population density is less than significant, because densities under constrained growth would remain stable.

Regional Economy and Employment

Proposed Action

- Impacts on jobs from reduced farm production in some years would be substantially avoided through the use of groundwater to substitute for any surface water delivery reductions. The impacts are less than significant.

Alternative Action

- Job losses would be less than significant. Potential output and income losses could be significant but mitigated through measures to reduce surface water losses to irrigated agriculture, i.e., groundwater substitution, conjunctive use, conservation, and tailwater recovery.

Agricultural Land Use

Proposed Action

- The potential reduction of 104,500 acre-feet of the Authority’s water to irrigation customers could adversely affect cropping patterns and productivity. However, most of this surface water would be replaced by groundwater, including conjunctive use water, or come from surface water supplies (carryover storage), and the adverse impact on agriculture would be less than significant.
4. Environmental Consequences and Mitigation Measures

• Reduced deliveries by Merced ID could adversely affect agricultural production in the short term, but this decline in productivity would be mitigated through a conjunctive use project and by groundwater pumping by individual farmers. After mitigation, the impact would be less than significant.

Alternative Action

• Some farmers may change their cropping patterns and reduce crop production, a potentially significant impact. Mitigation measures include alternative sources of water (including groundwater) to offset declines in surface water deliveries.
4. Environmental Consequences and Mitigation Measures

4.6 LAND USE

4.6.1 Key Impact Issues and Evaluation Criteria

4.6.2 Environmental Consequences

4.6.2.1 Socioeconomic Impacts

4.6.2.2 Regional Economy and Employment

4.6.2.3 Agricultural Land Use

4.6.3 Impact Summary and Mitigation of Impacts

4.6.3.1 Socioeconomic Impacts
4. Environmental Consequences and Mitigation Measures

4.7 CULTURAL RESOURCES

The affected environment section for cultural resources was divided into the San Joaquin River Region and Sacramento-San Joaquin Delta in order to best describe the prehistoric and historic conditions of the project area and vicinity. This cultural resources impact section focuses specifically on the project reservoirs and rivers in order to determine whether or not there are any existing cultural resources that could potentially be impacted by the proposed and alternative actions. The reservoirs evaluated are New Melones, New Don Pedro, and Lake McClure. The rivers assessed are the San Joaquin, Stanislaus, Tuolumne, and Merced rivers.

4.7.1 Impact Issues and Evaluation Criteria

In this section cultural resource impact issues are assessed for both reservoirs and rivers that could be affected by the proposed project. The main effect relates to the protection or exposure of cultural resources due to altered reservoir levels or river flows. There are no construction or land altering activities associated with the proposed and alternative actions, which are typically the activities that could potentially impact cultural resources. No key issues regarding cultural resources were identified during the public scoping phase of this project.

4.7.1.1 Reservoirs

Cultural resources could potentially be affected only if the water level in the reservoirs due to the project fluctuates above or below the levels due to normal operations. This would happen under the proposed project. Changes in reservoir elevation can both protect and expose cultural resources. Depending on the type of resource and where it is located in the pool, a reservoir level which covers the resource may be considered beneficial. Alternately, a reservoir level which exposes a cultural resource may subject the resource to damage from erosion, wave action, wet/dry cycles, or destruction from vandalism.

Reservoir levels also affect recreation use, which can, in turn, affect cultural resources. Changes in the reservoir levels which increase recreation use may potentially impact cultural resources. Higher water levels tend to attract more visitors, and the potential for vandalism to cultural sites is increased. However, lower reservoir levels may not protect cultural resources because some recreationists, such as off-highway vehicle (OHV) users, may damage exposed resources.

Recreation opportunity thresholds are based on water depths (or water elevation levels) of the reservoirs. Critical depths occur when boat ramps are no longer operational, causing marinas to close, or when campgrounds or picnic areas are limited by the small surface area of the reservoir available for recreation. These critical levels were established for each reservoir in the CVPIA Draft PEIS (1997a) and were based on information provided by the operators of the reservoirs. Elevation
levels (water depths) were calculated for this EIS/EIR from the area and capacity tables for each reservoir and the Reclamation model storage capacity output.

For cultural resources identified in the affected environment (see sections 3.7.1, 3.7.2, and 3.7.3), reservoir elevations calculated from reservoir storage levels in the Reclamation model have a level of uncertainty. Due to the nature of the hydrological input data and the use of average monthly operations, the model results may be expected to have a margin of error of 10 to 20 percent. Therefore, frequencies which differ less than 10 percent from the base case are considered insignificant for the purposes of cultural resources impact evaluations.

4.7.1.2 Rivers

Cultural resources could potentially be affected by the flows in the rivers. Any cultural resources identified in the affected environment would occur at a known elevation. These elevations could be calculated from rating tables for each river based on the Reclamation model.

Streamflows also affect recreation use, which can, in turn, affect cultural resources. Changes in the streamflows which increase recreation use may potentially impact cultural resources by increasing vandalism to cultural sites. Streamflows determine the recreation opportunity thresholds in the rivers. Critical flows occur when either boating or swimming activities are either optimal or are not available (due to too little water or too rapidly flowing water). These critical flows were established for each river in the CVPIA Draft PEIS (1997a) and were based on information provided by the operators of recreational facilities along the rivers, rafting guides, and fishing guides. As with the reservoir analyses, the river flow analyses are based on the Reclamation model output.

For any cultural resources identified in the affected environment (see sections 3.7.1, 3.7.2, and 3.7.3), the river flows calculated from the Reclamation model have a level of uncertainty. Due to the nature of the hydrological input data and the use of average monthly operations, the model results may be expected to have a margin of error of 10 to 20 percent. Therefore, frequencies which differ less than 10 percent from the base case are considered insignificant for purposes of cultural resources evaluation.

4.7.2 Environmental Consequences

4.7.2.1 Reservoirs

If a cultural resource is identified, elevations of the reservoir resulting from the proposed action can be calculated using the area and capacity tables for each reservoir. The proposed reservoir storage is based on the Reclamation model storage capacity output. Again, if a cultural resource is identified in the affected environment, the Water Right Priority System alternative also would be compared to the base case. The Water Right Priority System alternative is compared to the proposed project
qualitatively for each reservoir because this alternative was not modeled using Reclamation’s modeling system. Rather the basis for analyses of this other alternative is the SWRCB’s hydrologic modeling included in their recent Draft EIR (SWRCB 1997, 1998). Output from the two modeling systems are not directly comparable, and the base cases rely on different assumptions. Of concern to the cultural resources impact analyses is the fact that the Reclamation model alternatives include the New Melones Interim Plan of Operation (USBR 1997) which has been in effect for over a year, while the SWRCB/DWR modeling of the base case does not.

New Melones Reservoir

**No Action.** The New Melones Reservoir area was an area used extensively by prehistoric people. The reservoir was subject to an extensive program of inventory, evaluation, and mitigation before it was filled (USBR 1997d). Any cultural resources in the reservoir area were previously impacted by the construction of the dam and reservoir.

**Proposed Action.** During the peak recreation season, the proposed project does not have any significant impacts on reservoir levels except during the critical water years at the lowest reservoir elevations. The proposed action benefits recreation by increasing the levels of the reservoir in the critical water years. Cultural resources potentially could be impacted with this increase in recreation use associated with the proposed action, but the effect is less-than-significant because it occurs only in critical water years with the lowest reservoir levels.

**Alternative Action.** During the peak recreation season, the Water Right Priority System alternative for New Melones Reservoir does decrease the frequency of occurrences with which the elevation exceeds critical thresholds, but the impact is not significant. In a critical period (represented in the modeling for the period 1928 through 1934), the Water Rights System Priority alternative is significantly different from Alternative 2 by decreasing the frequencies for the most extreme thresholds. This action could increase recreation use and thus increase the potential for impacts to cultural resources.

New Don Pedro Reservoir

**No Action.** The New Don Pedro Reservoir area was an area used extensively by prehistoric people. Any cultural resources in the reservoir area were previously impacted by the construction of the dam and reservoir. Construction of the New Don Pedro Dam was completed in 1971, and it is unlikely that there were any surveys for cultural resources performed prior to construction.

**Proposed Action.** During the peak recreation season and in all water years, the proposed project does not have any significant impacts on reservoir levels. The proposed project would affect the
4. Environmental Consequences and Mitigation Measures

reservoir levels, but these levels are not out of the range that could occur during normal operation of the reservoir. There is no impact to cultural resources (that could be present) from any change in recreation use.

**Alternative Action.** During the peak recreation season, the Water Right Priority System alternative for New Don Pedro Reservoir does not differ significantly from Alternative 2 during the entire period of record, but in the critical years, the alternative has a negative impact at both 720 ft. and 780 ft. MSL. The lower reservoir levels could increase recreation use by OHV users and possibly expose cultural resources (that could be present). The increase in potential for impacts to cultural resources, however, is considered less than significant because it only occurs in critical years.

**Lake McClure**

**No Action.** The Lake McClure area was an area used extensively by prehistoric people. Any cultural resources in the reservoir area were previously impacted by the construction of the dam and reservoir. Construction of the New Exchequer Dam was completed in 1967, and it is unlikely that there were any surveys for cultural resources performed prior to construction.

**Proposed Action.** During the peak recreation season, the proposed project does not have any significant impacts on reservoir levels during all water years. The proposed action would not impact cultural resources.

**Alternative Action.** During the peak recreation season, the Water Right Priority System alternative for Lake McClure does not differ significantly from Alternative 2 during the entire period of record and in the critical years. There would be no impact to cultural resources.

**4.7.2.2 Rivers**

Cultural resources could potentially be affected by the flows in the rivers. Any cultural resources identified in the affected environment would occur at a known elevation. These elevations could be calculated from rating tables for each river based on the Reclamation model. Again, if a cultural resource is identified in the affected environment, the Water Right Priority System alternative also would be compared to the base case.

Streamflows also affect recreation use, which can, in turn, affect cultural resources. Changes in the streamflows which increase recreation use may potentially impact cultural resources by increasing vandalism to cultural sites.
4. Environmental Consequences and Mitigation Measures

San Joaquin River

No Action. The San Joaquin River was an area used extensively by prehistoric people. The river crosses through Fresno, Madera, San Joaquin, and Stanislaus counties. These counties have over 5,000 recorded prehistoric sites, and the counties range from 2 to 5 percent surveyed for cultural resources. In addition, historic resources related to early agricultural activities may exist in the proximity of the river.

Proposed Action. During the peak recreation season and in all water years, the proposed project does not have any significant impacts on critical river flows or optimal ranges of flows. Thus, the project would not have an impact on cultural resources.

Alternative Action. During the peak recreation season, the Water Right Priority System alternative for the San Joaquin River has adverse impacts when compared to Alternative 2 for both the critical flows and for the optimal ranges. These impacts to recreation are insignificant for all except the 500 cfs critical flow when the frequency of occurrence of flows above the threshold is increased. It is unknown how recreation use would be affected above this infrequent flow; therefore, the impact of this short-term event on cultural resources is considered to be less-than-significant.

During critical periods, the Water Right Priority System alternative has a significant beneficial effect for recreation on the San Joaquin River by increasing the frequency of flows in the optimal boating range and decreasing the frequency of occurrences of flows below the critical threshold for swimming. In addition, the alternative action decreases the frequency of occurrences of flows in the optimal range for canoeing during critical periods, which is a significant adverse impact. Increasing or decreasing recreation opportunities has the potential to adversely impact cultural resources but only during infrequent critical periods. The impact is less-than-significant.

Stanislaus River

No Action. The Stanislaus River also was an area used by prehistoric people. The river crosses through Calaveras, Tuolumne, and Stanislaus counties. These counties have well over 1,200 recorded prehistoric sites, and the counties range from 3 to 15 percent surveyed for cultural resources. In addition, historical resources, such as mining-related structures, railroad grades, dams, and other structures, may exist in the proximity of the river.

Proposed Action. During the peak recreation season and in all water years, the proposed project does not have any significant impacts on critical river flows or optimal ranges of flows. Thus, the project would not have any significant impact on recreation use and, consequently, would not have any impacts on cultural resources.
4. Environmental Consequences and Mitigation Measures

Alternative Action. During the peak recreation season for both the entire period and the critical period, the Water Right Priority System alternative for the Stanislaus River is no different than Alternative 2 for the critical flows. For the entire period the frequency of occurrences of flows in the optimal range for the upper reach would be significantly beneficial with the Water Right Priority System alternative and would be beneficial, but not significant, in the lower reach. During critical periods the frequency of occurrences of flows is increased significantly in the optimal range for the lower reach and is decreased, but not significantly, in the upper reach. Increasing recreation use in most years on the Stanislaus River has the potential to adversely impact cultural resources, a potentially significant impact.

Tuolumne River

No Action. The Tuolumne River also was an area used by prehistoric people. The river crosses through Tuolumne and Stanislaus counties. These counties have over 280 recorded prehistoric sites, and the counties range from 3 to 10 percent surveyed for cultural resources. In addition, there may be historical resources, such as mining-related structures, railroad grades, dams, and other structures, in the proximity of the river.

Proposed Action. During the peak recreation season and in all water years, the proposed project does not have any significant impacts on critical river flows or optimal ranges of flows. Thus, the project would not have any significant impacts on recreation use and, consequently, would not have any impact on cultural resources.

Alternative Action. During the peak recreation season for both the entire period and the critical period, the Water Right Priority System alternative for the Tuolumne River is not significantly different than Alternative 2 for both the critical flows and for the optimal ranges. Thus, the alternative action would not have any significant impacts on recreation use and, consequently, would not have any impact on cultural resources.

Merced River

No Action. The Merced River also was an area used by prehistoric people. The river crosses through Mariposa and Merced counties. These counties have well over 1,100 recorded prehistoric sites, and the counties range from 2 to 5 percent surveyed for cultural resources. In addition, historical resources, such as mining-related structures, railroad grades, dams, and other structures, may exist in the proximity of the river.

Proposed Action. During the peak recreation season, the proposed project does have significant impacts on streamflows in critical, dry, and below normal years. The proposed action beneficially impacts recreation by decreasing the frequency of critical low flows for boating. Cultural resources
4. Environmental Consequences and Mitigation Measures

potentially could be impacted indirectly with the increase in recreation use, but the effect of the project on cultural resources would be less-than-significant with higher flows offsetting impacts from increased use.

Alternative Action. During the peak recreation season for both the entire period and the critical period, the Water Right Priority System alternative for the Merced River is not significantly different than Alternative 2 for both the critical flows and for the optimal range. Thus, the alternative action would not have any significant impacts on recreation use and, consequently, would not have any impact on cultural resources.

4.7.3 Impact Summary and Mitigation of Impacts

4.7.3.1 Proposed Action

Reservoirs

• Recreation use at New Melones Reservoir may increase in critical water years at the lowest reservoir elevations as a result of the proposed action. This increase in recreational use could potentially impact cultural resources by increasing artifact collection or vandalism. This potential impact is considered less than significant, and no mitigation is necessary.

• At both New Don Pedro Reservoir and Lake McClure, reservoir levels do not change significantly; therefore, recreation use is not affected. There is no indirect impact on cultural resources. No mitigation is necessary.

Rivers

• There are no adverse impacts to cultural resources at the San Joaquin, Stanislaus, or Tuolumne rivers. No mitigation is necessary.

• As a result of the proposed action, the frequency of streamflows below the critical threshold are significantly decreased on the Merced River in critical, dry, and below normal years. This could potentially increase recreation use, which may potentially impact cultural resources: however, the potential impacts are considered to be less than significant. No mitigation is necessary.
4. Environmental Consequences and Mitigation Measures

4.7.3.2 Alternative Action

Reservoirs

- Recreation use at New Melones Reservoir may increase in critical water years at the lowest reservoir elevations. This action could potentially impact cultural resources by increasing artifact collection or vandalism. This potential impact is considered less than significant, and no mitigation is necessary.

- As a result of the alternative action, frequency of occurrences of lower reservoir levels at New Don Pedro Reservoir during critical water years at the lowest elevations is increased. More area of the reservoir pool would be exposed, which could potentially increase recreational use of these exposed areas and adversely impact cultural resources. The impact is less than significant because it would occur only in critical years.

Rivers

- As a result of the alternative action, the frequency of occurrence of flows for recreation on the San Joaquin River above the 500 cfs threshold is increased, which is an infrequent adverse impact. It is unknown how recreation use would be affected above this flow, a short term effect; therefore the impact on cultural resources is considered to be less than significant.

- During critical periods, the alternative action has a significant beneficial effect for recreation on the San Joaquin River by increasing the frequency of flows in the optimal boating range and decreasing the frequency of occurrences of flows below the critical threshold for swimming. In addition, the alternative action decreases the frequency of occurrences of flows in the optimal range for canoeing during critical periods, which is a significant adverse impact. Increasing or decreasing recreation opportunities has the potential to impact cultural resources. The impact is less than significant, since it could occur infrequently.

- As a result of the alternative action, flows for recreation during the entire period on the Stanislaus River are beneficially impacted in the optimum range in the upper reach. During critical water years, the flows for recreation in the optimum range of the lower reach are beneficially impacted. Increasing recreation opportunities in most years has the potential to impact cultural resources. The impact is potentially significant. Mitigation may include surveying for the location of sensitive resources and implementing controls on recreation use if this use threatens identified resources.

Mitigation measures will vary according to ownership of the reservoirs. CEQA provides the principal state policy for the protection of prehistoric and historic archaeological resources. A public agency
4. Environmental Consequences and Mitigation Measures

following the Federal clearance process under the NHPA or NEPA may use the documentation prepared under the federal guidelines in place of documentation necessary for CEQA. For the CVP reservoirs, any cultural resource research will need to meet federal standards, which will in turn satisfy the CEQA guidelines.

The federal agency responsible for operation of the reservoir should ensure that NRHP-eligible resources potentially affected by the proposed action will be treated. Preservation, rehabilitation, restoration, and stabilization are common treatments for architectural properties.
## 4. Environmental Consequences and Mitigation Measures

### 4.7 CULTURAL RESOURCES

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<th>Section</th>
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<td>4.7.1 Impact Issues and Evaluation Criteria</td>
<td>104</td>
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<td>4.7.1.1 Reservoirs</td>
<td>104</td>
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<td>4.7.1.2 Rivers</td>
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<td>4.7.2 Environmental Consequences</td>
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<td>4.7.3 Impact Summary and Mitigation of Impacts</td>
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<td>4.7.3.2 Alternative Action</td>
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</table>
4. Environmental Consequences and Mitigation Measures

4.8 RECREATION

In this section impacts to recreation are assessed for both reservoirs and rivers that could be affected by the proposed project. The proposed flow objectives are compared to the existing conditions as described in the affected environment. In addition, the Water Right Priority System alternative is compared to both the base case and the proposed project. The reservoirs evaluated are New Melones, New Don Pedro, and Lake McClure. The rivers assessed are the San Joaquin, Stanislaus, Tuolumne, and Merced rivers. There would be no impacts to recreation in the conveyance facilities, wildlife refuges, hunting clubs, or in the Sacramento-San Joaquin Delta as a result of the proposed project.

4.8.1 Impact Issues and Evaluation Criteria

No key issues regarding recreation were identified during the public scoping phase of this project. The main effect that the proposed project could potentially have on recreation relates to reservoir levels and flow of water in the rivers. Recreational use is affected by the amount and timing of water levels and releases.

4.8.1.1 Reservoirs

Recreation opportunity thresholds are based on water depths (or water elevation levels) of the reservoirs. Critical depths occur when boat ramps are no longer operational, causing marinas to close, or when campgrounds or picnic areas are limited by the small surface area of the reservoir available for recreation. These critical levels were established for each reservoir in the CVPIA Draft PEIS (1997a) and were based on information provided by the operators of the reservoirs. Elevation levels (water depths) were calculated for this EIS/EIR from the area and capacity tables for each reservoir and the Reclamation model storage capacity output.

Due to the nature of the hydrological input data and the use of average monthly operations, Reclamation’s model results may be expected to have a margin of error of 10 to 20 percent. Therefore, frequencies which differ less than 10 percent from the base case are considered to be insignificant.

4.8.1.2 Rivers

Streamflows determine the recreation opportunity thresholds in the rivers. Critical flows occur when either boating or swimming activities are either optimal or are not available (due to too little water or too rapidly flowing water). These critical flows were established for each river in the CVPIA
4. Environmental Consequences and Mitigation Measures

Draft PEIS (1997d) and were based on information provided by the operators of recreational facilities along the rivers, rafting guides, and fishing guides. As with the reservoir analyses, the river flow analyses are based on the Reclamation model output.

Due to the nature of the hydrological input data and the use of average monthly operations, Reclamation’s model results may be expected to have a margin of error of 10 to 20 percent. Therefore, frequencies which differ less than 10 percent from the base case are considered to be insignificant.

4.8.2 Environmental Consequences

The projected reservoir storage capacity and flow figures were obtained from the Reclamation model results. The Water Right Priority System alternative is compared to the proposed project qualitatively for each reservoir because this alternative was not modeled using Reclamation’s modeling system. Rather the basis for analyses of this other alternative is the SWRCB’s hydrologic modeling included in their recent Draft EIR (SWRCB 1997, 1998). Output from the two modeling systems are not directly comparable, and the base cases rely on different assumptions. Of concern to the recreation impact analyses is the fact that the Reclamation model alternatives include the New Melones Interim Plan of Operation (USBR 1997c) which has been in effect for over a year, while the SWRCB/DWR modeling of the base case does not.

4.8.2.1 Reservoirs

The peak recreation seasons vary, but typically the majority of use occurs between Memorial Day and Labor Day. The recreation impact analysis, therefore, considers the water surface elevations of the reservoirs at the end of month for May and September. The frequency of occurrence when the reservoir falls below the critical elevations is summarized both in terms of numbers of months of occurrence, and in terms of percentages (Tables 4.8-1 through 4.8.-3). A frequency which is lower than the base case would indicate a beneficial effect of the proposed project. The entire 71-year period of record is examined as well as each of the water year types: critical, dry, below normal, above normal, and wet (Tables 4.8-1 through 4.8.-3).

New Melones Reservoir

The results for New Melones Reservoir from Reclamation’s model are summarized in Table 4.8-1. Explanatory notes for the table appear on the page following the table.
Table 4.8-1: RECREATION IMPACT ASSESSMENT FOR NEW MELONES RESERVOIR

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4. Environmental Consequences and Mitigation Measures

Notes:

<850 ft. MSL - last boat ramps inoperable (old roads at Mark Twain, Parrot’s Ferry, and Old Town recreation areas)
<860 ft. MSL - last official boat ramp inoperable (Glory Hole), limited lake surface area, decline in campground and picnicking use
<880 ft. MSL - marina closes
<900 ft. MSL - decline in beach use

No Action. At the beginning of the summer in May, the base case shows that beach use is impaired about 26.7 percent of the time during a critically dry year. During critical years, the marina would be closed 13.3 percent of the time, while limited lake surface area, boat ramps, and campground/picnicking use would be adversely affected as well. The last boat ramp would be inoperable 6.7 percent of the time. For all other year types, there are no adverse effect on recreation uses at New Melones Reservoir. By September, beach use declines in all year types with the most restricted activity occurring (46.7 percent) in a critical year. Only in critical years does the surface water elevation drop below 850 ft, and this occurs for 26.7 percent of the end of summer months.

Proposed Action. In May the proposed project does not differ at all from the base case for all of the water years considered. In September the proposed project benefits recreational use by decreasing the frequencies with which the water depth falls below critical thresholds. During critical water years, this project benefit is significant for the most extreme thresholds (850 ft. MSL and 860 ft. MSL).

Alternative Action. The Water Right Priority System alternative is compared to the Reclamation’s No Action alternative in a qualitative way. The SWRCB’s Alternative 2 is similar to the Reclamation base case and is used for the comparison. During the peak recreation season, the Water Right Priority System alternative for New Melones Reservoir does decrease the frequency of occurrences with which the water depth falls below critical thresholds, but the impact is not significant. In a critical period (1928 through 1934), the Water Right Priority System alternative is significantly different from SWRCB’s Alternative 2 by decreasing the frequencies for the most extreme thresholds (850 ft. MSL and 860 ft. MSL) from 32 percent to 0 and 34 percent to two percent, respectively. These impacts are beneficial.

New Don Pedro Reservoir

The results for New Don Pedro Reservoir from the Reclamation’s model are summarized in Table 4.8-2.
## Table 4.8-2: RECREATION IMPACT ASSESSMENT FOR NEW DON PEDRO RESERVOIR

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<th>With Project - May</th>
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</thead>
<tbody>
<tr>
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<td>71</td>
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<td>0</td>
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<tr>
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<td>12</td>
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<tr>
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</tr>
<tr>
<td>Wet</td>
<td>19</td>
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<table>
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<th>630 ft</th>
<th>720 ft</th>
<th>780 ft</th>
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<td>Wet</td>
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<table>
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<th>600 ft</th>
<th>630 ft</th>
<th>720 ft</th>
<th>780 ft</th>
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<tbody>
<tr>
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<td>71</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12</td>
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<td>Critical</td>
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<tr>
<td>Dry</td>
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<td>1</td>
</tr>
<tr>
<td>Below Normal</td>
<td>12</td>
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<td>0</td>
<td>0</td>
<td>2</td>
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<tr>
<td>Above Normal</td>
<td>14</td>
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<tr>
<td>Wet</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
4. Environmental Consequences and Mitigation Measures

Notes:
- <600 ft. MSL - last boat ramp inoperable (Fleming Meadow), marina closes (Fleming Meadows)
- <630 ft. MSL - marina closes (Moccasin Point)
- <720 ft. MSL - some boat ramps inoperable (Moccasin Point and Blue Oaks), limited lake surface area, and decline in campground and picnicking use
- <780 ft. MSL - decline in beach use

No Action. At the beginning of the summer in May, the base case shows that beach use is impaired, ranging from 80.0 percent of the time (critically dry year) to 5.3 percent of the time (wet year). During critical years, the boat ramps at Moccasin Point and Blue Oaks would be inoperable 26.7 percent of the time. For all other year types, there are no adverse effects on boat ramp operation at New Don Pedro Reservoir. By September, beach use declines in all year types except wet with the most restricted activity occurring (100.0 percent) in both critically dry and dry years. During critical, dry, and below normal years, the boat ramps at Moccasin Point and Blue Oaks would be inoperable, ranging from 9.1 to 60.0 percent of the time.

Proposed Action. For both May and September months, the proposed project does not differ significantly from the base case for all the water years considered. The proposed project slightly increases the frequencies with which the reservoir falls below critical thresholds, but these increases are at the highest elevation (780 ft. MSL) and are not significant impacts.

Alternative Action. During the peak recreation season, the Water Right Priority System alternative for New Don Pedro Reservoir does not differ significantly from the SWRCB’s Alternative 2 during the entire period of record; but in the critical years, the alternative has a negative impact at both 720 ft. and 780 ft. MSL. This impact is less than significant, because some boat ramps would still be operable.

Lake McClure

The results for Lake McClure from the Reclamation’s model are summarized in Table 4.8-3.
Table 4.8-3: RECREATION IMPACT ASSESSMENT FOR LAKE MCCLURE

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<td>630 ft</td>
<td>650 ft</td>
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<td>%</td>
<td>Total</td>
<td>%</td>
<td>Total</td>
<td>%</td>
<td>Total</td>
</tr>
<tr>
<td>All Years</td>
<td>71</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dry</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>Wet</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

|                      | With Project - May    |                       |                       |                       |                       |                       |                       |
|                      | Total Months          | 590 ft                | 600 ft                | 630 ft                | 650 ft                |                       |                       |
|                      | Total                 | %                     | Total                 | %                     | Total                 | %                     | Total                 | %                     |
| All Years            | 71                    | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     |
| Critical             | 15                    | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     |
| Dry                  | 11                    | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     |
| Below Normal         | 12                    | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     |
| Above Normal         | 14                    | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     |
| Wet                  | 19                    | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     |

|                      | Without Project-September |                       |                       |                       |                       |                       |                       |
|                      | Total Months              | 590 ft                | 600 ft                | 630 ft                | 650 ft                |                       |                       |
|                      | Total                     | %                     | Total                 | %                     | Total                 | %                     | Total                 | %                     |
| All Years            | 71                       | 0                     | 0                     | 0                     | 0                     | 0                     | 1                     | 1.4                   |
| Critical             | 15                       | 0                     | 0                     | 0                     | 0                     | 0                     | 1                     | 6.7                   |
| Dry                  | 11                       | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     |
| Below Normal         | 12                       | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     |
| Above Normal         | 14                       | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     |
| Wet                  | 19                       | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     |

|                      | With Project - September |                       |                       |                       |                       |                       |                       |
|                      | Total Months              | 590 ft                | 600 ft                | 630 ft                | 650 ft                |                       |                       |
|                      | Total                     | %                     | Total                 | %                     | Total                 | %                     | Total                 | %                     |
| All Years            | 71                       | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     |
| Critical             | 15                       | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     |
| Dry                  | 11                       | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     |
| Below Normal         | 12                       | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     |
| Above Normal         | 14                       | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     |
| Wet                  | 19                       | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     | 0                     |
4. Environmental Consequences and Mitigation Measures

Notes:

<590 ft. MSL - last boat ramps inoperable (northern Barrett Cove and Pinney Creek)
<600 ft. MSL - limited lake surface area and marina closes
<630 ft. MSL - boat ramp closes (southern Barrett Cove)
<650 ft. MSL - boat ramp closes (McClure Point)

No Action. At the beginning of the summer in May, the base case shows that for all water years all the boat ramps are operable. By September, in critical water years, only the boat ramp at McClure Point is inoperable 6.7 percent of the time.

Proposed Action. For both May and September, the proposed project does not differ significantly from the base case for all the water years considered. On average, reservoir levels are lower with the project (see Table 4.2-8 for end of the year storage), but the levels do not reach critical elevations during the recreation season. The proposed project slightly decreases the frequencies with which the reservoir water levels fall below critical thresholds in critical water years in September, but this decrease is at the highest elevation and is not a significant impact.

Alternative Action. During the peak recreation season, the Water Right Priority System alternative for Lake McClure does not differ at all from the SWRCB’s Alternative 2 during the entire period of record and in the critical years. The alternative action would have no impact on the base case.

4.8.2.1 Rivers

The peak recreation seasons vary by river, but typically the majority of use occurs between Memorial Day and Labor Day. This recreation impact analysis, therefore, considers the river flows during the peak season from May through September. The frequency of occurrence when the river flows are between or below the critical flows is summarized both in terms of numbers and in terms of percentages (Tables 4.8-4 through 4.8-7).

When a critical flow threshold above or below which flow-related recreation activities are impaired, a frequency of occurrence higher than the base case indicates a negative impact, and a frequency lower than the base case indicates a beneficial impact. However, when the optimal flow is stated as a range, the reverse is true. A frequency of occurrence that is higher than the base case indicates a beneficial impact, while a frequency of occurrence lower than the base case indicates a negative impact. The entire 71-year period of record is examined as well as each of the water year types: critical, dry, below normal, above normal, and wet.

The projected river flow figures were obtained from the Reclamation model. The Water Right Priority System alternative is compared to No Action qualitatively for each river because the basis for the analyses is a different set of model results, i.e., output reported in the SWRCB’s Draft EIR (SWRCB 1997, 1998). The Reclamation model includes the New Melones Interim Plan of Operation which has been in effect for over a year (USBR 1997c).
San Joaquin River

The results for the San Joaquin River from the Reclamation’s model are summarized in Table 4.8-4.

### Table 4.8-4: RECREATION IMPACT ASSESSMENT FOR THE SAN JOAQUIN RIVER

<table>
<thead>
<tr>
<th>Without Project - May through September</th>
<th>Total Months</th>
<th>Frequency that River is Between or Below Critical Flow Thresholds</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>&gt; 500 cfs</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>%</td>
</tr>
<tr>
<td>All Years</td>
<td>355</td>
<td>301</td>
</tr>
<tr>
<td>Critical</td>
<td>75</td>
<td>29</td>
</tr>
<tr>
<td>Dry</td>
<td>55</td>
<td>52</td>
</tr>
<tr>
<td>Below Normal</td>
<td>60</td>
<td>58</td>
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<tr>
<td>Above Normal</td>
<td>70</td>
<td>67</td>
</tr>
<tr>
<td>Wet</td>
<td>95</td>
<td>95</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>With Project - May through September</th>
<th>Total Months</th>
<th>Frequency that River is Between or Below Critical Flow Thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>&gt; 500 cfs</td>
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<tr>
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<td>%</td>
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<td>70</td>
<td>67</td>
</tr>
<tr>
<td>Wet</td>
<td>95</td>
<td>95</td>
</tr>
</tbody>
</table>

Notes:
- >500 cfs - unknown recreational opportunities
- 300-500 cfs - optimal flow range for all boating activities
- 200-300 cfs - optimal range of canoeing flows
- <300 cfs - below optimal flows for swimming

**No Action.** Critical flows for the San Joaquin River occur above 500 cfs and below 300 cfs. During all water years the river has flows above 500 cfs, ranging from 38.7 percent of the time in critically dry years to 100.0 percent of the time in wet years. Flows are below 300 cfs only in critical years (2.7 percent of the time). The optimal range for all boating activities is between 300 and 500 cfs, and this range is achieved during all but wet years, ranging from 3.3 percent of the time (below normal years) to 58.7 percent of the time (critical years). Canoeing flows are optimized between 200 and 300 cfs, and this range is only achieved during critical years (2.7 percent of the time).

**Proposed Action.** With the project, the frequency of occurrence of flows above 500 cfs is slightly increased, but the impact is insignificant. Occurrence of flows below 300 cfs is exactly the same with
or without the project. The occurrence of optimal flow ranges for boating is decreased slightly with the project, but the impact is insignificant. There is no difference between the project and the base case for the flows between 200 and 300 cfs.

**Alternative Action.** During the peak recreation season for all water years, the Water Right Priority System alternative for the San Joaquin River increases the flows above 500 cfs more than 12 percent of the time when compared to Alternative 2. This change exceeds the evaluation criteria (10 percent), but since the recreation opportunities are unknown above this threshold, the impact would be considered potentially significant.

During the critically dry water years, the Water Right Priority System alternative would provide more flows in the optimal range for all boating and less flows in the optimal range for canoeing. In addition, flows below the critical threshold for swimming would decrease, thus providing a beneficial impact. The alternative action would provide both beneficial and adverse impacts; therefore, the overall impact to recreation would be considered less than significant during critically dry water years.

**Stanislaus River**

The Reclamation model’s results for the Stanislaus River are summarized in Table 4.8-5.

**Table 4.8-5: RECREATION IMPACT ASSESSMENT FOR THE STANISLAUS RIVER**

<table>
<thead>
<tr>
<th>Without Project - May through September</th>
<th>Frequency that River is Between or Below Critical Flow Thresholds</th>
<th>Total Months</th>
<th>700-800 cfs</th>
<th>&lt;300 cfs</th>
<th>700-2,000 cfs</th>
<th>&lt;700 cfs</th>
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<td></td>
<td>Total</td>
<td>%</td>
<td>Total</td>
<td>%</td>
<td>Total</td>
<td>%</td>
</tr>
<tr>
<td>All Years</td>
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<td>2.7</td>
<td>46</td>
<td>61.3</td>
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<td>55</td>
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<td>1.8</td>
<td>22</td>
<td>40.0</td>
<td>25</td>
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<tr>
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<td>60</td>
<td>10</td>
<td>16.7</td>
<td>16</td>
<td>26.7</td>
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<td>8.6</td>
<td>25</td>
<td>35.7</td>
<td>25</td>
</tr>
<tr>
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<td>95</td>
<td>6</td>
<td>6.3</td>
<td>18</td>
<td>18.9</td>
<td>42</td>
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<table>
<thead>
<tr>
<th>With Project - May through September</th>
<th>Total</th>
<th>%</th>
<th>Total</th>
<th>%</th>
<th>Total</th>
<th>%</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Years</td>
<td>355</td>
<td>31</td>
<td>8.7</td>
<td>122</td>
<td>34.4</td>
<td>140</td>
<td>39.4</td>
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<tr>
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<td>2.7</td>
<td>44</td>
<td>58.7</td>
<td>13</td>
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<td>5.5</td>
<td>22</td>
<td>40.0</td>
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<td>11</td>
<td>18.3</td>
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<td>25</td>
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<td>11.4</td>
<td>23</td>
<td>32.9</td>
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<td>41.4</td>
<td>41</td>
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<tr>
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<td>95</td>
<td>7</td>
<td>7.4</td>
<td>17</td>
<td>17.9</td>
<td>44</td>
<td>46.3</td>
<td>50</td>
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</tbody>
</table>
4. Environmental Consequences and Mitigation Measures

Notes:
- 700-800 cfs - optimal flow range for all boating activities on the lower reach
- <300 cfs - below minimum flows for all boating activities on the lower reach
- 700-2,000 cfs - optimal flow range for all boating activities on the upper reach
- <700 cfs - below minimum flows for all boating activities on the upper reach

No Action. Critical flows for the Stanislaus River occur below 300 cfs on the lower reach of the river and below 700 cfs on the upper reach. Flows are below 300 cfs in all water years, ranging from 18.9 percent of the time during wet years to 61.3 percent of the time in critical years. During all water years the river has flows below 700 cfs, ranging from 54.7 percent of the time in wet years to 86.7 percent of the time in critically dry years. The optimal range for boating activities on the lower reach is between 700 and 800 cfs, and this range is achieved during all years, ranging from 1.8 percent of the time (dry years) to 16.7 percent of the time (below normal years). Boating flows on the upper reach are optimized between 700 and 2,000 cfs, and this range is achieved during all years, ranging from 13.3 percent of the time in critical years to 45.5 percent of the time in dry years. Flows below Goodwin Dam would not exceed 1,500 cfs except for flood flows. The No Action alternative has flows above 1,500 cfs 14 months during the recreation season during above normal and wet years (8.5 percent of the time).

Proposed Action. Critical flows for the Stanislaus River occur below 300 cfs in the lower reach of the river and below 700 cfs in the upper reach. With the project the occurrences of flows below 300 cfs on the lower reach and 700 cfs on the upper reach are slightly decreased (beneficial impacts), but these impacts are not significant. Again, the flows below Goodwin Dam would not exceed 1,500 cfs except for flood flows. With the project there would be flows above 1,500 cfs 17 months during the recreation season during above normal and wet years (10.3 percent of the time). The occurrence of optimal flow ranges for boating is increased slightly in the both the lower and upper reaches, but again the impacts are insignificant.

Alternative Action. During the peak recreation season for both the entire period and the critical period, the Water Right Priority System alternative for the Stanislaus River is no different than Alternative 2 for the critical flows (300 cfs in the lower reach and 700 cfs in the upper reach). For the entire period, flows in the optimal range for the upper reach (700 to 2,000 cfs) are significantly beneficial with the Water Right Priority System alternative, and are beneficial, but not significant, in the lower reach (700 to 800 cfs). During critical periods, flows are increased significantly in the optimal range for the lower reach and are decreased, but not significantly, in the upper reach.

Tuolumne River

The results from Reclamation’s model for the Tuolumne River are summarized in Table 4.8-6.
### Table 4.8-6: RECREATION IMPACT ASSESSMENT FOR THE TUOLUMNE RIVER

<table>
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<th>Without Project - May through September</th>
<th>Frequency that River is Between or Below Critical Flow Thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Months</td>
</tr>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>All Years</td>
<td>355</td>
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<td>Critical</td>
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<td>70</td>
</tr>
<tr>
<td>Wet</td>
<td>95</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>With Project - May through September</th>
<th>Total Months</th>
<th>400-700 cfs</th>
<th>200-600 cfs</th>
<th>&lt;500 cfs</th>
<th>&lt;150 cfs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>%</td>
<td>Total</td>
<td>%</td>
<td>Total</td>
</tr>
<tr>
<td>All Years</td>
<td>355</td>
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<td>4.8</td>
<td>112</td>
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<tr>
<td>Critical</td>
<td>75</td>
<td>9</td>
<td>12.0</td>
<td>10</td>
<td>13.3</td>
</tr>
<tr>
<td>Dry</td>
<td>55</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Below Normal</td>
<td>60</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Above Normal</td>
<td>70</td>
<td>0</td>
<td>0.0</td>
<td>56</td>
<td>80.0</td>
</tr>
<tr>
<td>Wet</td>
<td>95</td>
<td>8</td>
<td>8.4</td>
<td>46</td>
<td>48.4</td>
</tr>
</tbody>
</table>

Notes:

- 400-700 cfs - optimal flow range for all boating activities
- 200-600 cfs - optimal flow range for swimming
- <500 cfs - below minimum flows for power boating
- <150 cfs - below minimum flows for canoeing and kayaking

**No Action.** Critical flows for the Tuolumne River occur below 500 cfs for power boating and below 150 cfs for canoeing and kayaking. Flows are below 500 cfs for all water years, ranging from 48.4 percent of the time during wet years to 97.3 percent of the time in critical years. Flows are below 150 cfs in critical, dry, and below normal years, all 80 percent of the time. The optimal range for all boating activities is between 400 and 700 cfs, and this range is achieved in critical, dry, and wet years at 12.0, 7.3, and 7.4 percent of the time, respectively. Swimming flows are optimized between 200 and 600 cfs, and this range is achieved during critical, above normal, and wet years at 17.3, 80.0, and 48.4 percent of the time, respectively.

**Proposed Action.** There is no difference between the project and the base case for the flows below 500 cfs. Flows below 150 cfs are slightly improved during critical years, but this beneficial impact is not significant. The optimal flow ranges for boating for swimming are slightly decreased with the project, but the impact is not significant.
4. Environmental Consequences and Mitigation Measures

Alternative Action. During the peak recreation season for both the entire period and the critical period, the Water Right Priority System alternative for the Tuolumne River is not significantly different from Alternative 2 for both the critical flows (500 cfs and 150 cfs) and for the optimal ranges (400 to 700 cfs and 200 to 600 cfs).

Merced River

Reclamation model’s results for the Merced River are summarized in Table 4.8-7.

Table 4.8-7: RECREATION IMPACT ASSESSMENT FOR THE MERCED RIVER

<table>
<thead>
<tr>
<th>Without Project - May through September</th>
<th>Total Months</th>
<th>Frequency that River is Between or Below Critical Flow Thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>&lt; 500 cfs</td>
</tr>
<tr>
<td>All Years</td>
<td>355</td>
<td>293</td>
</tr>
<tr>
<td>Critical</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>Dry</td>
<td>55</td>
<td>55</td>
</tr>
<tr>
<td>Below Normal</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Above Normal</td>
<td>70</td>
<td>62</td>
</tr>
<tr>
<td>Wet</td>
<td>95</td>
<td>41</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>With Project - May through September</th>
<th>Total Months</th>
<th>Frequency that River is Between or Below Critical Flow Thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>&lt; 500 cfs</td>
</tr>
<tr>
<td>All Years</td>
<td>355</td>
<td>259</td>
</tr>
<tr>
<td>Critical</td>
<td>75</td>
<td>67</td>
</tr>
<tr>
<td>Dry</td>
<td>55</td>
<td>45</td>
</tr>
<tr>
<td>Below Normal</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>Above Normal</td>
<td>70</td>
<td>56</td>
</tr>
<tr>
<td>Wet</td>
<td>95</td>
<td>41</td>
</tr>
</tbody>
</table>

Notes:

<500 cfs - below minimum flows for all boating activities
50-200 cfs - optimal flow range for swimming

No Action. Critical flows for the Merced River occur below 500 cfs for all boating activities. Flows are below 500 cfs during all water years, ranging from 43.2 percent of the time (wet years) to 100.0 percent of the time (critical, dry, and below normal years). The optimal range for swimming is between 50 and 200 cfs, and this range is achieved during all water years, ranging from 16.7 percent of the time in below normal years to 26.3 percent of the time during wet years.
4. Environmental Consequences and Mitigation Measures

Proposed Action. With the project there is a decrease in frequency of flows below the threshold that is significant in critical, dry, and below normal years. Above normal and wet years are not significantly different with the project. The optimal flow range is between 50 and 200 cfs for swimming. With the project there is no change or no impact on recreation.

Alternative Action. During the peak recreation season for both the entire period and the critical period, the Water Right Priority System alternative for the Merced River is not significantly different from Alternative 2 for both the critical flows (500 cfs) and for the optimal range (50 to 200 cfs). There is no impact on recreation.

4.8.3 Impact Summary and Mitigation of Impacts

4.8.3.1 Reservoirs

Proposed Action

- There are no adverse impacts to recreational use at any of the reservoirs. No mitigation is necessary.

- As a result of the proposed action, New Melones recreationists would benefit from increased reservoir levels during critical years in September. No mitigation is necessary.

Alternative Action

- As a result of the alternative action, New Melones recreationists would benefit from increased reservoir levels during critical years. No mitigation is necessary.

- As a result of the alternative action, there is an adverse impact to recreational use at Lake Don Pedro during critical water years. Both beach use and the operation of some boat ramps would be negatively impacted. Some boat ramps would still be operable, however, so this impact is less than significant.

- There are no impacts for Lake McClure as a result of the alternative action. No mitigation is necessary.

4.8.3.2 Rivers

Proposed Action

- There are no significant impacts to river flows for recreationists for either the San Joaquin, Stanislaus, or Tuolumne rivers from the proposed action. No mitigation is required.
4. Environmental Consequences and Mitigation Measures

- With the project, there is a significant decrease in the frequency of flows below the critical threshold for boating activities during critical, dry, and below normal years on the Merced River. This impact is beneficial, and no mitigation is necessary.

Alternative Action

- With the alternative action, flows are increased above the critical threshold on the San Joaquin River in all water years. However, because the recreational opportunities are unknown above this flow level, the impact would be potentially significant. Until recreation opportunities can be determined and evaluated, the impact is unavoidable.

- During critically dry water years, the alternative action would provide additional flows for all boating activities and fewer flows for canoeing. In addition, there would be more flows in the optimal range for swimming. The alternative action, therefore, would provide both beneficial and adverse impacts. The overall impact to recreation would be considered less than significant.

- On the upper reach of the Stanislaus, there is a significant increase in the frequency of flows in the optimal range for boating for all years. During the critical years only, the frequency of occurrences of flows in the optimal range in the lower reach is also significant. These beneficial impacts do not require mitigation.

- There are no significant adverse impacts to river flows for recreationists for either the Tuolumne or Merced rivers from the alternative action. No mitigation is required.
4. Environmental Consequences and Mitigation Measures

4.8 RECREATION

4.8.1 Impact Issues and Evaluation Criteria

4.8.1.1 Reservoirs

4.8.1.2 Rivers

4.8.2 Environmental Consequences

4.8.2.1 Reservoirs

4.8.2.2 Rivers

4.8.3 Impact Summary and Mitigation of Impacts

4.8.3.1 Reservoirs

4.8.3.2 Rivers
4. Environmental Consequences and Mitigation Measures

4.9 ENERGY PRODUCTION

The production of electricity from falling water is a significant source of energy in the study areas. Major factors that influence hydrogeneration operations include upstream water regulation, downstream water needs, applicable license permit requirements, and electricity demands (which fluctuate according to the time of the year, weather conditions, and the economics of the energy market). Upstream releases from reservoirs are dependent on not only on upstream water sources (principally from snow melt), and the nature and extent of droughts, but also minimum downstream streamflow requirements, downstream flow fluctuation restrictions, and water quality requirements (USBR 1997d). In addition, downstream water needs are dependent on irrigation needs, water rights agreements, and other water supply contracts.

4.9.1 Key Impact Issues and Evaluation Criteria

This section of the EIS/EIR examines the issues associated with potential power production from reservoir releases to meet the project purpose. Power consumption from activities such as pumping are not addressed in this EIS/EIR because the proposed action does not call for any significant amount of pumping of water over what already occurs under existing conditions to deliver surface water and groundwater. There is the potential for indirect impacts to groundwater pumping to occur, but the energy consumption to accomplish this is not a significant issue. The key issue is to what extent the early release of water (to meet project objectives) would affect hydroelectric power production.

Hydroelectric generation projects typically start with an upstream water source, such as a storage reservoir. The electricity is generated in the powerhouse, which may be located at the reservoir or downstream. The amount of energy generated depends on the difference in elevation between the water in the reservoir and the powerhouse. Thus, the higher the elevation of the water in the storage reservoir, the greater the potential for power production.

In the competitive, deregulated energy market, electric utilities take all reasonable measures to maximize the value of their hydroelectric power production. Power produced during peak energy demand period is more valuable than that produced during lower demand periods. Because hydropower is a low cost energy source that can be turned on and off quickly, utilities generally employ it to meet peak loads. In California, these peak loads typically occur in the summer when maximum groundwater pumping, industrial, and air conditioning demands occur. When water is released in the spring to maintain river flows, less water is available in the summer to provide peak hydropower generation. Reductions in a hydroelectric plant’s ability to meet peak load requirements accelerates the need for additional peaking resources and increases the utility costs (McCann 1994, cited in SWRCB 1998).

4.9.2 Environmental Consequences
4. Environmental Consequences and Mitigation Measures

The proposed action and alternative require higher flows in the spring than occur at present. Model results show that achieving these flows often requires a shift in reservoir releases from the summer to the spring.

The projected reservoir storage capacity and flow figures were obtained from the Reclamation model results. The Water Right Priority System alternative is compared to the No Action alternative qualitatively for each reservoir, because this alternative was not modeled using Reclamation’s modeling system. Rather the basis for analyses of this other alternative is the SWRCB’s hydrologic modeling included in their recent Draft EIR (SWRCB 1997, 1998). Output from the two modeling systems are not directly comparable, and the base cases rely on different assumptions (see earlier discussion in Section 4.2, Surface Water). Of concern to the energy impact analyses is the fact that the Reclamation model alternatives include the New Melones Interim Plan of Operation (USBR 1997c) which has been in effect for over a year, while the SWRCB/DWR modeling of the base case does not.

4.9.2.1 Reservoirs

The changes in water storage based on the proposed action from the No Action alternative were averaged for both the April and May Reclamation model values. These differences in storage were then compared to the average storage capacity of each reservoir, and a percent change was calculated (Tables 4.9-1 through 4.9-3).

New Melones Reservoir

No Action. The storage capacity of New Melones Reservoir is 2,420,000 acre-feet. In the summer months, the storage levels average 1,455,000 acre-feet and range from 114,000 acre-feet to 2,420,000 acre-feet under existing conditions. Summer releases from New Melones Reservoir average 634 cfs and range from 255 cfs to 2,382 cfs.

The average annual generation for New Melones Reservoir and power plant is 385 Gigawatt Hours (GWH). The average annual generation from the Stanislaus River Basin is 1,946.15 GWH (FERC 1992), and for the entire state of California in 1995 a total of 51.66 thousand GWH were produced (CPUC 1998). Thus, while the New Melones plant produces roughly 20 percent of the power in the Stanislaus River Basin this represents less than one percent of the state’s total power production.

Proposed Action. Based on an average of the April and May releases from the Reclamation’s model, the proposed action affects total reservoir storage (Table 4.9-1). With the project action, the storage in the peak power producing months is increased, from 1.8 percent to 7.6 percent. Increasing the storage increases the potential for power production, and thus is a beneficial impact.
Table 4.9-1: AVERAGE STORAGE DURING SUMMER MONTHS BY WATER YEAR FOR NEW MELONES RESERVOIR*

<table>
<thead>
<tr>
<th>Year Type</th>
<th>No Action Average Storage (TAF)</th>
<th>With Project Changes in Average Storage During Summer Months</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>June</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average (TAF)</td>
</tr>
<tr>
<td>All</td>
<td>1,455.3</td>
<td>48.4</td>
</tr>
<tr>
<td>Critical</td>
<td>866.6</td>
<td>65.6</td>
</tr>
<tr>
<td>Dry</td>
<td>1,309.9</td>
<td>38.3</td>
</tr>
<tr>
<td>Below Normal</td>
<td>1,423.2</td>
<td>47.5</td>
</tr>
<tr>
<td>Above Normal</td>
<td>1,500.4</td>
<td>53.0</td>
</tr>
<tr>
<td>Wet</td>
<td>1,991.1</td>
<td>37.9</td>
</tr>
</tbody>
</table>

*April and May releases averaged.

Note: TAF = thousand acre feet

**Alternative Action.** The Water Right Priority System alternative is compared to the Reclamation’s No Action alternative in a qualitative way in the absence of directly comparable data. The SWRCB’s Alternative 2 is similar to the Reclamation base case and is used for the no action comparison. During peak power production, the Water Right Priority System alternative for net CVP energy generation reduces the amount of GWHs of power that can be produced in June and July but increases the potential generation capability slightly in August. The largest decrease is in July, but this only represents 0.3 percent of the power production in the Stanislaus River Basin. The overall adverse impact is less than significant.

**New Don Pedro Reservoir**

**No Action.** The storage capacity of New Don Pedro Reservoir is 2,030,000 acre-feet. In the summer months, the storage levels average 1,507,000 acre-feet and range from 578,000 acre-feet to 2,030,000 acre-feet under existing conditions. Summer releases from New Don Pedro Reservoir average 401 cfs and range from 50 cfs to 5,577 cfs.

The average annual generation for New Don Pedro Reservoir and power plant is 618.4 GWH. The average annual generation from the Tuolumne River Basin is 2,443.63 GWH (FERC 1992), and for the entire state of California in 1995 a total of 51.66 thousand GWH were produced (CPUC 1998). Thus, while the New Don Pedro plant produces roughly 25 percent of the power in the Tuolumne River Basin, this represents only 1.1 percent of the state’s total power production.
4. Environmental Consequences and Mitigation Measures

Proposed Action. Based on an average of the April and May releases from the Reclamation’s model, the proposed action affects total reservoir storage (Table 4.9-2). With the project action, the storage in the peak power producing months is decreased, from 0.0 percent to -1.6 percent. Decreasing the storage decreases the potential for power production at New Don Pedro but only slightly, and thus is a less-than-significant adverse impact.

Table 4.9-2: AVERAGE STORAGE DURING SUMMER MONTHS BY WATER YEAR FOR NEW DON PEDRO RESERVOIR*

<table>
<thead>
<tr>
<th>Year Type</th>
<th>No Action Average Storage (TAF)</th>
<th>With Project Changes in Average Storage During Summer Months</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average (TAF)</td>
<td>%</td>
</tr>
<tr>
<td>All</td>
<td>1,507.4</td>
<td>-13.7</td>
</tr>
<tr>
<td>Critical</td>
<td>1,006.3</td>
<td>-13.9</td>
</tr>
<tr>
<td>Dry</td>
<td>1,391.6</td>
<td>-22.4</td>
</tr>
<tr>
<td>Below Normal</td>
<td>1,459.3</td>
<td>-21.0</td>
</tr>
<tr>
<td>Above Normal</td>
<td>1,647.5</td>
<td>-18.2</td>
</tr>
<tr>
<td>Wet</td>
<td>1,897.1</td>
<td>-0.5</td>
</tr>
</tbody>
</table>

*April and May releases averaged.

Note: TAF = thousand acre feet

Alternative Action. The Water Right Priority System alternative is compared to the Reclamation’s no project alternative in a qualitative way. The SWRCB’s Alternative 2 is similar to the Reclamation base case and is used for the comparison. During peak power production, the Water Right Priority System alternative for net CVP energy generation reduces the amount of GWHs of power that can be produced in June and July but increases the potential generation capability slightly in August. The largest decrease is in July, and it only represents 0.2 percent of the power production in the Tuolumne River Basin. Overall, the adverse impact is less than significant.

Lake McClure

No Action. The storage capacity of Lake McClure is 1,024,000 acre-feet. In the summer months, the storage levels average 701,000 acre-feet and range from 142,000 acre-feet to 1,024,000 acre-feet under existing conditions. Summer releases from Lake McClure average 355 cfs and range from zero to 3,573 cfs.
The average annual generation for Lake McClure and power plant is 316.1 GWH. The average annual generation from the Merced River Basin is 406.75 GWH (FERC 1992), and for the entire state of California in 1995 a total of 51.66 thousand GWH were produced (CPUC 1998). Thus, while the Lake McClure plant produces roughly 78 percent of the power in the Merced River Basin, this represents less than one percent of the state’s total power production.

**Proposed Action.** Using an average of the April and May releases from the Reclamation’s model, the proposed action affects total reservoir storage (Table 4.9-3). With the project, the water storage in the peak power producing months is decreased, from -0.1 percent to -17.0 percent. Decreasing the storage significantly decreases the potential for power production. Decreases greater than 10 percent occur in critical, dry, and below normal years for June, July, and August; this is a potentially significant adverse impact.

**Table 4.9-3: AVERAGE STORAGE DURING SUMMER MONTHS BY WATER YEAR FOR LAKE MCCLURE**

<table>
<thead>
<tr>
<th>Year Type</th>
<th>No Action Average Storage (TAF)</th>
<th>With Project Changes in Average Storage During Summer Months</th>
<th>June</th>
<th>July</th>
<th>August</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Average (TAF)</td>
<td>%</td>
<td>Average (TAF)</td>
<td>%</td>
</tr>
<tr>
<td>All</td>
<td>701.3</td>
<td>-55.6</td>
<td>-7.9</td>
<td>-54.5</td>
<td>-7.8</td>
</tr>
<tr>
<td>Critical</td>
<td>414.8</td>
<td>-70.5</td>
<td>-17.0</td>
<td>-66.3</td>
<td>-16.0</td>
</tr>
<tr>
<td>Dry</td>
<td>573.3</td>
<td>-89.0</td>
<td>-15.5</td>
<td>-88.5</td>
<td>-15.4</td>
</tr>
<tr>
<td>Below Normal</td>
<td>667.8</td>
<td>-86.0</td>
<td>-12.9</td>
<td>-85.6</td>
<td>-12.8</td>
</tr>
<tr>
<td>Above Normal</td>
<td>830.5</td>
<td>-61.6</td>
<td>-7.4</td>
<td>-61.1</td>
<td>-7.4</td>
</tr>
<tr>
<td>Wet</td>
<td>927.4</td>
<td>-0.9</td>
<td>-0.1</td>
<td>-0.8</td>
<td>-0.1</td>
</tr>
</tbody>
</table>

*April and May releases averaged.
Note: TAF = thousand acre feet

**Alternative Action.** The Water Right Priority System alternative is compared to the Reclamation’s No Action alternative in a qualitative way. The SWRCB’s Alternative 2 is similar to the Reclamation base case and is used for the comparison. During peak power production, the Water Right Priority System alternative for net CVP energy generation reduces the amount of GWHs of power that can be produced in June and July but increases the potential generation capability slightly in August. The largest decrease is in July, and only represents 1.4 percent of the power production in the Merced River Basin. The overall adverse impact is less than significant.
4. Environmental Consequences and Mitigation Measures

4.9.2.2 Rivers

The changes in flows based on the proposed action from the No Action alternative were averaged for both the April and May Reclamation model values. These differences in flow were then compared to the average flows of each river, and a percent change was calculated.

Under certain circumstances of hydrology and operational objectives (not modeled) there could occur an operation whereby flows from the reservoir operators that would otherwise have been released at their discretion during the summer may, as the result of the proposed action, no longer be released. The likelihood of these instances is considered rare, and its effect, if any, on Vernalis flow is complicated due to the potential reaction of New Melones Reservoir operations to flow and resultant water quality changes at Vernalis.

Stanislaus River

No Action. Summer releases on the Stanislaus River average 634 cfs and range from 255 cfs to 2,382 cfs.

Proposed Action. Based on averages of the April and May releases from the Reclamation’s model (which simulates flows that are all at or above the established flows), the proposed action affects flow on the Stanislaus River (Table 4.9-4). With the project, the flow in the peak power producing months is changed, from -1.4 percent to 7.9 percent. Increasing the flow increases the potential for power production and thus is a beneficial impact. Consequently, decreasing the flow decreases the potential for power production and is an adverse impact on the potential to produce power. Since most of the flows are higher under the proposed action, the overall effect is beneficial but less than significant.
4. Environmental Consequences and Mitigation Measures

Table 4.9-4: AVERAGE FLOW DURING SUMMER MONTHS BY WATER YEAR FOR THE STANISLAUS RIVER*

<table>
<thead>
<tr>
<th>Year Type</th>
<th>No Action Average Flow (cfs)</th>
<th>With Project Changes in Average Flows During Summer Months</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average Flow</td>
<td>June</td>
</tr>
<tr>
<td></td>
<td>(cfs)</td>
<td>Average (cfs)</td>
</tr>
<tr>
<td>All</td>
<td>634.3</td>
<td>27.4</td>
</tr>
<tr>
<td>Critical</td>
<td>417.4</td>
<td>22.1</td>
</tr>
<tr>
<td>Dry</td>
<td>710.6</td>
<td>-0.1</td>
</tr>
<tr>
<td>Below Normal</td>
<td>632.8</td>
<td>-9.0</td>
</tr>
<tr>
<td>Above Normal</td>
<td>634.8</td>
<td>40.9</td>
</tr>
<tr>
<td>Wet</td>
<td>762.1</td>
<td>60.4</td>
</tr>
</tbody>
</table>

*April and May releases averaged.

**Alternative Action.** The Water Right Priority System alternative is compared to the Reclamation’s No Action alternative in a qualitative way in the absence of directly comparable data. The SWRCB’s Alternative 2 is similar to the Reclamation base case and is used for the No Action comparison. During peak power production, the alternative for net CVP energy generation reduces the amount of GWHs of power that can be produced in June and July, but increases the potential generation capability slightly in August. The largest decrease is in July and only represents 0.3 percent of the power production in the Stanislaus River Basin. The impact is less than significant.

**Tuolumne River**

**No Action.** Summer releases on the Tuolumne River average 401 cfs and range from 50 cfs to 5,577 cfs. The FERC required minimum flow is 50 cfs in critical water years in summer months, and increases to 300 cfs in wet years.

**Proposed Action.** Using Tuolumne River averages of April and May releases (based on Reclamation’s model, which simulates flows that are at or above the established flows), the proposed action affects flow (Table 4.9-5). With the project, the flow in the peak power producing months is changed, from -2.3 percent to 10.6 percent. Increasing the flow increases the potential for power production, and thus is a beneficial impact. Consequently, the overall impact is less than significant except in below normal years when the impact is significantly beneficial.
4. Environmental Consequences and Mitigation Measures

Table 4.9-5: AVERAGE FLOW DURING SUMMER MONTHS BY WATER YEAR FOR THE TUOLUMNE RIVER*

<table>
<thead>
<tr>
<th>Year Type</th>
<th>No Action Average Flow (cfs)</th>
<th>With Project Changes in Average Flows During Summer Months</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average Flow (cfs)</td>
<td>June Average (cfs)</td>
</tr>
<tr>
<td>All</td>
<td>401.1</td>
<td>2.7</td>
</tr>
<tr>
<td>Critical</td>
<td>50.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Dry</td>
<td>66.1</td>
<td>5.1</td>
</tr>
<tr>
<td>Below Normal</td>
<td>75.3</td>
<td>8.0</td>
</tr>
<tr>
<td>Above Normal</td>
<td>258.2</td>
<td>1.9</td>
</tr>
<tr>
<td>Wet</td>
<td>1,183.2</td>
<td>0.7</td>
</tr>
</tbody>
</table>

*April and May releases averaged;

**Alternative Action.** The Water Right Priority System alternative is compared to the Reclamation’s No Action alternative in a qualitative way. The SWRCB’s Alternative 2 is similar to the Reclamation base case and is used for the comparison. During peak power production, the alternative for net CVP energy generation reduces the amount of GWHs of power that can be produced in June and July, but increases the potential generation capability slightly in August. The largest decrease is in July and only represents 0.2 percent of the power production in the Tuolumne River Basin. The impact is less than significant.

**Merced River**

**No Action.** Summer releases on the Merced River average 634 cfs and range from 255 cfs to 2,382 cfs.

**Proposed Action.** Using an average of the April and May Merced River releases (based on Reclamation’s model, which simulates flows that are at or above the established flows), the proposed action affects flows (Table 4.9-6). With the project, the flow in the peak power producing months is changed, from -46.4 percent to 2.2 percent. Increasing the flow increases the potential for power production, and thus is a beneficial impact. Consequently, decreasing the flow decreases the potential for power production and is an adverse impact. The large percentage decrease occurs only in above normal water years in June but is only a decrease of 117 cfs. This impact is potentially significant.

Table 4.9-6: AVERAGE FLOW DURING SUMMER MONTHS BY WATER YEAR
4. Environmental Consequences and Mitigation Measures

FOR THE MERCED RIVER*

<table>
<thead>
<tr>
<th>Year Type</th>
<th>No Action Average Flow (cfs)</th>
<th>With Project Changes in Average Flows During Summer Months</th>
<th>June</th>
<th>July</th>
<th>August</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Average (cfs)</td>
<td>%</td>
<td>Average (cfs)</td>
</tr>
<tr>
<td>All</td>
<td>355.1</td>
<td></td>
<td>-39.9</td>
<td>-11.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Critical</td>
<td>133.6</td>
<td></td>
<td>2.6</td>
<td>1.9</td>
<td>1.2</td>
</tr>
<tr>
<td>Dry</td>
<td>146.5</td>
<td></td>
<td>2.5</td>
<td>1.7</td>
<td>1.4</td>
</tr>
<tr>
<td>Below Normal</td>
<td>180.4</td>
<td></td>
<td>2.1</td>
<td>1.2</td>
<td>3.9</td>
</tr>
<tr>
<td>Above Normal</td>
<td>252.2</td>
<td></td>
<td>-116.9</td>
<td>-46.4</td>
<td>4.0</td>
</tr>
<tr>
<td>Wet</td>
<td>836.8</td>
<td></td>
<td>-67.8</td>
<td>-8.1</td>
<td>1.0</td>
</tr>
</tbody>
</table>

*April and May releases averaged.

Alternative Action. The Water Right Priority System alternative is compared to the Reclamation’s No Action alternative in a qualitative way. The SWRCB’s Alternative 2 is similar to the Reclamation base case and is used for the comparison. During peak power production, the alternative for net CVP energy generation reduces the amount of GWHs of power that can be produced in June and July, but increases the potential generation capability slightly in August. The largest decrease is in July and only represents 1.4 percent of the power production in the Merced River Basin. The impact is less than significant.

San Joaquin River

No hydropower is generated on the San Joaquin River that would be affected by either the proposed action or alternative action. No mitigation is necessary.

4.9.3 Impact Summary and Mitigation of Impacts

4.9.3.1 Reservoirs

Proposed Action

- Increases in storage capacity at New Melones have a beneficial effect on potential hydropower production. No mitigation is necessary.

- There are less-than-significant impacts to hydropower production at New Don Pedro Reservoir. No mitigation is necessary.
4. Environmental Consequences and Mitigation Measures

- Decreases greater than 10 percent occur in critical, dry, and below normal years for June, July, and August for Lake McClure. This adverse impact to potential hydropower production is potentially significant and unavoidable, because the effects of changing the reservoir levels cannot be mitigated while still accomplishing project objectives.

Alternative Action

- There are less-than-significant impacts to potential hydropower production on either New Melones Reservoir, New Don Pedro Reservoir, or Lake McClure. No mitigation is necessary.

4.9.3.2 Rivers

Proposed Action

- Proposed releases on the Stanislaus River would have a less-than-significant effect on potential hydropower production. No mitigation is required.

- There are significant beneficial impacts to hydropower production at Tuolumne River powerplants during below normal years in June. No mitigation is necessary.

- Decreases greater than 10 percent occur in above normal years in June for the Merced River. This adverse impact to potential hydropower generation is potentially significant and unavoidable because the effects of changing the average flow cannot be mitigated while still accomplishing project objectives.

Alternative Action

- There are less-than-significant impacts to potential hydropower production on the Stanislaus, Tuolumne, or Merced rivers. No mitigation is required.
4. Environmental Consequences and Mitigation Measures

4.9 ENERGY PRODUCTION

4.9.1 Key Impact Issues and Evaluation Criteria

4.9.2 Environmental Consequences

4.9.2.1 Reservoirs

4.9.2.2 Rivers

4.9.3 Impact Summary and Mitigation of Impacts

4.9.3.1 Reservoirs

4.9.3.2 Rivers
5. CONSULTATION AND COORDINATION

This chapter reviews agency consultation and coordination that occurred prior to and during preparation of this EIS/EIR. It also includes the list of agencies and individuals who received the Draft document. The consultation process began in December 1998 with a Notice of Preparation of an EIS/EIR (CEQA) and the comparable Notice of Intent under NEPA. Three public meetings were held in January 1998 to obtain input on issues and concerns to be evaluated in the EIS/EIR. A report on the public scoping process is included as Appendix E.

5.1 FISH AND WILDLIFE COORDINATION

5.1.1 Fish and Wildlife Coordination Act

The action proposed in this document is a joint activity of the U.S. Bureau of Reclamation (Reclamation) and the U.S. Fish and Wildlife Service (Service). In addition, Reclamation has coordinated closely with the Service and with the National Marine Fisheries Service (NMFS) on the preparation of this EIS/EIR. These activities have met any consultation/coordination requirements that may exist pursuant to the Fish and Wildlife Coordination Act.

5.1.2 Endangered Species Act

Reclamation and the Service are continuing close coordination for Endangered Species Act (ESA) compliance of all aspects of the Central Valley Project Improvement Act (CVPIA).

The Service and NMFS have been consulted regarding the effects of the proposed action on species listed pursuant to the ESA. For this proposed action, endangered species protections include compliance with existing ESA requirements, including the Service’s 1995 and 1996 Biological Opinions for the Delta Smelt and the 1995 Biological Opinion for the Winter-run Chinook Salmon.

In April 1998, Reclamation requested assistance from the Service in identifying threatened, endangered, proposed, and candidate plant and animal species that may be located in the San Joaquin River project area. The Service responded in June 1998 with lists of species that may be present in or may be affected by projects in the subject project area. Using this information, Reclamation prepared this EIS/EIR for the proposed action; this document was used to initiate informal consultation. Appendix D presents a comprehensive list of sensitive species that may be present in the project area and whether they could be affected by the proposed and alternative actions. The results of this consultation have been incorporated into this EIS/EIR.

NMFS identified the fall/late fall-run chinook salmon as proposed-as-threatened and the steelhead as threatened species to be addressed. Critical habitat for chinook salmon has been proposed in the San Joaquin River Agreement (SJRA) project area of the San Joaquin River and its tributaries.
5. Consultation and Coordination

The provision of water for instream flow will improve conditions for fishery resources, including the proposed-as-threatened fall-run chinook salmon. Indirectly, this action will also improve conditions for other native species including the splittail. As a result of compliance with the existing Biological Opinions and further consultation with the NMFS, there are no anticipated adverse significant impacts to listed species including the threatened steelhead due to water supply activities. Reclamation believes that all possible adverse impacts to listed aquatic species from the 1999-2010 period of implementation of the proposed action have been addressed in existing biological opinions (or will be addressed in biological opinions that will be completed prior to taking a federal action). Consultation is continuing with the Service and NMFS to complete ESA compliance activities. Reclamation will complete Section 7 consultation pursuant to the Endangered Species Act for threatened Central Valley steelhead and all other required federal Endangered Species Act compliance activities before any final federal action is taken.

5.1.3 State Agency Coordination

CEQA requires that the Lead Agency must formally consult with responsible and trustee agencies in determining whether to prepare an EIR. The primary tool for this coordination is the preparation of a Draft EIS/EIR for review by state agencies. Section 5.4 is a list of all agencies receiving this document directly from Reclamation and the San Joaquin River Group Authority (SJRGA); however, additional State agencies may receive a copy directly from the State Clearinghouse.

Prior to release of the Draft EIS/EIR, an Administrative Draft EIS/EIR was sent to the Department of Fish and Game (DFG), the Regional Water Quality Control Board, and the Department of Water Resources (DWR). DFG biologists were consulted pursuant to the Fish and Wildlife Coordination Act and the California Endangered Species Act. In May 1998, the SJRGA requested assistance in developing species lists for the EIS/EIR. DFG started their participation on the steering committee in July 1998. This and other consultations will occur both prior to and during the public review of the Draft EIS/EIR and include agencies who comment on the Draft EIS/EIR.

5.2 COOPERATING AGENCY INVOLVEMENT

Federal, State, and local agencies involved with Reclamation and the SJRGA in the development of this EIS/EIR participated on a steering committee for development and review of NEPA/CEQA documentation for projects involving water supplies for flows on the San Joaquin River and its tributaries. These agency representatives are:

U.S. Fish and Wildlife Service

Richard Jewell, Central Valley Fish and Wildlife Restoration Program

National Marine Fisheries Service
5. Consultation and Coordination

Laura Hamilton, Protected Resources Division  
Dennis E. Smith, Protected Resources Division

**California Department of Fish and Game**

Jeff Single, Environmental Services Division

**California Department of Water Resources**

Mike Ford, State Water Project  
Jim Spence, State Water Project

**San Joaquin River Group Authority**

Tim O’Laughlin, Oakdale Irrigation District  
Marc Van Camp, Merced Irrigation District  
Richard Martin, South San Joaquin Irrigation District  
Richard Moss, Friant Water Users Authority  
Dan Fults, Friant Water Users Authority  
Allen Short, Modesto Irrigation District  
William Johnston, Modesto Irrigation District  
Walter Ward, Modesto Irrigation District  
Art Godwin, Turlock Irrigation District  
Steve Chedester, San Joaquin River Exchange Contractors Water Authority

All members of the SJRA steering committee have reviewed one or more drafts of this EIS/EIR.

The City and County of San Francisco, Public Utilities Commission, is cooperating with the SJRGA in developing solutions to Bay/Delta issues. Westlands Water District and the Metropolitan Water District have also participated on the committee and in review of preliminary CEQA/NEPA documentation.
5. Consultation and Coordination

5.3 LIST OF ENVIRONMENTAL COMMITMENTS

U. S. Bureau of Reclamation

As a member of the San Joaquin River Technical Committee, Reclamation will develop a flow regime for releases of purchased water in coordination with the SJRGA and DWR. By February 15 of each year, the operations plan will be developed and describe how the Vernalis Adaptive Management Plan (VAMP) and the other flows in the Agreement will be implemented in that year.

State Water Resources Control Board

The Parties’ obligations under the San Joaquin River Agreement are conditioned upon the entry and enforcement by the California State Water Resource Control Board (SWRCB) of an order pursuant to Water Code Section 1707 or similar protection that prohibits (1) unauthorized diversions of any portion of the flows provided by the SJRGA’s members pursuant to this Agreement until they pass Vernalis; and, (2) unauthorized diversions of any existing flow between SJRGA members’ last point of control and Vernalis. Section 1707 petitions were filed on December 10, 1998.

There is no construction proposed nor would alterations of stream channels occur under the proposed action. No permit is required from the U.S. Army Corps of Engineers. There are no local or State permits required for the water purchases for release to the rivers.

5.4 DISTRIBUTION LIST

Recirculation of the Draft EIS/EIR is not necessary, because all of the comments received resulted in minor modifications to the Draft EIS/EIR. This Final EIS/EIR is being circulated to the commenters and interested parties for review and final comment during a 30-day no action period from February 5, 1999 through March 8, 1999 under NEPA (and a 10-day review from January 29, 1999 to February 9, 1999 under CEQA). The distribution list is provided on the following pages.
5. Consultation and Coordination

5. CONSULTATION AND COORDINATION

5.1 FISH AND WILDLIFE COORDINATION

5.1.1 Fish and Wildlife Coordination Act

5.1.2 Endangered Species Act

5.1.3 State Agency Coordination

5.2 COOPERATING AGENCY INVOLVEMENT

5.3 LIST OF ENVIRONMENTAL COMMITMENTS

5.4 DISTRIBUTION LIST
6. COMPLIANCE REQUIREMENTS

This EIS/EIR was prepared in compliance with the appropriate federal, state, and local requirements. A brief description of applicable compliance requirements is discussed in the sections of this chapter.

6.1 FEDERAL

6.1.1 Central Valley Project Improvement Act (CVPIA)

As mentioned in Chapter 1, the CVPIA (Title XXXIV of Public Law 102-575) mandated changes in Central Valley Project management to protect, restore, and enhance fish and wildlife. The statutory obligations include increasing instream flows in Central Valley streams to provide for improved flow stability, and migration and attraction flow conditions for anadromous fish, in accordance with the fish, wildlife, and habitat restoration purposes and measures authorized by the CVPIA.

The CVPIA directs the Secretary of the Interior to develop and implement a program in coordination with the Anadromous Fish Restoration Program (AFRP) to acquire water to supplement the up to 800,000 acre-ft of CVP yield dedicated for fish and wildlife purposes by Section 3406(b)(2); to assist the State of California in its efforts to protect the waters of the Bay-Delta estuary; and to help meet such obligations as may be legally imposed upon the CVP under state or Federal law subsequent to enactment of the CVPIA. The prescription for the dedicated water, commonly called “(b)(2) water,” will vary depending on hydrologic conditions, and will be determined annually by the U.S. Fish and Wildlife Service (Service) through consultation with the U.S. Bureau of Reclamation (Reclamation).

To the extent that (b)(2) water is either not available or insufficient to meet the fish and wildlife provisions of the CVPIA, supplemental water will be acquired under the authority of Section (b)(3) of the Act from willing sellers within the geographic area of need.

The proposed action is consistent with this provision of the CVPIA in that it seeks to implement the Act in the San Joaquin Valley under the authority of Section 3406 (b)(3).

6.1.2 Delta Smelt Biological Opinion

The Service’s March 6, 1995 Biological Opinion for Delta Smelt, Delta Smelt Critical Habitat, and Proposed Threatened Sacramento Splittail limits CVP exports during the April and May 31-day spring pulse flow period to flows in the San Joaquin River at Vernalis. The Opinion also states that Reclamation will pursue acquisition of additional water. The proposed action will increase the ability of Reclamation to meet this objective in 1999-2010, and it would be implemented under this Biological Opinion.
6. Compliance Requirements

6.1.3 National Environmental Policy Act

This EIS/EIR was prepared pursuant to regulations implementing the National Environmental Policy Act (NEPA) (42 USC 4321 et seq.). NEPA ensures that federal agencies will consider the environmental effects of their actions. It also requires that an EIS be included in every recommendation or report on proposals for legislation and other major federal actions significantly affecting the quality of the human environment. This EIS/EIR provides detailed information regarding the No Action, Proposed Action, and the Alternative Action, the environmental impacts of each alternative, potential mitigation measures, and adverse environmental impacts that cannot be avoided (USBR 1997d).

6.1.4 Endangered Species Act

The Endangered Species Act (ESA) most recently amended in 1988 (16 USC 1536), establishes a national program for the conservation of threatened and endangered species of fish, wildlife, and plants and the preservation of the ecosystems upon which they depend. Section 7(a) of the ESA requires federal agencies to consult with the Service and/or National Marine Fisheries Service (NMFS) on any activities that may affect any species listed as threatened or endangered (USBR 1997d). Sections 4.4 and 4.5 provide detailed discussions on any potential impacts and mitigation for terrestrial and aquatic resources which may result from the proposed or alternative actions. Consultations with these agencies is addressed in Section 5.1.2.

6.1.5 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (FWCA) requires consultation with Service and consideration of these views and recommendations when any water body is impounded, diverted, controlled, or modified for any purpose. The Service and state agencies charged with administering wildlife resources are to conduct surveys and investigations to determine the potential damage to wildlife and the mitigation measures that should be taken. The Service may incorporate the concerns and findings of the state agencies and other federal agencies, including the NMFS, into a report that addresses fish and wildlife concerns and provides recommendations for mitigating or enhancing impacts to fish and wildlife affected by a federal project. Compliance can also be addressed by fully considering the Service’s recommendations and integrating the Service into the development of the selection of the preferred alternative and mitigation actions (USBR 1997d). Compliance with the Coordination Act will be coordinated with consultation for ESA, as described above. Sections 4.4 and 4.5 provide detailed discussions on any potential impacts and mitigation for terrestrial and aquatic resources which may result from the proposed or alternative actions. Section 5.1.1 addresses coordination with the Service and NMFS.

6.1.6 Environmental Justice
6. Compliance Requirements

Executive Order 12898 requires each Federal agency to achieve environmental justice as part of its mission, by identifying and addressing disproportionately high and adverse human health or environmental effects, including social or economic effects, of programs, policies, and activities on minority populations and low-income populations of the United States. (USBR 1997d)

This EIS/EIR evaluates the environmental, social, and economic impacts on minority and low-income populations in Section 4.11.

6.1.7 Indian Trust Assets

The United States Government’s trust responsibility for Native American Natural resources requires that federal agencies take measures to protect and maintain trust resources. These responsibilities include taking reasonable actions to preserve and restore tribal resources. Indian Trust Assets (ITAs) are legal interests in property and rights held in trust by the United States for Native American tribes or individuals. Indian reservations, rancherias, and allotments are common ITAs. Section 4.10 provides a discussion on any potential impacts and mitigation for ITAs which may result from the proposed or alternative actions.

6.1.8 Indian Sacred Sites

Executive Order 13007 provides that in managing Federal lands, each federal agency with statutory or administrative responsibility for management of Federal lands shall, to the extent practicable and as permitted by law, accommodate access to and ceremonial use of Native American sacred sites by Native American religious practitioners, and avoid adversely affecting the physical integrity of such sacred sites.

No sacred sites were identified during the scoping or planning process of the Draft PEIS (USBR 1997d) or the public scoping for this EIS/EIR. If sites are identified in future scoping efforts, efforts will be made to identify and protect the sacred sites.

6.1.9 National Historic Preservation Act

This project requires compliance with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended and its implementing regulations, 36 CFR Part 800. Section 106 requires that federal agencies take into account the effects of their actions on properties that may be eligible for or listed in the National Register of Historic Places (NRHP). To determine whether an undertaking could affect NRHP-eligible properties, cultural resources (including prehistoric and historic archeological sites and structures, buildings, and ethnographic resources) must be inventoried and evaluated for the NRHP. The second step is to identify the possible effects of proposed actions on
any NRHP-eligible properties or cultural resources. The lead agency must examine whether feasible alternatives exist that would avoid such effects. If an effect cannot be avoided, measures must be taken to minimize or mitigate potential adverse effects. In addition to compliance with Section 106, implementation of the project must also take into consideration the American Indian Religious Freedom Act and the Native American Graves Protection and Repatriation Act.

Due to the fact that two of the affected reservoirs, New Don Pedro and Lake McClure, were constructed before guidelines required cultural resources surveys, there may be cultural resources that are impacted by the proposed action or alternative action. If any resources are discovered, compliance under Section 106 would require that a survey be conducted (USBR 1997d). Section 4.7 provides a discussion on any potential impacts and mitigation for cultural resources which may result from the proposed or alternative action.

### 6.1.10 Flood Plain Management

Executive Order 11988 requires federal agencies to evaluate the potential effects of any actions they might take in a flood plain and to ensure that planning, programs, and budget requests reflect consideration of flood hazards and flood plain management. If a federal agency program will affect a flood plain, the agency must consider alternatives to avoid adverse effects in the floodplain or to minimize potential harm (USBR 1997d). Section 4.2 provides a detailed discussion on any potential impacts and mitigation for surface water resources which may result from the proposed or alternative actions.

### 6.1.11 Wetlands Protection

Executive Order 11990 authorizes federal agencies to take actions to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands when undertaking federal activities and programs. Any agency considering a proposal that might affect wetlands must evaluate factors affecting wetland quality and survival. These factors should include the proposal’s effects on the public health, safety, and welfare due to modifications in water supply and water quality; maintenance of natural ecosystems and conservation of flora and fauna; and other recreational, scientific, and cultural uses (USBR 1997d). Section 4.4 provides a detailed discussion on any potential impacts and mitigation for terrestrial resources which may result from the proposed or alternative actions.

### 6.1.12 Wild and Scenic Rivers Act
The Wild and Scenic Rivers Act designates qualifying free-flowing river segments as wild, scenic, or recreational. The Act establishes requirements applicable to water resource projects affecting wild, scenic, or recreational rivers within the National Wild and Scenic Rivers System, as well as rivers designated on the national Rivers Inventory. Under the Act, a federal agency may not assist the construction of a water resources project that would have a direct and adverse effect on the free-flowing, scenic, and natural values of a wild or scenic river. If the project would affect the free-flowing characteristics of a designated river or unreasonably diminish the scenic, recreational, and fish and wildlife values present in the area, such activities should be undertaken in a manner that would minimize adverse impacts and should be developed in consultation with the National Park Service. None of the proposed actions would affect flows in any designated wild and scenic rivers. (USBR 1997d)

6.1.13 **Clean Water Act of 1977**

The Clean Water Act (PL 95-217), through implementation by the U.S. Environmental Protection Agency (U.S. EPA), seeks to restore and maintain the chemical, physical, and biological integrity on the Nation’s waters. The significant features of the Act include:

- the National Pollutant Discharge Elimination System (NPDES);
- technology based effluent limits;
- a program for imposing more stringent water quality based limits in permits to achieve state water quality standards;
- additional provisions applicable to certain toxic and other pollutant discharges of particular concern or special character; and
- a program of financial assistance to help fund publicly owned treatment works.

In addition to the elements described above, the Act prescribes special guidelines for protecting aquatic habitats, including wetlands and estuaries. It also provides several enforcement options to the U.S. EPA (Water Environment Federation 1997). Section 303(d) of the Clean Water Act requires that each state develop a list, known as a 303(d) list, of waterbodies that are impaired with respect to water quality. In 1996, California identified approximately 90 impaired waterbodies in its 303(d) list (CALFED 1998). Sections 4.2 and 4.3 provide a detailed discussion of potential impacts and mitigation which may result from the proposed or alternative actions.

6.1.14 **Memorandum on Farmland Preservation and the Farmland Protection Policy Act**
The Farmland Protection Policy Act of 1981 (FPPA) and Memoranda on Farmland Preservation require federal agencies preparing EISs to include assessments of the effects of proposed projects on prime and unique farmlands. Before taking any action that would result in the conversion of designated prime or unique farmland for nonagricultural purposes, the federal agencies must examine the potential impacts of the proposed action and, if there are adverse effects on farmland preservation, consider alternatives to lessen those effects. Federal agencies must also ensure that their programs, to the extent possible, are compatible with state, local, and private programs for the protection of farmland (CALFED 1998). Section 4.6 mentions potential impacts for prime and unique farmlands which may result from the proposed or alternative actions.

6.1.15 Federal Agriculture Improvement and Reform Act of 1996 and 1985 Food Security Act

The Federal Agriculture Improvement and Reform Act of 1996, also known as the 1996 Farm Bill, includes conservation provisions designed to provide landowners with a variety of incentives programs and technical assistance for incorporating sound conservation practices into farming, grazing, and livestock operations. The 1996 Farm Bill replaces and incorporates portions of previous farm bills, including the Food Security Act of 1985 and the 1990 Farm Bill.

Under Title III, the Wetlands Reserve Program and the Conservation Reserve Program of the Food Security Act of 1985 are extended through 2002. Changes in the programs provide landowners with more options for protecting wetlands and highly erodible lands. Also addressed under Title III is a new Wildlife Habitat Incentives Program to help landowners improve wildlife habitat on private land. A Flood Risk Reduction Program was established to provide incentives to move farming operations from frequently flooded lands (CALFED 1998). Section 4.6 provides a discussion of potential impacts and mitigation for conservation of farmlands which may result from the proposed or alternative actions.

6.2 STATE

6.2.1 California Environmental Quality Act

The California Environmental Quality Act (CEQA) was enacted in 1970 and has six main objectives (California State CEQA Guidelines, California Administrative Code, Section 15000, et seq). These objectives are:

- disclose to decision makers and the public significant environmental effects of proposed activities;
- identify ways to avoid or reduce the environmental damage;
6. Compliance Requirements

- prevent environmental damage by requiring implementation of feasible alternatives or mitigation measures;
- disclose to the public reasons for agency approval of projects with significant environmental effects;
- foster interagency coordination in the review of projects; and
- enhance public participation in the planning process.

CEQA applies to all discretionary activities proposed to be carried out or approved by California public agencies, including state, regional, county, and local agencies, unless an exemption applies. This EIS/EIR provides detailed information regarding the No Action, Proposed Action, and the Alternative Action, the environmental impacts of each alternative, potential mitigation measures, and adverse environmental impacts that cannot be avoided. (USBR 1997d)

6.2.2 California Endangered Species Act

The California Endangered Species Act (CESA) provides for the protection and conservation of threatened and endangered species and their habitats. It is very similar to the Federal ESA. In general, CESA

- authorizes determination and listing of species as endangered or threatened;
- prohibits the take, possession, purchase, or sale of endangered, threatened or candidate species;
- provides authority for state agencies to purchase habitat for endangered and threatened species; and
- directs the California Department of Fish and Game (CDFG) to work closely with the Service and NMFS, to participate to the greatest extent practicable in Federal consultations, and to adopt the Federal biological opinion whenever possible.

The Natural Community Conservation Planning Act (California Fish and Game Code Section 2800, et seq.) provides for the preparation and implementation of large-scale natural resource conservation plans. A natural community conservation plan (NCCP) must identify and provide for “the regional or area wide protection and perpetuation of natural wildlife diversity, while allowing compatible and appropriate development and growth.” NCCPs are intended to provide comprehensive management and conservation of multiple wildlife species including, but not limited to, species listed pursuant to the CESA, Section 2050, et seq. (CALFED 1998, California and Federal Endangered Species Act Compliance Technical Appendix)

6.2.3 State Historic Preservation Officer
6. Compliance Requirements

Under any alternative involving a federal undertaking, Reclamation will consult with the California State Historic Preservation Officer (SHPO) about meeting the requirements of 36 CFR 800. Consultation with Reclamation and SHPO will address cultural resources identification, evaluation, effects, and possible mitigation needs (SWRCB 1998).

Due to the fact that two of the affected reservoirs, New Don Pedro and Lake McClure, were constructed before guidelines required cultural resources surveys, there may be cultural resources which are impacted by the proposed action or alternative action. Section 4.7 provides a detailed discussion on any potential impacts and mitigation for cultural resources which may result from the proposed or alternative action.

6.2.4 Delta Protection Commission

The Delta Protection Commission (DPC) is a state regional planning agency with authority over a 450,000 acre portion of the Legal Delta. The authorizing legislation (PRC Section 29700 et seq.) was passed in 1992. The DPC was charged with preparing a regional land use and resources management plan for the Primary Zone of the Delta to protect and enhance the three existing land uses: agriculture, wildlife habitat, and recreation. The plan was adopted in 1995. Local governments are required to ensure that their general plans are in conformance with the regional plan; local general plan amendments were completed in 1997 (CALFED 1998). Section 4.6 provides a detailed discussion on any potential impacts and mitigation for local plans which may result from the proposed or alternative action.

6.2.5 The Delta Protection Act of 1959

The Delta Protection Act of 1959 requires adequate water supplies for multiple uses (for example, agriculture, industry, urban, and recreation) within the Delta and for export. Various water quality and flow objectives have been established by the State Water Resources Control Board (SWRCB) and the Central Valley Regional Water Quality Control Board (CVRWQCB) since the passing of this Act. (CALFED 1998) Section 4.2 provides a detailed discussion on any potential impacts and mitigation for surface water resources which may result from the proposed or alternative action.

6.2.6 Porter-Cologne Act

In 1967, the Porter-Cologne Act established the SWRCB and nine regional boards as the state agencies with primary authority over the regulation of water quality and allocation of appropriative surface water rights in California. The Porter-Cologne Act is the primary state water quality legislation administered by SWRCB and provides the authority to establish water quality control plans that are reviewed and revised, as well as statewide plans. Water quality control plans, also known as basin plans, designate beneficial uses for specific surface water and groundwater resources and
establish water quality objectives to protect those uses. In acting on water rights applications, the SWRCB may establish terms and conditions in a permit to carry out water quality control plans (CALFED 1998). Sections 4.2 and 4.3 provide a detailed discussion on any potential impacts and mitigation for surface water and groundwater resources which may result from the proposed or alternative action.

6.2.7 D-1485 and the 1978 Water Quality Control Plan

In 1978, SWRCB adopted the Water Quality Control Plan for the Sacramento-San Joaquin Delta and Suisun Marsh (1978 Delta Plan). At the same time, SWRCB adopted Water Right Decision D-1485, which required compliance with water quality objectives in the 1978 Delta Plan, that were designed to protect natural resources by maintaining Delta conditions as they would exist in the absence of the CVP and State Water Project (SWP). D-1485 also required monitoring and study of the Delta aquatic resources. In 1978, legal challenges were brought against D-1485 and the 1978 Delta Plan.

In 1986, the State was required to revise its water quality standards. Pursuant to that decision, SWRCB implemented a hearing process, known as the Bay-Delta hearings, to review and amend the 1978 Delta Plan. Following this hearing process, SWRCB issued revised water quality objectives in the 1991 Delta Water Quality Control Plan for Salinity, Temperature and Dissolved Oxygen (1991 Delta Plan). The SWRCB conducted a water right hearing to receive evidence and recommendations on measures to protect fish and wildlife. After the hearing, the SWRCB released a draft water right decision, draft D-1630, that included interim water right terms and conditions. Actions taken by the NMFS and the Service to protect winter-run chinook salmon and Delta smelt resulted in the withdrawal of D-1630. Several of the concepts from D-1630 have been partially adopted in other actions taken by SWRCB, Department of Water Resources (DWR), Reclamation, fishery protection agencies, and other regulatory agencies (CALFED 1998). Sections 4.2 and 4.3 provide a detailed discussion on any potential impacts and mitigation for surface water and groundwater resources which may result from the proposed or alternative action.

6.2.8 1995 Water Quality Control Plan (WQCP)

In 1994, SWRCB initiated development of new water quality objectives and released a draft version, the same day the Bay-Delta Accord was signed. SWRCB subsequently released an environmental report that documented the effects of implementing the plan. The WQCP was adopted in May 1995 (1995 WQCP) and incorporated several elements of EPA, NMFS, and Service regulatory objectives for salinity and endangered species protection. The 1995 WQCP objectives are expected to be implemented with a new water-rights decision in 1998. The major changes associated with the WQCP in relation to the 1978 and 1991 WQCPs and associated D-1485 requirements are as follows:
6. Compliance Requirements

- Water-year classifications are based on the 40-30-30 Sacramento Valley Four-River Index and the 60-20-20 San Joaquin Valley Four-River Index. The outflow requirements from February through June depend on the previous month’s Eight-River Index runoff volume.

- Delta outflow requirements are the combination of fixed monthly requirements and estuarine habitat requirements (expressed in terms of “X2”, the position of the 2-parts-per-thousand [ppt] salinity gradient). Because the X2 requirements in the 1995 WQCP depend on the previous month’s Eight-River Index runoff, the required outflow must be calculated for each month.

- Combined SWP and CVP Delta exports are limited to a percentage of the Delta river inflow (which does not include rainfall). These percentages are in the range of 35 to 45 percent depending on the Delta inflow from February through June and 65 percent for the remainder of the year. Export pumping during the pulse-flow period was limited to an amount equivalent to the pulse flow during half of April and half of May. (CALFED 1998)

Section 4.2 provides a detailed discussion on any potential impacts and mitigation for surface water resources which may result from the proposed or alternative actions.

6.2.9 Water Rights

Water use in California is characterized by two basic types of water rights: riparian water rights and appropriative water rights. Riparian water rights are based on ownership of land adjacent to a waterbody, while appropriative water rights are based on the principle of “first in time, first in right” and are not related to riparian land ownership.

Riparian water rights are not lost if not used and are not quantified unless they are adjudicated. Landowners with these rights can divert portions of the natural waterflow for reasonable and beneficial use on their land, provided the land is located within the same watershed as the waterbody and on the smallest parcel adjacent to the waterbody. During times of water shortage, all riparian water rights holders must share the available supply according to each landowner’s reasonable requirements and uses (California’s SWRCB, 1989).

Appropriative water rights are quantified and may be lost if not used. Appropriative water rights obtained after 1914 require permits and licenses issued by the SWRCB. All existing rights before 1914 have seniority based on the date when they were initiated. The SWRCB issues appropriative rights with conditions to protect other water rights holders, including Delta and upstream riparian water users, and to protect the public interest, including fish and wildlife resources. The quantity and quality of water used by existing riparian and senior appropriative users can only be limited by
subsequent appropriations in limited circumstances where the senior rights are not legally injured. (CALFED 1998)

6.2.10 National Primary Drinking Water Standards

The National Primary Drinking Water Standards or maximum contaminant levels (MCLs) are the maximum permissible levels of contaminants in water that enters the distribution system of a public water system. The federal and state MCLs are enforceable and must be met by appropriate public drinking water systems. National maximum contaminant level goals (MCLGs) are the maximum levels of contaminants in drinking water at which no known or anticipated adverse effect on the health of persons would occur and which allow an adequate margin of safety. MCLGs are non-enforceable health goals and are strictly health based. Action levels (ALs) are health-based numbers that take into account analytical detection levels. They are interim guidance levels that may trigger mitigation action on the part of a water purveyor. An AL is dropped once an MCL is promulgated and final. (CALFED 1998)

6.2.11 National Secondary Drinking Water Standards

National Secondary Drinking Water Standards, or secondary MCLs, were established by the EPA in 1979 and 1991. The secondary MCLs are maintained to protect public welfare and to assure a supply of pure, wholesome, and potable water. They are applied at the point of delivery to the consumer and generally involve protection of the taste, odor, or appearance of drinking water. Federal secondary MCLs are nonenforceable; however, state secondary MCLs are enforceable for all new systems and new sources developed by existing systems. (CALFED 1998)

6.2.12 California Nonpoint Source Program

Two primary federal statutes, Clean Water Act (CWA) §319 and Coastal Zone Act Reauthorization Amendments (CZARA) §6217, along with the Porter-Cologne Act, establish a framework for addressing nonpoint source (NPS) pollution in California. As enacted by Congress in 1987, CWA §319 required California to develop an assessment report detailing the extent of nonpoint pollution and a management program specifying nonpoint source controls. In 1990, Congress passed §6217 that requires the state to “develop and implement management measures for nonpoint source pollution to restore and protect coastal waters...” which is to serve as an update and expansion of the existing NPS program.

In 1994 the State initiated a comprehensive process to consider the requirements of CZARA and update the existing statewide Nonpoint Source Program rather than create a separate program dealing specifically with coastal waters. The State’s updated program calls for managing nonpoint sources
on a watershed basis and focuses on Nonpoint source problems associated with pesticides, grazing, urban runoff, hydromodification, and abandoned mines. (CALFED 1998)

6.2.13 Bay-Delta Framework Agreement and the Bay-Delta Accord

In June 1994, a Bay-Delta Framework Agreement was signed by the Federal Ecosystem Directorate and the Governor’s Water Policy Council of the State of California. The framework established a comprehensive program in the Bay-Delta estuary for coordination and cooperation of environmental protection and water supply. It addressed three major areas of agreement including formulation of a new WQCP acceptable to both EPA and SWRCB, coordination of SWP and CVP operations in order to rapidly respond to environmental conditions in the Delta with an adaptive management approach, and implementation of a long-term management approach integrating objectives for water supply and environmental protection. The Principles for Agreement, or Bay-Delta Accord, was signed on 15 December 1994.

In addition, the Bay-Delta Accord calls for early implementation of certain ecosystem restoration projects before the comprehensive solution is finalized. Funding for these projects has come from Proposition 204, passed by California voters in 1996, from the California Bay Delta Environmental Enhancement Act, passed by Congress in 1996, and from voluntary contributions from urban water agencies. (CALFED 1998)

6.3 LOCAL

The proposed action will take place on the San Joaquin River system which is located in the following counties: San Joaquin, Stanislaus, Merced, Fresno, Madera, Mariposa, and Tuolumne. Each county and city is required by Section 65300 of the California Government Code to have a comprehensive, long-term general plan for the physical development of the county and city. Mandatory elements of the general plan that have bearing on the proposed action are land use, open space, and conservation. Additional optional plan elements may include agriculture.

This section of the EIS/EIR summarizes key goals and policies in these counties, where most of the proposed action of additional stream flows and deliveries to wetland habitats occur and could potentially impact local communities and businesses. Since the proposed action does not involve urban development, key issues are whether the water purchases are consistent with county policies for resource conservation and support of agriculture. In conclusion, the proposed action is consistent with county goals, objectives, and policies as presented in the following sections. The goals and objectives of each county which are relevant to the proposed action are summarized below (Table 6.3-1). The full text of each county’s objectives and policies relevant to the proposed action is contained in Appendix F.
### County General Plan Policy Summary

<table>
<thead>
<tr>
<th>County</th>
<th>Goals and Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Joaquin</td>
<td>Protect and improve the county’s vegetation, fish, and wildlife resources. Provide undeveloped open space for nature study, protection of endangered species, and preservation of wildlife habitat.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Stanislaus</td>
<td>Conserve water resources and protect water quality in the county. Provide for the long-term conservation and use of agricultural lands. Protect fish and wildlife species in the county. Protect the natural resources that sustain agriculture in Stanislaus County.</td>
</tr>
<tr>
<td>Merced</td>
<td>Protect rare and endangered species from urban development and recognize them in rural areas. Protect surface and groundwater resources from contamination, evaporation and inefficient use. Support measures to protect and improve water quality.</td>
</tr>
<tr>
<td>Fresno</td>
<td>Preserve and enhance the value of the river environment as a multiple use, open space resource. Maintain the environmental and aesthetic qualities of the area. Protect the quality and quantity of the surface water and ground water resources. Conserve and enhance the natural wildlife habitat. Preserve and enhance areas of significant natural resources, the retention of which is necessary to maintain the environmental quality and economic potential of the area. Manage vegetation and wildlife resources in a responsible and productive manner. Protect the habitats of plants and wildlife from unnecessary activities of man.</td>
</tr>
<tr>
<td>Madera</td>
<td>Promote the wise, efficient, and environmentally-sensitive use of county land to meet the present and future needs of county residents and businesses. Protect and enhance the natural quality of county’s streams, creeks and groundwater. Protect wetland communities and related riparian areas throughout Madera County as valuable resources.</td>
</tr>
</tbody>
</table>
Table 6.3-1: COUNTY GENERAL PLAN POLICY SUMMARY (CONT.)

<table>
<thead>
<tr>
<th>County</th>
<th>Goals and Objectives</th>
</tr>
</thead>
</table>
| Madera | Protect, restore, and enhance habitats that support fish and wildlife species so as to maintain populations at viable levels.  
Preserve and enhance open space lands to maintain the natural resources of the county. |
| Mariposa | Provide for the identification, delineation, description, and maintenance of vegetative types and related wildlife habitats in order to maintain the inherent diversity of both vegetation and wildlife species in Mariposa County for the recreational, commercial, and aesthetic enjoyment of both present and future residents and visitors to the county.  
Enhance the natural open space resources of Mariposa County to include preservation of natural resources, managed production of resources, outdoor recreational resources and open space for public health and safety, for the benefit of present and future residents of the county and visitors to the area. |
| Tuolumne | Conserve the quality and quantity of the county’s water resources, while protecting the rights of the land owner.  
Conserve public water resource areas with high recreational value for future public use. |

6. COMPLIANCE REQUIREMENTS

6.1 FEDERAL

- 6.1.1 Central Valley Project Improvement Act (CVPIA)  
- 6.1.2 Delta Smelt Biological Opinion  
- 6.1.3 National Environmental Policy Act  
- 6.1.4 Endangered Species Act  
- 6.1.5 Fish and Wildlife Coordination Act  
- 6.1.6 Environmental Justice  
- 6.1.7 Indian Trust Assets  
- 6.1.8 Indian Sacred Sites  
- 6.1.9 National Historic Preservation Act  
- 6.1.10 Flood Plain Management  
- 6.1.11 Wetlands Protection  
- 6.1.12 Wild and Scenic Rivers Act  
- 6.1.13 Clean Water Act of 1977  
- 6.1.14 Memorandum on Farmland Preservation and the Farmland...
6. Compliance Requirements

6.1 Protection Policy Act

6.1.15 Federal Agriculture Improvement and Reform Act of 1996 and 1985
   Food Security Act

6.2 STATE

6.2.1 California Environmental Quality Act
6.2.2 California Endangered Species Act
6.2.3 State Historic Preservation Officer
6.2.4 Delta Protection Commission
6.2.5 The Delta Protection Act of 1959
6.2.6 Porter-Cologne Act
6.2.7 D-1485 and the 1978 Water Quality Control Plan
6.2.8 1995 Water Quality Control Plan (WQCP)
6.2.9 Water Rights
6.2.10 National Primary Drinking Water Standards
6.2.11 National Secondary Drinking Water Standards
6.2.12 California Nonpoint Source Program
6.2.13 Bay-Delta Framework Agreement and the Bay-Delta Accord

6.3 LOCAL


6. Compliance Requirements
7. PREPARERS OF EIS/EIR

The following personnel were directly involved in the preparation of the EIS/EIR.

**Bureau of Reclamation**

- Mike Delamore: Project Manager
- Kellye Kennedy: Program Manager
- Frank Michny: Deputy Regional Environmental Officer
- Lowell Ploss: Operations Manager, Central Valley Project Operations
- Don Treasure: Environmental Specialist, NEPA Review

**U.S. Fish and Wildlife Service**

- Richard Jewell: Hydrologist

**San Joaquin River Group Authority**

- Dan M. Fults: Project Manager

Technical and support personnel from EA Engineering, Science, and Technology and other firms who were involved in document preparation are listed in Table 7-1.

**Table 7-1: LIST OF TECHNICAL AND SUPPORT PERSONNEL**

<table>
<thead>
<tr>
<th>Preparers</th>
<th>Degree(s)/Years of Experience</th>
<th>Experience and Expertise</th>
<th>Role in Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reimold, B.</td>
<td>Ph.D., Marine Science M.A., Marine Science B.A., Biology 35 years</td>
<td>Senior Technical Review</td>
<td>Project Director</td>
</tr>
<tr>
<td>Hootkins, S.</td>
<td>M.U.P., Urban and Regional Planning B.A., Human Biology 25 years</td>
<td>Public Scoping, Land Use, Environmental Justice, Other Impacts</td>
<td>Project Manager</td>
</tr>
<tr>
<td>Cheslak, E.</td>
<td>Ph.D., Aquatic/Systems Ecology M.S., Biology/Ecology B.S., Zoology</td>
<td>Alternatives, Surface Water, Aquatic Resources</td>
<td>Senior Aquatic Ecologist</td>
</tr>
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</table>

Final EIS/EIR  
January 28, 1999  
7-1
<table>
<thead>
<tr>
<th>Preparers</th>
<th>Degree(s)/Years of Experience</th>
<th>Experience and Expertise</th>
<th>Role in Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lofholm, S.</td>
<td>M.S., Geology 27 years</td>
<td>Groundwater Resources</td>
<td>Senior Geologist</td>
</tr>
<tr>
<td></td>
<td>B.S., Geology 19 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yin, H.</td>
<td>M.S., Civil Engineering 15 years</td>
<td>Surface Water</td>
<td>Hydrologist</td>
</tr>
<tr>
<td></td>
<td>B.S., Hydrology 19 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Davidson, S.</td>
<td>B.S., Forest Management Science 17 years</td>
<td>Recreation, Cultural Resources, Energy Production, Indian Trust Assets</td>
<td>Resource Planner</td>
</tr>
<tr>
<td>Swaney, W.</td>
<td>B.S., Water Resources 17 years</td>
<td>Aquatic Resources</td>
<td>Aquatic Biologist</td>
</tr>
<tr>
<td>Mathews, M.</td>
<td>B.S., Resource Management 9 years</td>
<td>Groundwater Resources</td>
<td>Watershed Specialist</td>
</tr>
<tr>
<td>Pool, A.</td>
<td>B.S., Wildlife and Fisheries Science 7 years</td>
<td>Terrestrial Resources</td>
<td>Terrestrial Ecologist</td>
</tr>
<tr>
<td>Isaacs, J.</td>
<td>M.A., Geography, Resource Management, Environmental Planning B.S., Psychology (Biology emphasis) 8 years</td>
<td>Mapping, Land Use</td>
<td>GIS Analyst</td>
</tr>
<tr>
<td>Melendez, L.</td>
<td>A.A., Office Administration (pending) 9 years</td>
<td>Report Production</td>
<td>Editor</td>
</tr>
<tr>
<td>Hensley, D.</td>
<td>B.S., Journalism 14 years</td>
<td>Report Production</td>
<td>Editor</td>
</tr>
<tr>
<td>Anderson, E.</td>
<td>B.A., Fine Art 25 years</td>
<td>Report Production</td>
<td>Graphic Artist</td>
</tr>
</tbody>
</table>

| Other Consultants  |                                             |                                              |                       |
| Bair, J.           | M.A., Biology (pending) Terrestrial Resources, Riparian Botanist |
| McBain and Trush   | B.S., Biology/Botany Riparian Vegetation    |                                               |                       |
| Trush              | 11 years                                    |                                               |                       |
| Steiner, D.        | B.S. Civil Engineering Hydrology Hydrologic Modeling |
| Consulting Engineer|                                            |                                               |                       |
8. REFERENCES

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8. References


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USBR (U.S. Bureau of Reclamation). 1997m. Volume Nine. Fish Habitat Water Quality M/M; Vegetation and Wildlife M/M; Recreation M/M; Fish Wildlife and Recreation Economics M/M.


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8. References

8. References


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8. References

8.0 REFERENCES ................................................................................................................... 8-1
8.1 LITERATURE CITED .................................................................................................... 8-1
8.2 PERSONAL AND OTHER COMMUNICATION .......................................................... 8-12
Hydrologic Analysis

San Joaquin River Agreement

Prepared for the
United States Bureau of Reclamation and
San Joaquin River Group Authority

By
Daniel B. Steiner, Consulting Engineer
September, 1998
I. INTRODUCTION

Several interests, including the Department of Interior (Interior), the San Joaquin River Group Authority and its members, the Department of Water Resources and the Department of Fish and Game, and Central Valley Project/State Water Project Export Interests have developed the San Joaquin River Agreement (SGRA) which provides for a San Joaquin River flow and SWP/CVP export study during the April-May pulse flow period to gather better scientific fisheries information on the lower San Joaquin River while at the same time provide environmental benefits in the lower San Joaquin River and Delta.

The proposed project/action is the acquisition of water by Interior from the San Joaquin River Group Authority and its members to provide a pulse flow at Vernalis during April and May, and the acquisition of other water identified by the SJRA. The water is needed to support the Vernalis Adaptive Management Plan (VAMP) during the pulse flow period and to assist Interior in meeting the Anadromous Fish Restoration Plan, Bay-Delta flow objectives and the U.S. Fish and Wildlife Service 1995 Biological Opinion for Delta Smelt.

As part of the VAMP, Central Valley Project (CVP) and State Water Project (SWP) exports during the VAMP test period (April/May) will be managed to specified levels. These levels in relation to Vernalis flows are less than allowed under current regulatory requirements. The San Joaquin River Agreement provides for the development of an operations plan acceptable to all parties including address of export reductions caused by VAMP.

This technical report presents the results of an analysis that models potential hydrologic effects of an action under which Interior purchases water identified by the SJRA.

II. DESCRIPTION OF THE PROPOSED PROJECT/ACTION

The proposed project/action is acquisition of water by Interior from certain San Joaquin River Group Authority (SJPGA) members for use as a pulse flow at Vernalis during April and May, and the acquisition of other water for use during other times of the year. The SJPGA members that will be providing water are Modesto Irrigation District (MID), Turlock Irrigation District (TID), Merced Irrigation District (Merced), South San Joaquin Irrigation District (SSJID), Oakdale Irrigation District (OID), and the San Joaquin River Exchange Contractors Water Authority (Exchange Contractors). This water is intended to supplement flows of the San Joaquin River during the next twelve years, 1999 through year 2010.
The water provided by the SJRGA will be provided by several potential means, including the increase of flows from tributary reservoirs, the bypass of diversions, indirect substitution of groundwater, reduction of applied surface water, and increased system efficiency.

**Water Made Available Through the SJRA**

Four components of water will be provided by the SJRGA members:

- Up to 110,000 acre-feet per year towards meeting the VAMP flow target. Water provided under this component will be divided among the SJRGA members. This water is to only be used during the VAMP 31-day test flow period;

- Additional water from willing SJRGA members to achieve full flow targets;

- Additional water from Merced (12,500 acre-feet) during October of all years. This flow will be provided above the “existing flow” in the Merced River during October.

- Additional water from OID (15,000 acre-feet) every year to be available to Reclamation. In addition to this water, any of the (up-to) 11,000 acre-feet of OID VAMP water not provided towards meeting the VAMP flow target is also available to Reclamation.

**Determination of VAMP Water**

The SJRA defines the determination of water to be provided for VAMP by the SJRGA’s members. The SJRGA members will provide, during the pulse flow period, the amount of water needed to achieve the VAMP flow target or 110,000 acre-feet, whichever is less. The water provided by the SJRGA members will be determined as the sum of flows released in excess of flows which would otherwise have been released during the pulse flow period.

The VAMP flow target is determined by a series of procedures and conditions based on the flow at Vernalis which would occur in the absence of the SJRA (“existing flow”), and the San Joaquin Valley Water Year Hydrologic Classification. The SJRA provides a VAMP flow target that will be incrementally larger than the existing flow at Vernalis consistent with the following table:

<table>
<thead>
<tr>
<th>San Joaquin Valley Water Year Hydrologic Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>The San Joaquin Valley Water Year Hydrologic Classification was developed as an index of wetness and water supply availability within the San Joaquin River basin. The index is mathematically derived as the summation of 0.6 times the current year’s April through July San Joaquin Valley unimpaired runoff plus 0.2 times the current year’s October through March unimpaired runoff plus 0.2 times the previous year’s index (with the previous year’s index capped at 4.5 million acre-feet). The index is commonly referred to as the 60-20-20 Classification. The streams used in the index are the Stanislaus, Tuolumne and Merced rivers and the San Joaquin River at Friant. The index defines five different year types: wet, above normal, below normal, dry and critical.</td>
</tr>
</tbody>
</table>
The SJRA assigns a numeric adjunct (60-20-20 Indicator) to the San Joaquin Valley Water Year Hydrologic Classification: a wet year is assigned the numeric value of 5, an above normal year is assigned the numeric value of 4, a below normal year is assigned the numeric value of 3, a dry year is assigned the numeric value of 2, and a critical year is assigned the numeric value of 1. In any year when the sum of the current year’s 60-20-20 Indicator and previous year’s 60-20-20 Indicator is seven (7) or greater, the 31-day flow target will be the flow target one level higher than that established by the table described above (e.g., if the existing flow is 3,500 cfs then the flow target will be 5,700 cfs). This condition is referred to as a “double-step”.

As described above, the SJRGA members will provide up to 110,000 acre-feet of water to achieve the VAMP flow target. The SJRA also provides for relaxation of this obligation during sequential dry-year periods (if such a period were to occur during the term of the SJRA). During years when the sum of the current year’s 60-20-20 Indicator and the previous two years’ 60-20-20 Indicator is four (4) or less (a sequence of dry and critical years), the SJRGA members will not be required to provide water above the existing flow.

**Assumed Division of Flow**

The SJRGA members have executed an agreement (the “Division Agreement”) that identifies the division of the water to be provided for the proposed project/action. The hierarchy for the provision of flow by the SJRGA members is consistent with the following table:

<table>
<thead>
<tr>
<th>Entity (in order of providing flow)</th>
<th>First 50,000 AF</th>
<th>Next 23,000 AF</th>
<th>Next 17,000 AF</th>
<th>Next 20,000 AF</th>
<th>Totals</th>
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</thead>
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<tr>
<td>Merced</td>
<td>25,000</td>
<td>11,500</td>
<td>8,500</td>
<td>10,000</td>
<td>55,000</td>
</tr>
<tr>
<td>OID/SSJID</td>
<td>10,000</td>
<td>4,600</td>
<td>3,400</td>
<td>4,000</td>
<td>22,000</td>
</tr>
<tr>
<td>Exchange Contractors</td>
<td>5,000</td>
<td>2,300</td>
<td>1,700</td>
<td>2,000</td>
<td>11,000</td>
</tr>
<tr>
<td>MID/TID</td>
<td>10,000</td>
<td>4,600</td>
<td>3,400</td>
<td>4,000</td>
<td>22,000</td>
</tr>
</tbody>
</table>

* For the purpose of determining water to be provided by the SJRGA’s members. The VAMP Test Flow Target is 3,200 cfs.
This component of contribution will draw from each member up to the following maximum amounts of water: Merced, 55 TAF; OID, 11 TAF; SSJID, 11 TAF; Exchange Contractors, 11 TAF; MID, 11 TAF; and TID, 11 TAF. For the other components of water, an individual entity is responsible. Although the above described hierarchy for providing VAMP flows is established by the Division Agreement, the agreement also allows for other arrangements between the members to provide water, so long as the VAMP pulse flow is met.

III. MODELING

This analysis was conducted to evaluate a range of potential hydrologic effects attributable to the proposed project/action. The SJRA has a term of 12 years (unless extended); however, the hydrologic character of the next 12 years cannot be predicted. To evaluate a range of conditions and hydrologic impacts that may occur, the SJRA was evaluated using a long-term hydrologic sequence, the hydrology of the period 1922 through 1992. Within that period of record various sequences of hydrologic events occurred ranging from flood to extended periods of drought.

Two primary operational settings were developed, the No-action setting and the Proposed Project/Action setting. The No-action setting depicts an environment representative of existing hydrology and operations within the Bay-Delta watershed absent the SJRA. This setting includes the CVP and SWP meeting the 1995 Water Quality Control Plan and biological opinions for winter run Chinook salmon and Delta Smelt. Operations for the San Joaquin River include Reclamation operating New Melones to the Interim Plan of Operations, and due to limited availability of water from New Melones the water quality and flow objectives of the 1995 Water Quality Control Plan for the San Joaquin River are not always met.

The Proposed Project/Action setting depicts the performance of the SJRA if it were in place for the entire 71 years of sequential hydrology. The elements of the SJRA that are directly evaluated are the 110,000 acre-feet component of VAMP water, and the Merced October flows, and the OID reallocation water.

Operation Simulation Models

This analysis relied on the interface of three hydrologic models to simulate the potential hydrologic effects of the proposed project/action.

San Joaquin Area Simulation Model (SANJASM)

The Bureau of Reclamation’s (Reclamation) SANJASM provided the simulation of the San Joaquin River upstream of the confluence of the Stanislaus River, including the hydrology of west side San Joaquin Valley CVP deliveries.
Stanislaus Operations Model (STNMODAM version)

Reclamation’s STNMODAM spreadsheet model provided the simulation of Stanislaus River operations under assumptions of Reclamation’s Interim Plan of Operation for New Melones.

Projects Simulation Model (PROSIM)

Reclamation’s PROSIM provided the simulation of the CVP and SWP, and the Bay-Delta.

Results of PROSIM are dependent on the flow at Vernalis resulting from SANJASM and STANMODAM. However, the flow and water quality at Vernalis are determined by SANJASM and STANMODAM for which those results are partially dependent on the results of PROSIM. This interaction between the models requires an iterative series of simulations to reach a point of closure between the models. Figure 1 illustrates the interaction between the models. The iteration begins with developing a simulation of non-Stanislaus River hydrology, e.g., the operation of the Merced and Tuolumne Rivers. From that result, non-Stanislaus River flow and water quality information are provided to Reclamation’s STNMODAM for integration with a Stanislaus River operation that is consistent with Reclamation’s Interim Plan of Operation for New Melones. The results of that step then provide the simulation of flow and water quality conditions at Vernalis, which is then provided to PROSIM for simulation of the CVP and SWP and west side San Joaquin Valley deliveries. The results of that PROSIM study are then re-entered into San Joaquin River operations for a redetermination of Vernalis flows and quality. A PROSIM study is then rerun to provide closure between the revised Vernalis flow and quality conditions and CVP and SWP Delta operations.

Although there is only the No-action and Proposed Project/Action settings, four simulations were performed. Due to a combination of modeling constraints (average monthly hydrologic data and a monthly modeling time-step) and the potential for the VAMP test flow period being established anytime during the April through May period, the No-action and Proposed Project/Action were each modeled to occur entirely during the month of April or May.

Modeling Assumptions - No-action Setting

New Melones Reservoir is assumed to operate consistent with the Interim Plan of Operation as modeled within STNMODAM, with the out-migration pulse flow focused during either the month of April or May. As hydrologic and operational conditions of the San Joaquin River upstream of the mouth of the Stanislaus River change with each analysis, the operation of the Stanislaus River will sometimes change as the result of water quality operations.

The allocation of annual water supplies to the uses of fishery, Vernalis water quality, Bay-Delta, and CVP contractors was assumed as follows, dependent on the water supply of New Melones:

<table>
<thead>
<tr>
<th>New Melones Allocation of Supplies (1,000 acre-feet)</th>
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<tbody>
<tr>
<td>New Melones</td>
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<tr>
<td>Storage Plus Inflow</td>
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</tr>
<tr>
<td>2,000</td>
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<tr>
<td>2,500</td>
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<td>3,000</td>
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</table>

Allocations to OID and SSJID were assumed consistent with their 1988 agreement with Reclamation.

The Merced and Tuolumne River reservoir systems are modeled to operate to meet diversion demands and minimum instream flow requirements. The FERC required spring pulse flows for the Tuolumne River are assumed to be scheduled coincident with the period of desired supplemental flow in the San Joaquin River (April or May). Releases in excess of minimum flow requirements on the tributaries occasionally occur in accordance with flood control storage reservation requirements.

Primary assumptions for the hydrology and operation of the SWP and CVP include the following:

- Implementation of the State Water Resources Control Board’s 1995 Water Quality Control Plan through the operations of the SWP and CVP. At times, full compliance to San Joaquin River flow and quality objectives does not occur. Combined SWP/CVP exports are allowed to pump up to 100 percent of the flow occurring at Vernalis during the spring pulse flow period;

- Delta Smelt and winter run chinook salmon Biological Opinions for the SWP and CVP;

- November 1997 AFRP actions for instream flows in Clear Creek and below Keswick and Nimbus reservoirs, and a Trinity River maximum required release of 340 TAF. No additional AFRP Delta actions other than the 1995 WQCP;

- Current level of hydrology and operations in the San Joaquin Valley, including delivery of Level 4 refuge supplies.

The No-action setting modeling results in Vernalis flow conditions that define the “existing flow” for the SJRA. The results also define the SWP/CVP export levels which are associated with a pre-SJRA setting. The Vernalis flow simulated from this setting is used to calculate the VAMP flow to be provided by the SJRGA members.

**Modeling Assumptions - Proposed Project/Action Setting**
Subsequent to the determination of the water to be provided by the SJRGA members for the VAMP, and its division among the members, a series of procedures to simulate the Proposed Project/Action setting were employed. These procedures are described as follows.

Water originating from Merced is assumed to occur as increased stream releases from New Exchequer Dam. This release is modeled as an increase in flow above the release which would otherwise be made in the absence of the proposed project/action. Merced’s VAMP contribution is added to the Merced River flow that occurred within the No-action simulation. Merced’s additional provision of water during October is depicted by increasing Merced’s minimum flow requirement during October by 12,500 acre-feet. In certain sequential critical year sequences, surface water diversions by Merced are reduced to accommodate the additional stream releases.

Water originating from MID and TID is also modeled as additional stream releases, in this case from New Don Pedro Dam. As with the Merced release, this release is modeled as an increase in flow above the release which would otherwise be made in the absence of the proposed project/action.

VAMP water originating from OID and SSJID is assumed to occur two different ways: 1) if lower Stanislaus River flow from Goodwin is less than 1,500 cfs, OID and SSJID flows are modeled to occur as an increase in releases below Goodwin, but will not in combination with the existing flow at Goodwin exceed the 1,500 cfs objective, or 2) when Goodwin releases are 1,500 cfs, it is assumed that OID and SSJID will provide their respective flow through diversion bypass via a “hydraulic means” that will not frustrate the 1,500 cfs flow objective on the Stanislaus River. This “hydraulic means” is currently assumed to be a conveyance of water from OID and SSJID to MID occurring over several months and MID releasing the OID/SSJID component of VAMP pulse flow to the Tuolumne River.

Water originating from the Exchange Contractors is assumed to occur as an incremental additional accretion to San Joaquin River near the mouth of the Merced River.

Under the Proposed Project/Action setting, New Melones is assumed to operate consistent with the allocations of the Interim Plan of Operation as described above for the No-action setting with the exception that subsequent to the determination of water available to OID and SSJID, 15,000 acre-feet plus any unrequired VAMP flow from OID (up to 11,000 acre-feet) will be reduced from OID’s allocation and diversion. The reduction in diversion will result as additional storage in New Melones and be subsequently reallocated to other uses in subsequent years consistent with the allocations of the Interim Plan of Operation.

OID/SSJID VAMP water that is released at Goodwin to the Stanislaus River (within the 1,500 cfs flow objective) and OID water that is reduced from OID’s allocation of New Melones supplies are assumed as reductions to OID’s diversions during the months of March, April, September and October.

Hydrology and operation assumptions of the CVP and SWP are the same between the No-action setting and the Proposed Project/Action setting.
Adjustment of New Melones Operations due to Reallocation of OID Water

As a result of OID decreasing its diversion of its entitlement from Reclamation, the allocation of water to the fishery (and other uses) increases. In instances when the No-action release to the Stanislaus River was less than 1,500 cfs, this additional allocation of fishery water would result in releases from Goodwin to the Stanislaus River higher than would occur without the OID reallocated water. If left unadjusted, this revised Goodwin release in combination with the VAMP flows provided by the SJRGA members would overshoot the Vernalis flow target. This occasional occurrence was remedied by shifting any excess in Vernalis flow caused by the OID reallocation water from the assumed month of VAMP to the other potential pulse flow month.

IV. SIMULATIONS AND RESULTS

Results of this analysis are available from Reclamation upon request (hard copy) and are accessible from the Internet at www.mp.usbr.gov.mp140.vampdir.html. The following listed files contain the results of the SANJASM and STANMODAM simulations of the No-action and Proposed Project/Action settings.

<table>
<thead>
<tr>
<th>Setting</th>
<th>April</th>
<th>May</th>
</tr>
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<tbody>
<tr>
<td>No-Action Setting</td>
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<td>VMB_IT3.BIN</td>
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<td>VAB_IT3.WK4</td>
<td>VMB_IT3.WK4</td>
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<tr>
<td>Proposed Project/Action Setting</td>
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<td>VMP_IT1.BIN</td>
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<tr>
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<td>SJRA_A_1.WK4</td>
<td>SJRA_M_1.WK4</td>
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</tbody>
</table>
Numerous hydrologic parameters can be extracted from these data files. Table 1 lists the parameters that were extracted for consideration. Figure 2 provides a geographical representation of the area analyzed by the studies, and the general location of the parameters depicted in the modeling.

Additional information not directly included in the previously described data files is provided in Tables 2 through 5. Table 2 provides a listing of the San Joaquin Valley Water Year Hydrologic Classification for the years 1922 through 1992. Table 3 and Table 4 illustrate the determination of VAMP pulse flow water for the months of April and May, respectively, and Table 5 illustrates the modeled division of VAMP pulse flows between the SJRGA’s members.

Figure 1
Representation of Interaction Between Modeling Tools.
### Table 1
Hydrologic Analysis Parameters

#### Stanislaus River

**New Melones Storage (TAF)**
- 1 April No-action
- 2 April Proposed Action
- 3 April - difference
- 4 May No-action
- 5 May Proposed Action
- 6 May - difference

**Goodwin Release to River (cfs)**
- 7 April No-action
- 8 April Proposed Action
- 9 April - difference
- 10 May No-action
- 11 May Proposed Action
- 12 May - difference

**New Melones Fish Release (TAF)**
- 13 April No-action
- 14 April Proposed Action
- 15 April - difference
- 16 May No-action
- 17 May Proposed Action
- 18 May - difference

**New Melones WQ Release (TAF)**
- 19 April No-action
- 20 April Proposed Action
- 21 April - difference
- 22 May No-action
- 23 May Proposed Action
- 24 May - difference

**New Melones Bay-Delta Release (TAF)**
- 25 April No-action
- 26 April Proposed Action
- 27 April - difference
- 28 May No-action
- 29 May Proposed Action
- 30 May - difference

**New Melones DO Release (TAF)**
- 31 April No-action
- 32 April Proposed Action
- 33 April - difference
- 34 May No-action
- 35 May Proposed Action
- 36 May - difference

**New Melones CVP Delivery (TAF)**
- 37 April No-action
- 38 April Proposed Action
- 39 April - difference
- 40 May No-action
- 41 May Proposed Action
- 42 May - difference

**New Melones Optional Delivery (TAF)**
- 43 April No-action
- 44 April Proposed Action
- 45 April - difference
- 46 May No-action
- 47 May Proposed Action
- 48 May - difference

#### Tuolumne River

**New Don Pedro Storage (TAF)**
- 49 April No-action
- 50 April Proposed Action
- 51 April - difference
- 52 May No-action
- 53 May Proposed Action
- 54 May - difference

**La Grange Release to River (cfs)**
- 55 April No-action
- 56 April Proposed Action - Including Routed Water from OID/SSJID
- 57 April - difference
- 58 May No-action
- 59 May Proposed Action - Including Routed Water from OID/SSJID
- 60 May - difference
- 61 April Proposed Action - Routed Water from OID/SSJID
- 62 May Proposed Action - Routed Water from OID/SSJID

#### Merced River

**New Exchequer Storage (TAF)**
- 63 April No-action
- 64 April Proposed Action
- 65 April - difference
- 66 May No-action
- 67 May Proposed Action
- 68 May - difference

**Merced River below Diversion (cfs)**
- 69 April No-action
- 70 April Proposed Action
- 71 April - difference
- 72 May No-action
- 73 May Proposed Action
- 74 May - difference

**Merced ID Diversion (TAF)**
- 75 April No-action
- 76 April Proposed Action
- 77 April - difference
- 78 May No-action
- 79 May Proposed Action
- 80 May - difference
Table 1  
Hydrologic Analysis Parameters  
(Page 2/2)

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<thead>
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<td>108 May - Non-compliance with No-action</td>
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Figure 2
Area Location Map
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Table 2
San Joaquin Valley Water Year Hydrologic Classification
Table 3
Determination of VAMP Pulse Flow Water
April Pulse Flow
(1)

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1,419,960
2,929,392
2,300,478
3,558,896
2,632,779
2,004,556
2,015,911
1,201,582
3,410,716
2,440,943
1,440,989
3,556,198
3,739,440
3,897,088
5,910,218
2,198,200
3,364,440
4,425,888
4,440,778
4,023,556
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3,304,020
2,183,004
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2,531,320
2,853,264
3,138,053
5,165,011
3,025,800
2,720,960
2,300,392
4,463,078
3,008,616
4,772,923
2,208,800
1,854,560
1,375,912
3,073,382
3,572,476
2,186,695
3,804,739
2,511,948
5,251,790
2,213,800
6,094,560
3,182,800
2,884,560
2,155,912
3,498,382
3,903,676
3,848,135
1,571,027
840,805
4,583,561
3,668,400
4,731,480
2,441,000
5,446,000
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4,305,112
1,863,622

(2)

Year
Class
Wet
Above
Critical
Below
Dry
Above
Below
Critical
Critical
Critical
Above
Dry
Critical
Above
Above
Wet
Wet
Dry
Above
Wet
Wet
Wet
Below
Above
Above
Dry
Below
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Above
Wet
Below
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Dry
Wet
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Wet
Dry
Critical
Critical
Below
Above
Dry
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Dry
Wet
Above
Below
Dry
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Wet
Wet
Critical
Critical
Wet
Above
Wet
Dry
Wet
Wet
Above
Dry
Wet
Critical

(3)

Water
Year
1922
1923
1924
1925
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1927
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1930
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1986
1987

(4)
Current
Year
1 Crit
5 Wet

(5)
Current
Plus
Previous
Year
5
4
1
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3
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(6)
Current
Plus
2
Previous
9
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6

(7)
April
Vernalis
Existing
Flow
(CFS)
12
13
10
8
6
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3
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13
14
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8

10,088
6,559
1,778
4,713
3,495
6,617
5,611
2,314
2,334
1,470
5,484
2,471
1,617
7,889
7,812
10,157
22,643
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7,164
11,349
7,735
8,576
5,080
7,971
5,803
2,562
4,077
3,517
3,840
5,399
12,156
4,307
4,895
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6,576
4,340
15,080
3,450
2,453
1,783
4,857
6,626
2,418
7,214
3,522
15,097
3,517
24,593
5,786
4,223
2,595
7,988
8,324
8,458
2,476
1,626
18,120
7,635
8,609
3,735
25,315
27,742
5,349
3,492
12,240
2,542

(8)
Flow
Target

(9)
Suppl.
Flow
Required

(10)
Suppl.
Flow
Required

(CFS)

(CFS)

(TAF)

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7,000
2,000
5,700
4,450
7,000
7,000
3,200
3,200
2,000
5,700
3,200
2,000
7,000
7,000
7,000
7,000
5,700
7,000
7,000
7,000
7,000
7,000
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4,450
4,450
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7,000
3,200
2,000
7,000
7,000
7,000
5,700
7,000
7,000
7,000
4,450
7,000
3,200

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441
222
987
955
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1,389
886
866
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216
729
383
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1,797
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1,601
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1,393
805
515
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2,178
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1,214
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1,651
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658

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134
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91
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0
45
23
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0
0
121
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102
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0
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(11)
Suppl. w/
110
Cap
Invoked
(TAF)
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27
14
61
59
24
85
54
53
0
13
45
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110
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86
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110
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75
91
37
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45
23
0
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110
0
0
102
59
0
40


| Year | Critical | 1988 | | 1 | 2 | 7 | | 1,748 | 2,000 | 252 | 16 | 16 | | 1989 | 1,964,385 | Critical | | 1 | 2 | 3 | | 2,039 | 2,039 | 0 | 0 | 0 | | 1990 | 1,514,877 | Critical | | 1 | 2 | 3 | | 1,711 | 2,000 | 0 | 0 | 0 | | 1991 | 1,954,175 | Critical | | 1 | 2 | 3 | | 2,312 | 2,312 | 0 | 0 | 0 | | 1992 | 1,558,035 | Critical | | 1 | 2 | 3 | | 1,815 | 2,000 | 0 | 0 | 0 |
Table 4
Determination of VAMP Pulse Flow Water
May Pulse Flow
(1)

Index
602020
4,544,266
3,549,800
1,419,960
2,929,392
2,300,478
3,558,896
2,632,779
2,004,556
2,015,911
1,201,582
3,410,716
2,440,943
1,440,989
3,556,198
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3,897,088
5,910,218
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3,025,800
2,720,960
2,300,392
4,463,078
3,008,616
4,772,923
2,208,800
1,854,560
1,375,912
3,073,382
3,572,476
2,186,695
3,804,739
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5,251,790
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6,094,560
3,182,800
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2,155,912
3,498,382
3,903,676
3,848,135
1,571,027
840,805
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3,668,400
4,731,480
2,441,000
5,446,000
7,219,800
3,688,800
2,403,560
4,305,112
1,863,622

(2)

Year
Class
Wet
Above
Critical
Below
Dry
Above
Below
Critical
Critical
Critical
Above
Dry
Critical
Above
Above
Wet
Wet
Dry
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Dry
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Dry
Critical
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Dry
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Above
Dry
Wet
Critical

(3)

Water
Year
1922
1923
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1985
1986
1987

(4)
Current
Year
1 Crit
5 Wet

(5)
Current
Plus
Previous
Year
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Previous
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(7)
May
Vernalis
Existing
Flow
(CFS)
12
13
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9,711
2,204

(8)
Flow
Target

(9)
Suppl.
Flow
Required

(10)
Suppl.
Flow
Required

(CFS)

(CFS)

(TAF)

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7,000
2,000
4,450
3,200
5,700
5,700
3,200
2,000
2,000
4,450
3,200
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5,700
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3,200

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125
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71
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69
93
62
69
77
0
153
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113
100
55
69
29
17
61
35
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42
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149
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132
10
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(11)
Suppl. w/
110
Cap
Invoked
(TAF)
0
89
31
26
32
32
110
72
3
0
33
63
46
56
103
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Table 5
Modeled Division of VAMP Pulse Flow Water
(Values in 1,000 acre-feet)

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<th>May Pulse Flow</th>
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APPENDIX B
GROUNDWATER CONDITIONS

Appendix B describes in detail the groundwater conditions in each of the basins in the San Joaquin River Region. Included are the Turlock Groundwater Basin, Modesto Basin, Merced Groundwater Basin, Eastern San Joaquin County Groundwater Basin, and the San Joaquin River Exchange Contractors Service Area.

B.1 GROUNDWATER RESOURCES OF THE TURLOCK GROUNDWATER BASIN

B.1.1 Physical Description of the Basin

The Turlock Groundwater Basin lies on the eastern side of the San Joaquin Valley, and encompasses portions of both Stanislaus and Merced counties. The groundwater system is bounded by the Tuolumne River on the north, the Merced River on the south, and the San Joaquin River on the west, as shown in Figure B.1-1. The eastern boundary of the system is the western extent of the outcrop of low-permeability sediments on the western flanks of the Sierra-Nevada.

Groundwater within the Basin occurs under unconfined and confined conditions. The alluvial and continental deposits constitute two principal aquifers, which are separated by the Corcoran Clay in portions of the Turlock Basin. Although these deposits are characteristically heterogeneous in composition, the interbedded clays, with the exception of the Corcoran Clay, are generally discontinuous.

Groundwater is considered to be unconfined in both the shallow alluvial aquifer system overlying the Corcoran Clay and the aquifer system to the east. Long-term water level fluctuations in the shallow aquifer system about the Corcoran Clay and the unconfined aquifer system east of the Corcoran Clay demonstrate similar seasonal groundwater level fluctuations. The general direction of regional groundwater flow is westward and southward towards the valley trough. Groundwater within the Turlock basin also moves eastward towards a large cone of depression east of TID. The direction of groundwater flow is controlled by the elevations of the Tuolumne, Merced and San Joaquin Rivers which bound the basin (TID 1997).

B.1.2 Water Balance in the Turlock Groundwater Basin

Historically, municipal consumers within the Basin have relied solely on groundwater as the source of supply. The municipal suppliers (major utilities) within the Basin are: the cities of Turlock, Modesto, Ceres and Hughson; the Hilmar and Delhi county water districts; and the Denair and Keyes community services districts. The total water produced by these major water utilities in 1995 was 36,200 acre-feet, supplied entirely through groundwater pumping. An additional estimated 10,900 acre-feet per year is produced by small private residential water systems, commercial businesses, and industrial plants not served by the major utilities. Figure B.1-2 shows the historical groundwater production for the various municipal agencies.
### B. Groundwater Conditions

Agricultural land within the respective irrigation districts within the basin uses an average of 881,000 acre-feet per year (TID 1997). On the average the total crop-water requirements is comprised of approximately forty seven percent, or 411,000 acre-feet of groundwater (Table B.1-1). However, the deep percolation of extracted groundwater for irrigation returns a portion of the extracted groundwater to the aquifer.

#### Table B.1-1: AVERAGE ANNUAL AGRICULTURE USAGE IN THE TURLOCK GROUNDWATER BASIN

<table>
<thead>
<tr>
<th>Agency</th>
<th>Surface Water</th>
<th>Groundwater</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(AF/Yr)</td>
<td>(AF/Yr)</td>
<td>(AF/Yr)</td>
</tr>
<tr>
<td>Turlock Irrigation District (TID) *</td>
<td>435,000</td>
<td>106,000</td>
<td>541,000</td>
</tr>
<tr>
<td>Individual growers within TID **</td>
<td>0</td>
<td>123,000</td>
<td>123,000</td>
</tr>
<tr>
<td>Merced Irrigation District *****</td>
<td>22,000</td>
<td>0</td>
<td>22,000</td>
</tr>
<tr>
<td>Eastside Water District *****</td>
<td>0</td>
<td>155,000</td>
<td>155,000</td>
</tr>
<tr>
<td>Ballico-Cortez Water District *****</td>
<td>0</td>
<td>27,000</td>
<td>27,000</td>
</tr>
<tr>
<td>Individual Irrigators</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Municipal Waste Water Effluent ***</td>
<td>13,000</td>
<td>0</td>
<td>13,000</td>
</tr>
<tr>
<td>Total</td>
<td>470,000</td>
<td>411,000</td>
<td>881,000</td>
</tr>
</tbody>
</table>

Notes:
- * TID usage is based on a 1984-1996 average. Total usage equals the avg. SW & GW into the system minus the avg. spills to the river. Evaporation is minimal. The percentage of total usage to total system water was subtracted from the total GW & SW to calculate the GW & SW usage. (Note: Spills to the river from the TID canals vary from year to year and over the course of a season, depending on the type of year, irrigation and drainage requirements, etc.)
- ** Individual grower pumping is an estimate based on electrical usage.
- *** Waste water effluent from the municipalities is utilized for agricultural purposes.
- **** The individual irrigators refer to:
  1. The irrigation water used for those areas outside of other agency boundaries. There a fairly large area located on the eastern boundary of the Basin which could potentially be developed into agricultural farm land. The extent of the current development and water usage is unknown at this time.
  2. The individual growers within both the Merced Irrigation District which use groundwater to supply their crop-water requirement.
- ***** With the exception of minor amounts of surface water made available from Turlock and Merced irrigation districts in wet years, irrigators within the Eastside and Ballico-Cortez water districts rely on groundwater to supply irrigation water.
- ****** Groundwater is used to supply approximately 4% of Merced ID’s total deliveries, however, the wells used to supply that water are not located within the Turlock Groundwater Basin. Therefore, since the groundwater is not pumped from this Basin, Merced ID’s deliveries within the Turlock Groundwater Basin are assumed to be 100% surface water.

B. Groundwater Conditions

TID’s Groundwater Basin Management Plan (TID 1997), included an estimate of various components of the groundwater balance for the Turlock Basin. Table B.1-2 and Figure B.1-3 display the components. Based on a summary of the average annual values for the various components of inflow and outflow into the Basin, (Table B.1-1) the average annual water budget for 1988-89 indicated an average overdraft of 70,000 to 85,000 acre-feet per year. All inflow and most outflow component values were estimated. The data used to generate Table B.1-2 and Figure B.1-3 are based on old data that are not accurate, although they show generally the net inflows and outflows in the Turlock groundwater basin.

<table>
<thead>
<tr>
<th>Source</th>
<th>Acre Feet per Year</th>
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<tbody>
<tr>
<td><strong>Inflow</strong></td>
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<tr>
<td>Boundary Flow</td>
<td>2,000</td>
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<tr>
<td>Groundwater Inflow and Agricultural subsurface drainage</td>
<td>297,000</td>
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<tr>
<td>Turlock Lake Seepage</td>
<td>10,000</td>
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<tr>
<td>Municipal Inflow</td>
<td>7,500</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>316,500</strong></td>
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<tr>
<td><strong>Outflow</strong></td>
<td></td>
</tr>
<tr>
<td>Irrigation and Drainage Well Pumping</td>
<td>345,000</td>
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<tr>
<td>Municipal Pumping</td>
<td>30,000</td>
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<tr>
<td>Discharge to Streams</td>
<td>21,000</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>396,000</strong></td>
</tr>
<tr>
<td><strong>Difference</strong></td>
<td></td>
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<tr>
<td>Change in Storage</td>
<td>-79,500</td>
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</tbody>
</table>

Source: Turlock Groundwater Basin Groundwater Management Plan, Figure 10, October 1997.

The overdraft is not a basin-wide occurrence due to varying withdrawal rates throughout the Basin and heterogeneities in the underlying aquifers. Overdraft is occurring in the Turlock Groundwater Basin where the absence of surface supplies on the east side of the valley has resulted in concentrated pumping to support irrigated agriculture. Overdraft on the east side is the result. Simultaneously,
B. Groundwater Conditions

surplus supplies exist in the western portion of the basin, and pumping occurs for the maintenance of groundwater levels rather than for water supply purposes.
B. Groundwater Conditions

B.1.3 Groundwater Elevations

TID monitors static and high groundwater levels monthly from a total of 248 wells within its irrigation boundaries. Forty of those wells provide information on groundwater level trends within the District. The District monitors the other 208 shallow monitoring wells, located at section corners, to determine areas of high groundwater. In addition, the municipalities within the Basin monitor groundwater levels on a regular basis.

The depth to groundwater in most of the Turlock Basin ranges from less than 6 feet to over 100 feet below the ground surface (bgs). Fluctuations of water levels are of two main types, seasonal and long term. These fluctuations are controlled by irrigation practices, drainage techniques, and local pumpage. Seasonally, in areas of intense pumpage such as the vicinity of east of Turlock, the water table declines during the summer and rises during the winter.

Long term groundwater levels within the Basin for the period from 1971 through 1991 show that water levels declined throughout the period (DWR 1998). Figure B.1-4 represents conditions which existed in fall 1971. The fall 1991 map (Figure B.1-5), shows the decline in water levels over the 20 year period. The largest water level drop has developed approximately 6.5 miles east of Turlock within a large depression where the water table has declined as much as 90 feet. Water levels have declined approximately five feet throughout the western part of the Basin. The observed decline in water levels on the east side of the Basin is largely due to groundwater pumping. Within this area, surface water supplies are not available, and pumping has produced irrigation water in a large part by depleting stored groundwater (TID 1997).

B.1.4 Projected Turlock Basin Water Demand

For the foreseeable future, it is anticipated that cropping patterns and related irrigation requirements, on a per acre basis, will remain essentially the same (Table B.1-3). Furthermore, if no appreciable amount of additional lands are brought into agricultural production, it is estimated that agricultural water demand will decrease as municipal/industrial development gradually encroaches upon agricultural lands (TID 1997).
B. Groundwater Conditions

Table B.1-3. PROJECTIONS OF AGRICULTURAL AND MUNICIPAL GROUNDWATER DEMANDS IN THE TURLOCK GROUNDWATER BASIN

<table>
<thead>
<tr>
<th>Year</th>
<th>Agricultural Demands AF/Yr</th>
<th>Municipal Demands AF/Yr</th>
<th>Total Groundwater Demand AF/Yr</th>
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<tbody>
<tr>
<td>1995</td>
<td>411,000</td>
<td>36,405</td>
<td>447,405</td>
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<td>2005</td>
<td>411,000</td>
<td>48,390</td>
<td>459,390</td>
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<tr>
<td>2030</td>
<td>411,000(^1)</td>
<td>109,100</td>
<td>520,100</td>
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</table>


\(^1\)TID projects demand to remain at least static for the foreseeable future and perhaps decrease.

The population and developed municipal acreage are projected to triple by 2030 (TID 1997). Using current population trends within the Basin’s communities (projected to be a 3.6 percent increase per year), the population within the municipalities is expected to increase from 119,000 in 1995 to over 400,000 by 2030 with developed acreage increasing proportionally. As a result, the average daily water usage in these communities is expected to increase from 36,200 acre-feet per day in 1995 to over 109,000 acre-feet per day in the 2030 (Table B.1-3). The majority of the municipal/industrial demand is projected to be concentrated along the Highway 99 corridor. If groundwater remains the sole source of municipal supply, it is estimated that 205 additional wells will be required (TID 1997).

B.1.5 Groundwater Quality in the Turlock Groundwater Basin

The groundwater within the Basin is a mixture of groundwater recharge from irrigation water, streamflow, and precipitation. The major contributors to groundwater used for irrigation are the Tuolumne and Merced rivers and, to a lesser extent, precipitation. Its chemical character is formed by reactions of the mixtures with the physical, chemical, and biological environment in which it is found and the types of materials it has passed through. Hardness in the form of calcium bicarbonate is moderate to very hard (Page and Balding 1973). Exceptions to the general chemical composition of groundwater cited by Hall (1960) include: sodium bicarbonate water located in the western part of the area; and the mixing of saline water that has moved up into the fresh water bodies of the Basin.

B.1.5.1 Total Dissolved Solids

Total Dissolved Solids (TDS) concentrations in groundwater in the western two-thirds of the Basin are generally less than 500 ppm. TDS in groundwater increases westward towards the San Joaquin River and southward towards the Merced River (TID 1997). In these areas, high TDS water is found in wells deeper than 350 feet. Better quality groundwater (less than 1,000 ppm) in these areas is found at shallower depths.
Groundwater with high concentrations of total dissolved solids is present beneath the entire Basin at depths from about 400 feet in the west to over 800 feet in the west. The shallowest groundwater with high TDS occurs in zones five to six miles wide adjacent and parallel to the San Joaquin River and the lower part of the Merced River west of Hilmar, where high TDS water is believed to be upwelling (TID 1997).

**B.1.5.2 Nitrates**

The principal source of nitrate in groundwater is from plants that fix atmospheric nitrogen and then transfer it to the soil where it is used by plants, or is removed by downward percolation of water. Other sources of nitrate are decomposing plant debris, animal wastes, and nitrogen fertilizers. Natural nitrate concentrations in groundwater range from 0.1 to 10 mg/l (Driscoll 1986).

The maximum contaminant level (MCL) for nitrate in domestic water is set at 45 mg/l by the USEPA. Water containing as much as 90 mg/l of nitrate is harmful to infants. Communities within the Basin, including Ceres, Turlock, Keyes, Delhi, Hilmar, Deanir and South Modesto have had wells test high in nitrate concentrations close to or exceeding the current MCL (TID 1997).

Nitrate is an essential element for agricultural crops. However, permanent crops, including grape vineyards, may be adversely affected by excess nitrate concentrations. Nitrates may enter the groundwater from sewage discharges on land or from sewage lagoons. Additionally, many industrial waste chemicals contain high concentrations of nitrogen, which is reduced to nitrate. High nitrate concentrations are typically found in shallow groundwater zones and are attributed to the various sources described above.

**B.1.5.3 Arsenic**

Arsenic is a trace element that occurs naturally. Arsenic has also been an important component of pesticides, and thus enters streams or groundwater. Arsenic concentrations in water from public water supply wells in the Basin are below the current MCL of 0.05 mg/l. However, the Environmental Protection Agency (EPA) is considering lowering the MCL for arsenic to as low as 0.002 to 0.005 mg/l, which may have a considerable impact to use of groundwater supplies for drinking water.

**B.1.5.4 Iron and Manganese**

Groundwater in several areas within the Basin has elevated iron and manganese levels. Some wells in the cities of Ceres and Turlock, as well as within what was the Del Este system, have encountered problems due to manganese (TID 1997).
B. Groundwater Conditions

B.1.5.5  Radionuclides

The MCL for gross alpha is 15 picocuries per liter, and the MCL for uranium has recently been increased from 5 to 20 picocuries per liter. Natural sources are responsible for radionuclides which affect drinking water supplies (TID 1997). Sampling in the Basin for radiological constituents has generally been limited to public water systems. Groundwater with high uranium activity has been detected in the past 10 years in the Hilmar and Hughson areas (TID 1997).

B.1.5.6  Pesticides

Dibromochloropropane (DBCP) has contaminated the groundwater in portion of the basin. DBCP has been found in public water supply wells in the South Modesto, Keyes and Ceres areas at levels close to or exceeding the MCL. In cases where the DBCP levels are exceeding the MCL, wellhead treatment is being utilized (TID 1997).

Another trace organic compounds (used as a nematocide) that has been detected in the Basin’s groundwater is ethylene dibromide (EDB). EDB has been detected in one public water supply well in the Turlock area (TID 1997).

B.1.5.7  Volatile Organic Compounds

Trace organic compounds have been detected in the Basin’s groundwater including, but not limited to, carbon tetrachloride, perchloroethylene and hydrocarbon-based products.

Several unauthorized fuel releases from underground storage tanks (UST) have occurred in the Basin. Most of these cases are very localized in terms of groundwater impacts, and public water supply wells are not known to have been effected (TID 1997). The extent of methyl tertiary butyl ether (MTBE) in groundwater within the basin has not been fully evaluated.

B.1.6  Land Subsidence in the Turlock Groundwater Basin

Ground subsidence is not currently a problem in the Turlock Groundwater Basin. However, if overdrafting of the Basin continues and if the area experiences a multi-year drought, localized ground subsidence and loss of groundwater storage as groundwater levels decline could result.

B.1.7  Agricultural Subsurface Drainage and Waterlogging in the Turlock Groundwater Basin

TID reports that several areas in the western portion of the Basin experience localized high groundwater levels. The affected area varies from year to year and over the course of an irrigation
season as a result of pumping, precipitation and applied irrigation water. If left uncontrolled, groundwater levels of less than six feet from ground level would not be uncommon, resulting in agricultural seepage and potentially adverse impacts to local crop production (TID 1997).

To minimize these potentially adverse impacts on crops, the TID provides groundwater control or drainage pumping in areas where groundwater levels are within six feet of the ground surface. TID owns and operates approximately 170 drainage wells within their service area. In recent history subsurface drains have also been utilized to control groundwater levels. Water pumped for drainage is typically discharged into the District’s canal system where it is utilized, as much as possible, for irrigation (TID 1997).

B.2 GROUNDWATER RESOURCES OF THE MODESTO BASIN

B.2.1 Physical Description of the Modesto Basin

The Modesto Groundwater Basin is located in eastern Stanislaus County, which is part of the northeastern San Joaquin Valley. Elevations range from over 200 feet on the east to less than 40 feet on the west. The location of the Modesto Groundwater Basin is shown on Figure 3.1-1 in Section 3.1. The major physical features in the Modesto Groundwater Basin include the Sierra-Nevada foothills, the broad alluvial plain, and the Stanislaus and Tuolumne rivers that bound the basin on the north and south.

The alluvial and continental deposits constitute two principal aquifers, which are separated by the Corcoran Clay in portions of the Modesto Basin. Although these deposits are characteristically heterogeneous in composition, the interbedded clays, with the exception of the Corcoran Clay, are generally discontinuous. Groundwater in both the shallow alluvial aquifer system overlying the Corcoran Clay and the aquifer system to the east is considered to be unconfined.

B.2.2 Groundwater Balance in the Modesto Basin

Estimates of pumpage during the period of 1972-1993 were compiled from data provided by Modesto Irrigation District (MID) and Oakdale Irrigation District (OID). The Oakdale Irrigation District is divided by the Stanislaus River into the north zone and south zone. The south zone information is described in the Modesto groundwater Basin and the north zone is described in the Eastern San Joaquin County Basin. Data are summarized in Figure B.2-1, which includes estimated pumpage amounts from agricultural irrigation and drainage wells, private and Modesto Irrigation District wells, and municipal water supply wells, including Modesto, Riverbank, and Oakdale public supply wells. Data on pumping from a number of significant sources were not available, including industrial wells, small public water system, rural residential, and rural domestic wells.
B. Groundwater Conditions

Pumpage amounts have varied widely from year to year, peaking in drought years. Pumpage in the project area averaged approximately 160,000 acre-feet per year in the basin from 1970 through 1990 (FGMP MID 1996). An overall upward increase in annual groundwater use is observed, which roughly corresponds to the increase in pumpage from urban areas. Of the 160,000 acre-feet average amount, approximately 44,000 acre-feet per year was in the Modesto area; 7,000 acre-feet per year from other smaller urban areas; and 109,000 acre-feet per year from MID, OID, and privately-owned irrigation and drainage wells. By 1994, pumpage in the Modesto urban area increased to around 60,000 acre-feet, and pumpage in the other smaller urban areas increased to approximately 8,000 acre-feet, for a total municipal pumping rate of approximately 68,000 acre-feet in the Basin. These rates do not include the city of Oakdale, OID’s small public water system, or the numerous private domestic wells located throughout the Basin.

B.2.2.1 Groundwater Balance Calculations by DWR

The Department of Water Resources (DWR) Bulletin 160-93, *California Water Plan Update* published in October 1994, included an estimate of various components of the groundwater balance for the Modesto Basin. The components included:

- Groundwater extraction: 236,000 acre-feet per year
- Overdraft: 15,000 acre-feet per year
- Perennial Yield: 221,000 acre-feet per year

DWR defines overdraft as “the condition of a groundwater basin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years during which water supply conditions approximate average conditions.” Perennial yield is the maximum quantity of water that can be annually withdrawn from a groundwater basin over a long period of time (during which water supply conditions approximate average conditions) without developing an overdraft condition. The perennial yield was estimated by DWR by plotting the change in groundwater level against the amount of groundwater extracted each year over a 13-year period ending in 1982. A best fit curve was drawn and the intersections of the best fit curve with the line showing zero groundwater level change determines the estimated perennial yield of the basin.

B.2.2.2 Groundwater Balance Calculations by HCI Inc.

Table B.2-1 summarizes the average annual values for the various components of inflow and outflow that were utilized in modeling the area that approximates the Modesto Groundwater Basin (Hydrologic Consultants Inc. 1993). The average annual water budget for 1952-91 indicated an average overdraft of 2,300 acre-feet per year. Many inflow and most outflow component values were not directly measured but were estimated. Water level records for the model indicated that the water
B. Groundwater Conditions

levels in most wells in most of the area fell between 1971 and 1991. A slight overdraft was indicated by the water level decline, which averaged approximately 0.5 feet per year (HCI 1993).

Table B.2-1: INFLOW AND OUTFLOW IN THE MODESTO GROUNDWATER BASIN

<table>
<thead>
<tr>
<th>Values Based on 40 Year Average</th>
<th>Acre-Feet per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inflow</strong></td>
<td></td>
</tr>
<tr>
<td>Deep Percolation and Canal Seepage</td>
<td>226,000</td>
</tr>
<tr>
<td>Stream Bed Seepage</td>
<td>19,000</td>
</tr>
<tr>
<td>Modesto Reservoir Seepage</td>
<td>40,000</td>
</tr>
<tr>
<td>Groundwater Inflow</td>
<td>2,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>285,000</strong></td>
</tr>
<tr>
<td><strong>Outflow</strong></td>
<td></td>
</tr>
<tr>
<td>Irrigation and Drainage Well Pumping</td>
<td>100,000</td>
</tr>
<tr>
<td>Municipal Pumping</td>
<td>37,000</td>
</tr>
<tr>
<td>Discharge to Streams</td>
<td>150,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>287,000</strong></td>
</tr>
</tbody>
</table>

Difference Change in Storage: -2,000


MID reports in their 1996 Final Groundwater Management Plan that estimated long term decline in storage, rural plus urban, in the Basin is about 3,000 acre-feet per year. This estimate represents the average reductions in groundwater storage during the base period, and can be considered as overdraft. It should be noted that changes in storage in recent years have greatly exceeded this long term average, due to the 1987-1992 drought (MID 1996).

B.2.3 Groundwater Elevations and Flow Direction

The depth to groundwater in most of the Modesto Basin ranges from less than 5 feet to over 100 feet bgs. The measurement used to collect the data for these maps was collected from approximately 243 wells within and in the vicinity of the Modesto Basin.

Fluctuations of water levels are of two main types, seasonal and long term. These fluctuations are controlled in the project area by irrigation practices, drainage techniques, and local pumpage. In areas of intense pumpage such as around the vicinity of Modesto, the water table declines during the summer and rises during the winter. Long term fluctuations, such as those reported by DWR (HCI
B. Groundwater Conditions

1992) indicated that the Modesto Groundwater Basin represented by DWR’s Detailed Analysis Unit 206 has experienced groundwater level declines of 15.3 feet for the period 1970–90. This decline represents depletion of storage of 404,000 acre-feet.

Figure B.2-2 represents conditions which existed in spring 1985 after a period of relatively high rainfall and runoff. The spring 1994 map (Figure B.2-3), shows conditions after a prolonged period of relatively low rainfall and runoff. These two conditions represent relative extremes in the hydrologic record. In comparing the two water-level elevation maps, the water levels over most of the project areas dropped at least 10 feet from 1984 to 1994. Areas near pumping centers experienced even greater water level declines.

Changes in groundwater levels also affect streamflow in the rivers bordering the basin. Where groundwater elevations at the river are significantly lower than the water surface elevation in the river, streams lose flow through seepage into the groundwater and thus provide recharge. In 1985, the only river section which appeared to be significantly losing stream flow was an approximately five-mile long reach of the Tuolumne River near central Modesto. In 1994, this reach had extended approximately five additional miles to the east. Also in 1994, the entire portion of the Stanislaus River east of Highway 99 was apparently a losing stream (MID 1997).

In 1985, gaining reaches within the Basin included the Stanislaus River east of Riverbank, the Stanislaus River upstream of the confluence with the San Joaquin River, the San Joaquin River, and the Stanislaus River upstream of the San Joaquin confluence.

B.2.4 Projected Basin Water Demand in the Modesto Basin

Projected agricultural and municipal groundwater demands for the MID service area are listed in Table B.2-2. Projections are based on land use, irrigation applications, and population projections. The projections in Table B.2-2 were developed for the MID Irrigation Master Plan.

Table B.2-2: PROJECTIONS OF AGRICULTURAL AND MUNICIPAL GROUNDWATER DEMANDS IN THE MODESTO GROUNDWATER BASIN

<table>
<thead>
<tr>
<th>Year</th>
<th>Agricultural Demands (AF/Yr)</th>
<th>Municipal Demands (AF/Yr)</th>
<th>Total Groundwater Demand (AF/Yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>69,000</td>
<td>39,000</td>
<td>108,000</td>
</tr>
<tr>
<td>2000</td>
<td>94,000</td>
<td>53,000</td>
<td>147,000</td>
</tr>
<tr>
<td>2010</td>
<td>117,000</td>
<td>45,000</td>
<td>162,000</td>
</tr>
</tbody>
</table>
B. Groundwater Conditions

<table>
<thead>
<tr>
<th>Year</th>
<th>Use 1</th>
<th>Use 2</th>
<th>Use 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>147,000</td>
<td>75,000</td>
<td>222,000</td>
</tr>
</tbody>
</table>

Source: Modesto ID 1996

Projections for MID, OID and private agricultural groundwater use could range from approximately 69,000 acre-feet per year in 1995 to between 95,000 and 148,000 acre-feet per year in 2020. The broad interval for projected agricultural groundwater use in 2020 represents uncertainty associated with regulations and cost on local water supplies and the adoption of changing irrigation technologies.

Urban growth is a significant trend in the Modesto area (MID 1996). Urban land use is steadily displacing agricultural land, and with this transition the need for potable water is also projected to increase in the future. Municipal and industrial groundwater uses in the Modesto urban area that include the cities of Modesto and Waterford and the communities of Salida and Empire are projected to increase from about 34,000 acre-feet per year in 1995 to approximately 62,000 acre-feet per year in 2020 (MID 1996). Similarly, urban groundwater production for the cities of Riverbank and Oakdale is expected to increase from about 5,000 acre-feet per year in 1995 to almost 10,000 acre-feet per year in 2020 (Table 3.3-5 in Section 3.3).

B.2.5 Groundwater Quality in the Modesto Basin

According to Hall (1960), the chemical quality of water in the Mehrten is usually good in the northern part of the area, including Riverbank and Oakdale, but may be poor, depending on depth along the Tuolumne River east of Empire. West of Empire and Riverbank, the chemical water quality of the Mehrten is generally very poor. Saline water present in the Mehrten is a mixture of saline brines migrating upwards from the underlying marine layer and the downward percolation of groundwater through the Mehrten.

Groundwater quality within the Modesto Groundwater Basin is generally acceptable for most uses. Problem levels of some constituents, including TDS, nitrates, radionuclides, DBCP and some other trace organics have been found in the groundwater. In addition to the water constituents listed above, some localized areas within the Basin have been contaminated through spills or dumping of hazardous materials. The Basin includes two Superfund sites: the Norris plant located south and east of Riverbank, and Halford Cleaners located in the city of Modesto.

B.2.5.1 Total Dissolved Solids

TDS concentrations in water from most of the wells in much of the project area relatively low, presenting few problems for agricultural or potable uses. Water from wells in the Del Rio, Riverbank, Oakdale, Waterford, and northern Modesto areas have concentrations of TDS below 500 mg/l. TDS Concentrations in water from many of the wells west of Highway 99 are between 500 and 1,000 mg/l.
Some of these would be high enough to affect yields of salt sensitive crops. Most crops in the area, however, would not be affected by these salinity concentrations. A number of scattered wells in Central Modesto also have TDS levels between 500 and 1,000 mg/l. Some of these wells produce at least some of the pumped water from below the Corcoran Clay. These levels exceed recommended levels for drinking water, but are below the maximum allowed.

### B.2.5.2 Nitrates

A large zone of nitrate concentrations ranging from 64 to 96 mg/l was found in seven wells beneath the western part of the basin in the early 1990s. The eastern boundary of this zone is approximately three miles west and parallel to Highway 99.

A second zone of nitrate concentrations exceeding the MCL was detected in groundwater samples collected from wells tapping groundwater beneath the city of Modesto in the area north of the Tuolumne River and West of Highway 99. Water from six wells in this area had nitrate concentrations between 47 to 86 mg/l in the early 1990s. Most of this high nitrate area coincides with the former City sewage effluent disposal area. The remaining areas of high nitrate concentrations appear to be relatively localized point sources located near the Tuolumne River.

### B.2.5.3 Arsenic

Arsenic concentrations in water from public water supply wells in the Modesto Groundwater Basin are generally below the current MCL of 0.05 mg/l. However, the EPA is expected to lower the MCL for arsenic to as low as 0.002 to 0.005 mg/l, which will have a considerable impact to groundwater supplies for drinking water. In fact, the lowest MCL considered by EPA is higher than natural levels of arsenic that are present in groundwater in the basin. Much of the deeper groundwater will then be unusable for public supply without arsenic removal.

### B.2.5.4 Iron and Manganese

Groundwater in the western part of the Basin near the San Joaquin River frequently has high concentrations of naturally occurring iron. Deeper groundwater is also found to have elevated levels of iron and manganese. Shallow groundwater near streams often show high levels of manganese and sometimes high iron concentrations.

### B.2.5.5 Radionuclides

Groundwater with high uranium activities has been found in part of Modesto and in Empire. The occurrences are indicated to be natural and are based on available data (MID 1997). The largest area appears to be in Modesto. Uranium activity in water from six wells ranged from 20 to 37 picocuries
B. Groundwater Conditions

per liter in 1994. Most of the area with high uranium concentrations is east of Highway 99 and northwest of Dry Creek. Two north-northeast trending bands are present in this area, and are suggestive of buried stream channel deposits. The EPA has discussed establishing a standard for radon in drinking water.

B.2.5.6 Pesticides

DBCP has contaminated the groundwater in portion of the basin, exceeding the MCL in three areas. The largest area is in eastern Modesto and Empire. Most of this area is located between MID Lateral 3 and the Tuolumne River. The western edge of this area is several miles northeast of Highway 99. The area extends about five to six miles from east to west, and from two to three miles from north to south. Water from seven wells in this area exceeded the MCL.

Central Modesto has relatively large area of high DBCP concentrations, primarily northeast of Highway 99. High DBCP concentrations have also been detected south of Del Rio. DBCP concentrations ranged from about 0.3 to 0.5 ug/l in water from three wells in this area. DBCP has been detected in groundwater in several other areas of the basin, including Waterford and West Modesto, but at concentrations less than the MCL. The Riverbank and Oakdale areas have not had DBCP contamination problems, based on available data.

B.2.5.7 Other Trace Organics

Other trace organic compounds have been detected in the groundwater in and around the Modesto area. These include the nematacide, EDB, carbon tetrachloride, and petroleum products from such sources such as underground storage tank leaks. Volatile organic compounds (VOCs) derived primarily from solvents have locally contaminated the groundwater in a number of places in and around the city of Modesto. Some of these can be attributed to dry-cleaning establishments and other industries that used solvents. Perchloroethylene (PCE) has been detected at one time or another in nine of the city of Modesto’s wells. Industrial wastes and dry cleaners are a recognized source of PCE in groundwater in some urban areas, such as Turlock and Merced. Several fuel leaks from USTs have also occurred in and around the Modesto area. Most of these cases are very localized in terms of groundwater impacts, and public water supply wells are not known to have been affected. The extent of MTBE in groundwater within the basin has not been fully evaluated.

B.2.6 Land Subsidence in the Modesto Basin

Currently ground subsidence is not a problem within the MID service area.

B.2.7 Agricultural Subsurface Drainage and Waterlogging in the Modesto Basin

Final EIS/EIR
APP_B.DOC
January 28, 1999
B-15
B. Groundwater Conditions

Drainage wells have been employed by MID to control shallow groundwater levels in the western part of the MID service area since 1918 (MID 1996). The drainage wells are pumped to maintain groundwater levels below the crop root zone which allows the leaching of naturally occurring salts from the root zone. The area affected by shallow groundwater has declined through the years because of the increased use of groundwater in the Modesto urban area. The use of drainage wells in areas no longer affected by shallow groundwater has been discontinued or the wells are now used as irrigation wells (MID 1996).

B.3 GROUNDWATER RESOURCES OF THE MERCED GROUNDWATER BASIN

B.3.1 Physical Description of the Merced Groundwater Basin

The Merced Groundwater Basin lies on the eastern side of the San Joaquin Valley, located entirely within Merced County, and is generally described as the eastern one-half of Merced County. The groundwater system is bounded by the Merced River on the north, the San Joaquin River on the west, and the Chowchilla River on the south, as shown in Figure 3.1-1 in Section 3.1.

Four aquifers have been identified beneath the Merced area by the United States Geological Survey (Page 1977). From deepest to shallowest, they are as follows:

• The Mehrten Formation which is a maximum thickness of 700 feet and is composed of sandstone, siltstone, and claystone. The hydraulic conductivity is low to moderate, and the TDS is greater than 2,000 ppm throughout the area.

• A confined aquifer between the Mehrten Formation and the base of the Corcoran Clay which reaches a maximum thickness of 700 feet and is composed of gravels, sand, silt and clay. The hydraulic conductivity is moderate to high, and the TDS is generally less than 2,000 ppm, except in the far western portion of the area.

• An intermediate aquifer above the Corcoran Clay and below the shallow clay with a maximum thickness of 700 feet and is composed of gravels, sand, silt and clay. The hydraulic conductivity is moderate to high, and the TDS is generally less than 2,000 ppm.

• A shallow unconfined aquifer with a maximum thickness of 100 feet that is composed of gravels, sand and fine sand. The hydraulic conductivity is moderate to high, and the TDS is generally less than 2,000 ppm.

B.3.2 Groundwater Balance in the Merced Groundwater Basin
B. Groundwater Conditions

The total annual application of groundwater for irrigation purposes varies from year to year depending on the availability of surface water. Table B.3-1 displays agricultural water usage. Groundwater supplies an average of fifty-one percent of the total irrigation water applied to land within the basin, or approximately 621,000 acre-feet per year. Deep percolation of groundwater used for irrigation returns a portion of the extracted groundwater to the aquifer.

Table B.3-1: AVERAGE ANNUAL AGRICULTURAL USAGE IN THE MERCED GROUNDWATER BASIN.

<table>
<thead>
<tr>
<th>Agency</th>
<th>Surface Water</th>
<th>Groundwater</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AF/Yr</td>
<td>Percent</td>
<td>AF/Yr</td>
</tr>
<tr>
<td>Merced Irrigation District</td>
<td>522,000</td>
<td>96.3</td>
<td>20,000</td>
</tr>
<tr>
<td>Individual Growers, MID, &amp; SOI</td>
<td>–</td>
<td>0.0</td>
<td>510,000</td>
</tr>
<tr>
<td>LeGrand-Athlone Water District</td>
<td>5,000</td>
<td>6.8</td>
<td>68,800</td>
</tr>
<tr>
<td>Merquin Water District</td>
<td>22,000</td>
<td>88.0</td>
<td>3,000</td>
</tr>
<tr>
<td>Stevinson Water District</td>
<td>26,400</td>
<td>100.0</td>
<td>–</td>
</tr>
<tr>
<td>Turner Island Water District</td>
<td>–</td>
<td>0.0</td>
<td>–</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>575,400</td>
<td>48.9</td>
<td>601,800</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Agency</th>
<th>Surface Water</th>
<th>Groundwater</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AF/Yr</td>
<td>Percent</td>
<td>AF/Yr</td>
</tr>
<tr>
<td>Atwater Canning (effluent)</td>
<td>350</td>
<td>100.0</td>
<td>–</td>
</tr>
<tr>
<td>City of Atwater WWTP (effluent)</td>
<td>4,050</td>
<td>100.0</td>
<td>–</td>
</tr>
<tr>
<td>City of Merced WWTP (effluent)</td>
<td>7,525</td>
<td>100.0</td>
<td>–</td>
</tr>
<tr>
<td>Lipton/Ragu (effluent)</td>
<td>815</td>
<td>100.0</td>
<td>–</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>12,740</td>
<td>100.0</td>
<td>–</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grand Total</th>
<th>AF/Yr</th>
<th>Percent</th>
<th>AF/Yr</th>
<th>Percent</th>
<th>AF/Yr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>588,140</td>
<td>49.4</td>
<td>601,800</td>
<td>50.6</td>
<td>1,189,940</td>
</tr>
</tbody>
</table>


From approximately 1890 to 1915, the city of Merced used surface water conveyed by pipeline from Lake Yosemite for its primary supply. Since about 1915, all municipal consumers within the Basin have relied solely on groundwater as the source of supply. The municipal suppliers (major utilities) within the Basin are: the cities of Merced, Atwater, and Livingstone; the Winton Water and Sanitary
B. Groundwater Conditions

District; the Planada and Le Grand Community services districts; the Black Rascal Mutual Water Company and the Meadowbrook Water Company. In 1996, 36,134 acre-feet was produced by the water utilities (Table B.3-2). The city of Merced is the largest municipal water producer, with 57 percent of the total. An additional estimated 3,866 acre-feet was produced by small private residential water systems, commercial business and industrial plants not served by the major utilities.

Table B.3-2: GROUNDWATER USAGE BY MUNICIPALITIES IN THE MERCED GROUNDWATER BASIN

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Rascal Water</td>
<td>320</td>
<td>43</td>
<td>0.4%</td>
<td>366</td>
</tr>
<tr>
<td>City of Atwater</td>
<td>21,133</td>
<td>2,367</td>
<td>20.1%</td>
<td>307</td>
</tr>
<tr>
<td>City of Livingston</td>
<td>10,490</td>
<td>1,491</td>
<td>12.7%</td>
<td>389</td>
</tr>
<tr>
<td>City of Merced</td>
<td>61,187</td>
<td>6,729</td>
<td>57.2%</td>
<td>301</td>
</tr>
<tr>
<td>Le Grand CSD</td>
<td>-</td>
<td>-</td>
<td>0.0%</td>
<td>-</td>
</tr>
<tr>
<td>Meadowbrook</td>
<td>3,960</td>
<td>359</td>
<td>3.0%</td>
<td>248</td>
</tr>
<tr>
<td>Planada CSD</td>
<td>3,500</td>
<td>275</td>
<td>2.3%</td>
<td>215</td>
</tr>
<tr>
<td>Winton Water &amp; San.</td>
<td>9,000</td>
<td>511</td>
<td>4.3%</td>
<td>155</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>109,590</strong></td>
<td><strong>11,774</strong></td>
<td><strong>100.00%</strong></td>
<td><strong>294</strong></td>
</tr>
</tbody>
</table>


The various components of the groundwater balance for the Merced Basin were estimated from data supplied in the Merced Groundwater Basin, Groundwater Management Plan (Merced ID 1997). The components included:

- Groundwater extraction: 637,974 acre-feet per year
- Overdraft: 20,000 acre-feet per year
- Perennial Yield: 617,974 acre-feet per year

DWR defines overdraft as “the condition of a groundwater basin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years.
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during which water supply conditions approximate average conditions.” Perennial yield is the maximum quantity of water that can be annually withdrawn from a groundwater basin over a long period of time (during which water supply conditions approximate average conditions) without developing an overdraft condition.

B.3.3 Groundwater Elevations and Flow Direction

Groundwater is found at shallow to moderate depths in the Merced Basin. Since 1982, the depths to water ranged from 1 to 15 feet bgs in the city of Merced and up to 100 feet bgs in the El Nido area.

Figures B.3-1, B.3-2, and B.3-3 show the elevations of groundwater in the fall of 1974, the spring of 1988, and the fall of 1990. The 1974 contours are believed to represent steady state conditions; the 1988 and 1990 groundwater contours are representative of drought conditions (Luhdorff and Scalmanini 1991). The 1994 contours indicate that flow is towards the west-southwest in the areas where levels were contoured. The contours are relatively evenly spaced and straight, indicating uniform flow across the contoured area.

B.3.3.1 Fluctuations in Groundwater Elevations

There is a strong seasonal variation on the order of up to 4 feet with depths to water the shallowest during the summer irrigation season. Long term water level data indicates that the Merced Groundwater Basin has experienced groundwater level declines of up to 40 feet during the period 1960-92. This decline represents depletion of storage of 404,000 acre-feet.

B.3.3.2 Recharge

The Merced Groundwater Basin is part of the larger San Joaquin Basin system, and edge effects along the boundaries of the Modesto Groundwater basin cause impacts to the Basin. The hydrologic system includes not only the groundwater system but also the agricultural and urban land surface system. The latter systems comprise all of the processes that affect the delivery, consumption, and recharge of groundwater within agricultural and urban areas. Deep percolation of applied surface water to agricultural areas, is the major sources of groundwater recharge for the Basin. Precipitation also is an important source of water to the larger hydrologic system, but only a small proportion of groundwater recharge occurs as a result of precipitation.

B.3.4 Projected Basin Water Demand

Agricultural land within the Basin uses an average of 1,272,400 acre-feet per year. On the average, the total crop-water requirement is comprised of approximately fifty percent or 640,800 acre-feet of groundwater. Overall, the Basin’s agricultural acreage is expected to modestly increase, although
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total water use will decline because of increased water use efficiency and a trend toward cultivation of lower water use crops.

The population and developed municipal acreage are projected to triple by the year 2030 (Merced ID 1997). Using current population trends, as determined by Merced County Association of Governments, the regional planning agency, the Basin’s population is expected to increase from 180,000 in 1996 to over 540,000 by 2030 with developed acreage increasing proportionately. As a result, the average daily urban water use is expected to increase from 35.6 million gallons per day (MGD) in 1996 to 108 MGD in the year 2030. In addition, the majority of municipal/industrial demand is projected to be concentrated along the Highway 99 corridor. If groundwater remains the sole source of municipal supply, it is estimated that 72 new wells will be required to serve the cities of Atwater, Livingston, and Merced and the University of California Merced campus (Merced ID 1997).

B.3.5 Groundwater Quality in the Merced Groundwater Basin

There are numerous constituents detected in the Merced Groundwater Basin groundwater supply. Some constituents are naturally occurring, while others have been introduced into the groundwater from man-made sources. The constituents identified in this section either currently impact groundwater usage within the Basin or have the potential to impact the Basin’s future groundwater usage.

B.3.5.1 Total Dissolved Solids

TDS in groundwater in the eastern two-thirds of the Basin are generally less than 500 ppm. TDS increases westward towards the San Joaquin River and southward towards the Chowchilla River. In these areas, high TDS water is found in wells deeper than 350 feet. Higher quality groundwater (less than 1,000 ppm) in these areas is found at shallower depths.

Groundwater with high TDS concentrations in the Basin is principally the result of the migration of a deep, saline water body which originates in regionally deposited, marine sedimentary rocks that underlie the San Joaquin Valley. Groundwater with high TDS is present beneath the entire Basin at depths from about 400 feet in the west to over 800 feet in the east. The shallowest high TDS groundwater occurs in zones five to six miles wide adjacent and parallel to the San Joaquin River and the lower part of the Merced River west of Milam, where high TDS groundwater is upwelling.

B.3.5.2 Nitrates

Natural nitrate concentrations in groundwater range from 0.1 to 10 mg/l (Driscoll, 1986). The Meadowbrook Water Company has one well that, based on 10-year trend analysis, is expected to
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reach the MCL (45 mg/L) in 10 to 12 years. The Planada Community Services District has two wells that are at or near the MCL.
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B.3.5.3 Arsenic

Arsenic concentrations in water from public water supply wells in the Basin are below the current MCL of 0.05 mg/l. However, the EPA is expected to lower the MCL for arsenic to as low as 0.002 to 0.005 mg/l, which will have a considerable impact to groundwater supplies for drinking water.

B.3.5.4 Iron and Manganese

Groundwater in some areas within the Basin has elevated iron and manganese. Manganese is found near the Merced Airport at relatively shallow depths (Merced ID 1997).

B.3.5.5 Pesticides

The MCL for DBCP is 0.2 micrograms per liter (µg/l). DBCP has been detected in groundwater samples from public water supply wells in the Merced area at levels at or below the MCL. Another agricultural pesticide (nematicide) that has been detected in the Basin’s groundwater is EDB. EDB was banned in the early 1980s, but has been detected in at least one public water supply well and individual wells in the Atwater/Livingston area.

B.3.5.6 Organics

Trichloroethylene (TCE) has been detected in groundwater samples from two locations within the Basin, Castle Airport & Aviation & Development Center and Merced’s Eastern Industrial Park. Both sites have identified plumes and have remediation activities in progress (Merced ID 1997). One of the city of Merced’s municipal water supply wells (No. 10A) was replaced in 1988 when TCE was detected in concentrations exceeding the MCL.

PCE has been detected at one time or another in some of the Basin’s public water supply wells. Industrial wastes and dry cleaners are a recognized source of PCE in groundwater in many municipal areas, including Merced. Beginning in 1986, PCE was detected in three of the City of Merced’s wells. As a result, these three wells were replaced or rebuilt in the late 1980s.

Several fuel leaks from USTs have also occurred in and around the Modesto Area. Most of these cases are very localized in terms of groundwater impacts, and public water supply wells are not known to have been affected. The extent of MTBE in groundwater within the basin has not been fully evaluated.
B. Groundwater Conditions

B.3.6 Land Subsidence in the Merced Groundwater Basin

Ground subsidence is not currently a significant problem in the Merced Groundwater Basin. The groundwater basin is projected to continue to be overdrafted as a result of groundwater extraction rates exceeding recharge rates. Water levels within the Merced ID Groundwater Basin are projected to continue to decline, which could result in a loss of aquifer storage and localized land subsidence.

B.3.7 Agricultural Subsurface Drainage and Waterlogging in the Merced Groundwater Basin

The area of the Basin located generally between the cities of Atwater and Livingston, south of State Highway 99 and north of State Highway 140, has experienced localized high groundwater levels. Groundwater levels have varied from year to year and over the course of an irrigation season as a result of pumping, precipitation, and applied irrigation water.

To minimize these potentially adverse impacts, Merced ID provided groundwater control or “drainage pumping” in areas where groundwater levels were within 6 feet of the ground surface. Ninety-five wells, specifically designed and located for drainage purposes, were used. This localized condition within Merced ID has declined steadily over the past 10 years. As a result, many of the drainage wells are now used for irrigation during periods when insufficient surface water is available. Water pumped from these wells is typically discharged into Merced ID’s water distribution where it is utilized, as much as possible, for irrigation.

B.4 GROUNDWATER RESOURCES IN THE EASTERN SAN JOAQUIN COUNTY GROUNDWATER BASIN

B.4.1 Physical Description of the Eastern San Joaquin County Groundwater Basin

The Eastern San Joaquin County Groundwater Basin (ESJCGB) is located in northeastern San Joaquin Valley, encompassing agricultural land and a few urban centers (Figure 3.1-1 in Section 3.1). The major physical features in the Basin include the Sierra-Nevada foothills, the broad alluvial plain, and the Stanislaus River. Both the Stanislaus and other tributaries draining from the Sierra Nevada flow in a southwesterly to westerly direction and discharge into the San Joaquin River which in turn flows northwestward to the Sacramento-San Joaquin Delta.

The ESJCGB contains three important hydrogeologic formations — the Victor, Laguna, and Mehrten Formations. The Victor formation is the uppermost formation ranging from ground level down to 150 feet. The Victor formation is coarser grained than the underlying formations, as a result, surface waters migrate down through the Victor Formation and enter the deeper formations (SSJID 1994). The Laguna Formation is estimated to be 600 to 1000 feet thick composed of discontinuous lenses.
B. Groundwater Conditions

of unconsolidated to semi-consolidated sands and silts with lesser amounts of gravel and silt (SSJID 1994). This formation has a moderate permeability. Below the Laguna formation lies the Mehrten formation composed of semi-consolidated to consolidated silts, sands and gravels. Within the ESJCGB the formation is found 800 to 1,100 feet bgs and is approximately 600 feet thick.

The Valley Springs Formation underlies the Mehrten Formation and contains saline water of marine origin. This formation is not used for water supply.

B.4.2 Groundwater Balance of the ESJCGB

This section includes a review of groundwater pumpage estimates and water usage of the two irrigation districts within the ESJCGB — the South San Joaquin Irrigation District (SSJID) and Oakdale Irrigation District (OID). The Stanislaus River divides the OID into a northern section and a southern section. The northern section is described herein. This section also summarizes a review of a previous groundwater budget by UMA Engineering Inc, 1988. Tables B.4-1 and B.4-2 display the water budget for the SSJID and the OID.
## B. Groundwater Conditions

Table B.4-1: SOUTH SAN JOAQUIN IRRIGATION DISTRICT WATER BUDGET (1979-1998)

<table>
<thead>
<tr>
<th>Water Supply</th>
<th>Water Budget (AF)</th>
<th>Groundwater Budget (AF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflow to Woodward Reservoir</td>
<td>272,000</td>
<td></td>
</tr>
<tr>
<td>Seepage from Woodward Reservoir</td>
<td>(20,000)</td>
<td>20,000*</td>
</tr>
<tr>
<td>Evaporation from Woodward Reservoir</td>
<td>(12,000)</td>
<td></td>
</tr>
<tr>
<td>Precipitation onto Woodward Reservoir</td>
<td>5,000</td>
<td></td>
</tr>
<tr>
<td><strong>Net Available Water at Woodward:</strong></td>
<td><strong>245,000</strong></td>
<td></td>
</tr>
<tr>
<td>Canal Seepage</td>
<td>(10,000)</td>
<td>10,000</td>
</tr>
<tr>
<td>Canal Evaporation</td>
<td>(1,000)</td>
<td></td>
</tr>
<tr>
<td>Main Canal Spills</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Intercepted Flows from OID</td>
<td>8,100</td>
<td></td>
</tr>
<tr>
<td><strong>Total Surface Water Supply:</strong></td>
<td><strong>240,100</strong></td>
<td></td>
</tr>
<tr>
<td>Total Rainfall</td>
<td>89,000</td>
<td></td>
</tr>
<tr>
<td><strong>Total Available Water Supply to Farm:</strong></td>
<td><strong>371,500</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Water Uses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crop ET</td>
<td>(172,000)</td>
<td></td>
</tr>
<tr>
<td>Evaporation from Soil and Water Surfaces</td>
<td>(23,900)</td>
<td></td>
</tr>
<tr>
<td>Runoff and Surface Water Return</td>
<td>(57,000)</td>
<td></td>
</tr>
<tr>
<td>Other Losses</td>
<td>(14,000)</td>
<td></td>
</tr>
<tr>
<td>Deep Percolation of Rain and Applied Water</td>
<td>(104,600)</td>
<td>104,600</td>
</tr>
<tr>
<td><strong>Subtotal:</strong></td>
<td><strong>(371,500)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Other Groundwater Budget Components</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Table Pumping</td>
<td>(3,400)</td>
<td></td>
</tr>
<tr>
<td>Groundwater Storage Decline</td>
<td>4,000</td>
<td></td>
</tr>
<tr>
<td><strong>Net Groundwater Outflow:</strong></td>
<td><strong>72,800</strong></td>
<td></td>
</tr>
</tbody>
</table>

Source: *South San Joaquin Irrigation District Groundwater Management Plan, 1994*
B. Groundwater Conditions

Notes: Numbers in ( ) are negative.

*Seepage flows north of district (not included in groundwater budget).

Table B.4-2: OAKDALE IRRIGATION DISTRICT STUDY AREA NORTH

<table>
<thead>
<tr>
<th>Water Supply</th>
<th>Water Budget (AF/Yr)</th>
<th>Groundwater Budget (AF/Yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Main Canal</td>
<td>114,000</td>
<td></td>
</tr>
<tr>
<td>Gambini Pump</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>Groundwater Pumping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Private Wells</td>
<td>20,000</td>
<td>(20,000)</td>
</tr>
<tr>
<td>- District Wells</td>
<td>5,000</td>
<td>(5,000)</td>
</tr>
<tr>
<td>- Reclamation Wells</td>
<td>10,000</td>
<td>(10,000)</td>
</tr>
<tr>
<td>Precipitation</td>
<td>37,500</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water Uses</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop Evapotranspiration</td>
<td>(72,000)</td>
<td></td>
</tr>
<tr>
<td>Evaporation Losses</td>
<td>(18,800)</td>
<td></td>
</tr>
<tr>
<td>Canal Seepage</td>
<td>(13,000)</td>
<td>13,000</td>
</tr>
<tr>
<td>Surface Runoff</td>
<td>(33,000)</td>
<td></td>
</tr>
<tr>
<td>Urban Losses</td>
<td>(1,000)</td>
<td></td>
</tr>
<tr>
<td>Reclaimed Well Water Delivered Outside Study Area</td>
<td>(1,600)</td>
<td></td>
</tr>
<tr>
<td>Return Flows to SSJID Canal</td>
<td>(6,100)</td>
<td></td>
</tr>
</tbody>
</table>

| Net Deep Percolation of Precip and Applied Water | (41,500) | 41,500 |
| Observed Change in Groundwater Storage          | 3,000    |       |
| Seepage From Woodward Reservoir                 | 20,000   |       |

| Net Groundwater Outflow                   | (36,500) |       |

Source: South San Joaquin Irrigation District Groundwater Management Plan, 1994

Note: Numbers in ( ) are negative
B. Groundwater Conditions

B.4.2.1 Surface Water

The surface water supply budget for SSJID is estimated by the inflow into Woodward Reservoir. The average inflow between 1979 and 1988 was 272,000 acre-feet. Precipitation onto Woodward Reservoir contributes an additional 5,000 acre-feet. Subsurface drainage lost in the reservoir is estimated at 20,000 acre-feet per year. This is removed from the available surface water supply but is not included in the ground water budget because the water flows north, away from SSJID and towards the pumping depression east of Stockton. Another 12,000 acre-feet is lost to evaporation.

The surface water supply for OID averages 115,000 acre-feet per year. This includes 114,000 acre-feet in the North Main Canal and 500 acre-feet from the Stanislaus River. SSJID intercepts about 6,100 acre-feet of OID’s return flows annually. Combining surface water gains and losses from SSJID and OID, the total available surface water supply in the Eastern San Joaquin County Basin is 355,000 acre-feet.

B.4.2.2 Groundwater

Agricultural pumping of all the irrigation wells in the SSJID produced an annual discharge of 32,400 acre-feet. The cities of Manteca, Ripon and Escalon rely entirely on groundwater and annually pump an average of 16,200 acre-feet per year (SSJID 1994).

Groundwater pumping from OID produced an annual discharge of 35,000 acre-feet. Private wells, district wells and reclamation wells produced 20,000 acre-feet, 5,000 acre-feet, and 10,000 acre-feet respectively.

Combined, SSJID and OID pump approximately 83,600 acre-feet annually. This represents a storage decline of 7,000 acre-feet.

B.4.2.3 Water Use

Consumptive use by vegetation via evapotranspiration on agricultural lands accounts for 244,000 acre-feet per year. Evaporation loss from soil and water surfaces accounts for 42,700 acre-feet per year. Surface water return flows and runoff account for 96,100 acre-feet per year. This includes urban rainfall runoff, irrigation spills, and surface runoff from rainfall. Other losses include municipal and industrial water uses. These uses consume approximately 17,200 acre-feet per year. The net groundwater outflow from the ESJCB is the net change of all inputs and outputs. Approximately 108,800 acre-feet per year leaves ESJCGB. Much of this water migrates north to the pumping depression east of Stockton. Some of the water flows west toward the San Joaquin River (SSJID 1994).
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B.4.3 Fluctuations in Groundwater Elevations

Within the ESJCGB, groundwater flows southeast to northwest (SSJID 1993). Groundwater elevations in the project area are controlled by natural recharge in the winter and spring and irrigation practices, drainage techniques, and local pumpage in the summer and fall. Since 1964, groundwater levels within the SSJID district have declined 20 to 30 feet, with about 10 feet occurring between 1987 and 1993 (Kreinberg 1994). The majority of this decline has occurred in the central and eastern areas of the district, possibly a result of the cone of depression east of Stockton. North of SSJID and the area between Manteca and Lathrop water levels in the fall dropped below sea level. Water levels south of Manteca, along the Stanislaus River, remained relatively constant between the spring and fall measurements.

Wells in the OID service area show a seasonal fluctuation of five feet between fall and spring levels.

B.4.3.1 Recharge

The groundwater under the ESJCGB is recharged from four general sources: the Stanislaus River, groundwater inflow from the foothill areas, irrigation and precipitation, and the recharge ponds within the SSJID.

B.4.4 Projected ESJCGB Water Demand

Urban growth is a significant trend in the San Joaquin drainage. Urban land use is steadily displacing agricultural land. Associated with this transition is the need for increased potable water. The Eastern San Joaquin groundwater study, October 1985, estimated the perennial yield of groundwater to be 1.0 acre-feet per acre per year. This is a general estimate for the entire county. Perennial or safe yield is the amount of ground water that can be extracted without adversely affecting groundwater levels or water quality.

Currently, the annual water usage within the cities of Ripon, Manteca, and Escalon average 2.5 acre-feet per acre per year. As a result, groundwater levels are decreasing. Most notably, there is a cone of depression forming around the town of Manteca. This urban demand is estimated to increase to over 58,000 acre-feet at build out (SSJID 1993).

B.4.5 Groundwater Quality of the ESJCGB

The municipal well supplies, as required by the Department of Health Services, monitors groundwater quality. Otherwise, groundwater quality is not monitored. The water quality monitoring show increasing levels of both organic and inorganic contaminants. The primary inorganic contaminant in the well water for the city of Manteca is nitrates. Low levels of DBCP have also been detected. The
B. Groundwater Conditions

wells supplying water for Ripon have also experienced elevated levels of nitrate. As a result, several wells have been closed. Trace levels of organic contaminants have also been detected in Ripon’s wells (SSJID 1994). The town of Escalon has experienced elevated levels of nitrates and DBCP in their shallow wells (250-300 feet). Escalon has constructed several new wells, withdrawing ground water from 600 feet deep. Contaminants in the deeper wells have not been detected.

B.4.6 Land Subsidence in the ESJCGB

Ground subsidence is not reported to be a significant problem in the ESJCGB. Overdrafting in urban areas located within and adjacent to the SSJID service area water levels may cause localized ground subsidence and loss of groundwater storage as groundwater levels decline.

B.4.7 Agricultural Subsurface Drainage in the ESJCGB

Agricultural subsurface drainage is not a significant problem in the ESJCGB. Agricultural subsurface drainage and the associated problems may be a problem in isolated areas immediately adjacent to the San Joaquin River.

B.5 GROUNDWATER RESOURCES OF THE EXCHANGE CONTRACTORS WATER AUTHORITY

B.5.1 Physical Description of the Exchange Contractors Service Area

The San Joaquin River Exchange Contractors Water Authority (Exchange Contractors) is a Joint Powers Authority organized under the Joint Exercises of Powers Act. The member agencies are the Central California Irrigation District (CCID), Firebaugh Canal Water District (FCWD), Columbia Canal Company (CCC), and San Luis Canal Company (SLCC). The Exchange Contractors service area lies on the western side of the San Joaquin Valley, and encompasses portions of Fresno, Stanislaus, Merced and Madera counties. The service area is situated along the west bank of the San Joaquin River as shown in Figure 3.1-1 in Section 3.1; the Columbia Canal Company is on the east bank of the San Joaquin River.

The Exchange Contractors service area is located on a broad alluvial plain located approximately at the structural axis of the San Joaquin Valley formed by large coalescing alluvial fans draining the eastern slopes of the Coast Range and western slopes of the Sierra-Nevada. The San Joaquin River flows along the structural axis of the valley and is generally contained between natural and artificial levees. Many shallow natural drainage channels and sloughs meander across overflow lands adjacent to the main river channel.
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Unconfined groundwater flow in the areas west of the San Joaquin River generally moves from the southwest towards the northeast, although groundwater pumpage creates cones of depression and irrigation may cause mounding, complicating the flow patterns and causing them to change with time. The response of the aquifers to changes in pumpage and irrigation is relatively rapid, and flow directions are affected by these changes.

In 1981, groundwater was entering the upper aquifer from upslope areas along virtually all of the west and southwest boundaries of the service area (Schmidt and Associates 1997). West of a north-south line, extending from the Dos Palos Y at Highway 152, groundwater flow was primarily to the northeast or north toward the northern part of the Grassland Water District and the San Joaquin River. In the reach north of an east-west line passing through Gustine, groundwater on both sides of the river flows towards the river. A north-south trending groundwater divide was present just east of Dos Palos. A northeasterly direction of groundwater flow was indicated for the area east of this divide. Groundwater in the upper aquifer east of this divide was moving beneath the San Joaquin River and into the Madera area. This flow was due to extensive groundwater pumping in the Madera area.

In spring 1992, a period of deficient water supply was noted by the development of a cone of depression south of Crows Landing and northeast of Newman (Schmidt and Associates 1997). There was an additional groundwater cone of depression east and southeast of Mendota, which was primarily due to pumping by the Mendota Pool pumpers. The groundwater divide east of Dos Palos had migrated farther west than in Spring 1986, and near where it was located in Fall 1981. Otherwise the regional direction of flow in the upper aquifer was generally the same as in Fall 1981 and Spring 1986.

B.5.2 Groundwater Balance in the Exchange Contractors Service Area

The groundwater system in the southern San Joaquin Valley provides a supply of irrigation water when surface deliveries to the area are reduced due to hydrologic conditions. The groundwater system in the Exchange Contractors service area is divided into two aquifers divided by the Corcoran Clay. The groundwater components which influence the groundwater supply are shown in Figure B.5-1.

The long-term hydrogeographic record for the Exchange Contractors service area shows that groundwater is in balance or is rising (See Figures B.5-2, B.5-3, B.5-4 and B.5-5). Table B.5-1 summarizes the long-term water level trends in the Exchange Contractors service area. The predominant trend for water levels in groundwater production wells tapping strata above the Corcoran Clay in
B. Groundwater Conditions

Sub-Areas A, B, and E is long-term constancy. In Sub-Area C, about half of the wells have rising water levels, and the remainder have relatively constant water levels. In Sub-Areas F, G, and I, the predominant long-term trend in the wells tapping strata above the Corcoran Clay is one of rising water levels. On the long-term, water levels in most wells tapping strata below the Corcoran Clay were rising prior to 1989, except in Sub-Area B. In that sub-area, about half of the wells surveyed had no long-term water-level change. In Sub-Areas D, E, and G, little pumpage comes from the strata below the Corcoran Clay.

Table B.5-1: Long-Term Groundwater Trends in the Exchange Contractors Service Area (Prior to 1990)¹

<table>
<thead>
<tr>
<th>Sub-Area ²</th>
<th>Above Corcoran Clay</th>
<th>Below Corcoran Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>80% Constant 20% R ising</td>
<td>33% Constant 66% R ising</td>
</tr>
<tr>
<td>B</td>
<td>70% Constant 20% R ising 10% F falling</td>
<td>50% Constant 50% R ising</td>
</tr>
<tr>
<td>C</td>
<td>45% Constant 55% R ising</td>
<td>100% R ising</td>
</tr>
<tr>
<td>D</td>
<td>No wells with long-term hydrographs, except very shallow</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>80% Constant 20% R ising</td>
<td>No hydrographs</td>
</tr>
<tr>
<td>F &amp; I</td>
<td>25% Constant 75% R ising</td>
<td>100% R ising</td>
</tr>
<tr>
<td>G</td>
<td>25% Constant 75% R ising</td>
<td>No hydrographs</td>
</tr>
<tr>
<td>DMC Pumpers</td>
<td>25% Constant 25% R ising 50% F falling</td>
<td>100% R ising</td>
</tr>
</tbody>
</table>
B. Groundwater Conditions

Source: SJRECWA 1998

1. Trends are prior to 1990, and the effects of pumpage by DMC and Mendota Pool pumpers are not known.
2. See Figures B.5-2, B.5-3, B.5-4 and B.5-5 for locations of the sub-areas.

Even during the recent drought, the groundwater basin supported significantly increased groundwater usage. The groundwater usage during drought years averages 1.1 acre-feet per acre. Groundwater pumpage during normal years averages 0.6 acre-feet per acre.

Groundwater recharge to the Exchange Contractors service area occurs from several sources including:

- Subsurface lateral flow
- Creeks
- Surface Irrigation
- Precipitation

Table B.5-2 summarizes the annual average groundwater inflow/outflow within the service area for the period 1993-1996.

<table>
<thead>
<tr>
<th>Source Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inflows</strong></td>
<td>Acre-feet Per Year</td>
</tr>
<tr>
<td>Subsurface Lateral Recharge (Rainfall, Creeks)</td>
<td>80,000</td>
</tr>
<tr>
<td>Canal Seepage</td>
<td>102,000</td>
</tr>
<tr>
<td>Deep Percolation/L Leaching Reqmt.</td>
<td>112,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>318,500</td>
</tr>
<tr>
<td><strong>Outflows</strong></td>
<td></td>
</tr>
<tr>
<td>Subsurface Lateral</td>
<td>116,000</td>
</tr>
<tr>
<td>Municipal Pumpage</td>
<td>16,500</td>
</tr>
<tr>
<td>Vertical Through the Corcoran Clay</td>
<td>42,000</td>
</tr>
<tr>
<td>Agricultural Pumpage</td>
<td>144,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>318,500</td>
</tr>
<tr>
<td><strong>Net Change in Groundwater Storage</strong></td>
<td></td>
</tr>
</tbody>
</table>
B. Groundwater Conditions

### B.5.3 Projected Basin Water Demand in the Exchange Contractors Service Area

The projected agricultural demand for groundwater in the Exchange Contractors service area is static (SJRECWA 1998, personal communication). There are over 500 agricultural wells in the service area, and little or no expansion of the existing groundwater production well field is projected.

The Exchange Contractors project an increased demand for municipal water supply wells over the next 20 years. Currently, the average annual groundwater production rate from municipal wells within the service area is 16,500 acre-feet. That figure is projected to double by the year 2020 (SJRECWA 1998, personal communication).

The Exchange Contractors portion of the San Joaquin River Agreement flow is estimated at 11,000 acre-feet annually. That equates generally to 11 wells pumping 1,000 acre-feet per year each or approximately two percent of the 500 wells in the service area. The amount of groundwater pumpage ranges from 0.6 to 11 acre-feet per year depending on the hydraulic conditions. This equates to 144,000 acre-feet (normal year) to 264,000 acre-feet (dry year). The 11,000 acre-feet ranges from eight percent to two percent, respectively, of the total pumpage depending on the year type.

### B.5.4 Groundwater Quality in the Exchange Contractors Service Area

The Exchange Contractors report water quality issues within their service area occur only in urban areas. High manganese concentrations have been detected from groundwater samples collected from wells in Firebaugh and Mendota. The city of Dos Palos developed a surface water quality problem because of the poor quality of groundwater. The Exchange Contractors report that localized areas west and southwest of their boundaries contain poor quality water (SJRECWA 1997).

### B.5.5 Land Subsidence in the Exchange Contractors Service Area

Subsidence occurs in the western San Joaquin Valley where land that had been used for grazing or dry farming was converted to irrigated agriculture. Subsidence in the San Joaquin Valley results...
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from lowered groundwater elevations and the subsequent compaction of the deterred soil interstitial spaces. Between 1920 and 1970, 5,200 square miles in the valley had subsided more than one foot. Land subsidence is a significant problem in the western San Joaquin Valley in the San Joaquin River basin. The largest of the three land subsidence areas in the San Joaquin Valley is the 2,600 square mile Los Banos-Kettleman City area which extends from Merced County to Kings County and lies within both the San Joaquin and Tulare Basins. Groundwater production prior to completion of the California Aqueduct in 1967 caused land subsidence of one foot regionally and up to 29 feet locally.

The Exchange Contractors have measured land subsidence annually within their service area from 1957 to 1962. During this period, land subsidence in their service area has ranged from less than a foot under the San Luis Water District to over four feet near the Mendota Pool. The Exchange Contractors will continue the annual subsidence monitoring within their service area. In the years since 1970, the rate of subsidence has declined because surface water was imported to the areas (DWR 1998). Recent increases in subsidence are the result of increased groundwater extraction to compensate for water supply deficiencies caused by Bay/Delta export restrictions.

B.5.6 Agricultural Subsurface Drainage and Waterlogging in the Exchange Contractors Service Area

Inadequate drainage and accumulating salts have been persistent problems for irrigated agriculture along the west side and in parts of the east side of the San Joaquin River Region for more than a century. The most extensive drainage problems exist on the west side of the San Joaquin River and Tulare Lake regions (USBR 1997f).

The soils on the west side of the region are derived from marine sediments and are high in salts and trace elements. Irrigation of these soils has mobilized these compounds and facilitated their movement into the shallow groundwater. Since the 1950s, much of this irrigation has been with imported water, resulting in rising groundwater and increasing soil salinity. Where agricultural drains have been installed to control rising water tables, drainage water frequently contains high concentrations of salts and trace elements (SJVDP 1990). Only a small portion (approximately 28,000 acres) of the Exchange Contractors service area is located within an area experiencing subsurface drainage problems.
APPENDIX B GROUNDWATER CONDITIONS

B.1 GROUNDWATER RESOURCES OF THE TURLOCK GROUNDWATER BASIN

B.1.1 Physical Description of the Basin
B.1.2 Water Balance in the Turlock Groundwater Basin
B.1.3 Groundwater Elevations
B.1.4 Projected Turlock Basin Water Demand
B.1.5 Groundwater Quality in the Turlock Groundwater Basin

B.1.5.1 Total Dissolved Solids
B.1.5.2 Nitrates
B.1.5.3 Arsenic
B.1.5.4 Iron and Manganese
B.1.5.5 Radionuclides
B.1.5.6 Pesticides
B.1.5.7 Volatile Organic Compounds

B.1.6 Land Subsidence in the Turlock Groundwater Basin
B.1.7 Agricultural Subsurface Drainage and Waterlogging in the Turlock Groundwater Basin

B.2 GROUNDWATER RESOURCES OF THE MODESTO BASIN

B.2.1 Physical Description of the Modesto Basin
B.2.2 Groundwater Balance in the Modesto Basin

B.2.2.1 Groundwater Balance Calculations by DWR
B.2.2.2 Groundwater Balance Calculations by HCI Inc.

B.2.3 Groundwater Elevations and Flow Direction
B.2.4 Projected Basin Water Demand in the Modesto Basin
B.2.5 Groundwater Quality in the Modesto Basin

B.2.5.1 Total Dissolved Solids
B.2.5.2 Nitrates
B.2.5.3 Arsenic
B.2.5.4 Iron and Manganese
B.2.5.5 Radionuclides
B.2.5.6 Pesticides
B.2.5.7 Other Trace Organics

B.2.6 Land Subsidence in the Modesto Basin
B.2.7 Agricultural Subsurface Drainage and Waterlogging in the Modesto Basin

B.3 GROUNDWATER RESOURCES OF THE MERCED GROUNDWATER BASIN

B.3.1 Physical Description of the Merced Groundwater Basin
# B. Groundwater Conditions

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.3.2</td>
<td>Groundwater Balance in the Merced Groundwater Basin</td>
</tr>
<tr>
<td>B.3.3</td>
<td>Groundwater Elevations and Flow Direction</td>
</tr>
<tr>
<td>B.3.3.1</td>
<td>Fluctuations in Groundwater Elevations</td>
</tr>
<tr>
<td>B.3.3.2</td>
<td>Recharge</td>
</tr>
<tr>
<td>B.3.4</td>
<td>Projected Basin Water Demand</td>
</tr>
<tr>
<td>B.3.5</td>
<td>Groundwater Quality in the Merced Groundwater Basin</td>
</tr>
<tr>
<td>B.3.5.1</td>
<td>Total Dissolved Solids</td>
</tr>
<tr>
<td>B.3.5.2</td>
<td>Nitrates</td>
</tr>
<tr>
<td>B.3.5.3</td>
<td>Arsenic</td>
</tr>
<tr>
<td>B.3.5.4</td>
<td>Iron and Manganese</td>
</tr>
<tr>
<td>B.3.5.5</td>
<td>Pesticides</td>
</tr>
<tr>
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<td>Land Subsidence in the Exchange Contractors Service Area</td>
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B. Groundwater Conditions

B.5.6 Agricultural Subsurface Drainage and Waterlogging in the Exchange Contractors Service Area ..................................................34
B. Groundwater Conditions
Vegetation resources in the project area are located in two ecological zones: San Joaquin River and East San Joaquin Basin. These zones are shown in Figure 3.5-1 and fully described in Section 3.5.1.

C.1 San Joaquin River Ecological Zone

This ecological zone is divided into four units, two of which will be potentially impacted by proposed pulse flows (CALFED 1998). The proposed project area does not include areas downstream of the San Joaquin River near Vernalis. The San Joaquin River between Friant Dam and the Mendota Pool in many years has no water, and the Mendota Pool is where some water input for the pulse flows could occur for the San Joaquin River. Therefore, the potentially affected ecological zones within the San Joaquin unit include the Vernalis Station to Merced Ecological unit, and the Merced River to Mendota Pool ecological unit. Both relevant ecological units will be treated as one because riparian vegetation is similar.

The San Joaquin River flows out of the southern Sierra Nevada foothills into the Central Valley at Friant Dam (river mile [RM] 267.5). Due to proposed project alternatives, the assessment of potential project effects is restricted to upstream of the San Joaquin River near Vernalis (RM 73) to the Mendota Pool (RM 205). Water diversion prevents the river from flowing until the Delta-Mendota Canal drains into the river at the Mendota Pool. In extremely wet water years, the Kings River is diverted north and drains into the San Joaquin River at Mendota Pool through the Fresno Slough. Twenty five miles downstream of the Mendota Pool, the Arroyo Canal (RM 182) de-waters the San Joaquin River until Bear Creek drains into it (RM 135.6). The combined effects of agriculture, levees, burning, urbanization and flow regulation have reduced riparian vegetation along California’s third largest river to a shattered remnant of its former extent.

At Mendota Pool there is a 21-acre parcel on the east bank that has been reduced to a thicket of willows and exotic species in under 15 years. In 1984, the same stand had a canopy of cottonwoods that has since been burned.

Five miles downstream of Mendota Pool, riparian vegetation is continuous but is only one tree wide. On some point bars, riparian vegetation has been allowed to remain, but there are no valley oaks and few Fremont cottonwoods. Riparian vegetation is almost exclusively individual mature black willow trees, with an occasional pocket of cottonwoods. Where vegetation has not been completely removed to facilitate floodwater conveyance, it has encroached into the bankfull channel. Upstream of Firebaugh (RM 196), riparian vegetation reaches its widest point since Mendota Pool, yet at the downstream end of town near the sewage treatment facilities riparian vegetation is reduced to one tree width.
C. Vegetation Resources in Ecological Zones

Between RM 192 and RM 190 riparian vegetation has been cleared, and mostly narrowleaf or arroyo willow resprouted. There is no continuity between riparian stands and the vegetation is sparse. Mature black willow trees have been left for their windbreak value only. Downstream of where the Arroyo Canal diverts the San Joaquin River (RM 181-182) and again dewater the channel, the river corridor is devoid of any perceptible riparian vegetation, and grasses are all that remain.

From RM 181 to Fremont Ford (Valley Grasslands State Park), riparian vegetation consists of a line of black willow trees and grasses. This is the only region of the project area that has great valley grasslands.

At RM 171, some agriculture groundwater recharge creates ponds in the San Joaquin River channel. At the Sand Slough control structure (RM 168.7) flow is returned to the San Joaquin River, resulting in riparian vegetation with a much different character. Upstream of Sand Slough, the riparian vegetation has been cleared for ease of floodwater conveyance. Downstream of Sand Slough, riparian vegetation has not been cleared and is encroaching into the bankfull channel. Some meander lobes downstream of Sand Slough have been skimmed for gravel deposits; however, where riparian vegetation has been allowed to persist on abandoned oxbows, Fremont cottonwoods, valley oaks, and both tree and shrub form willows grow in multiple age classes with multistoried canopies.

Between RM 151-136, the river flows through several wildlife refuges. The floodway is wide but the lack of water results in riparian vegetation that is mostly grass and occasionally individual valley oaks. Because of a high soil pH and texture in this area great valley grasslands dominate riparian vegetation, and few riparian hardwoods are able to grow.

Where Bear Creek flows into the San Joaquin River, the discharge is roughly doubled, and riparian vegetation takes on a form that is consistent throughout the rest of the riparian corridor. Downstream of the Merced River confluence (RM 118.3), relic stands of valley oak border the floodway, narrowleaf willow grows in thickets within the floodway, and scroll bars are more evident. Where Orestimba Creek flows into the San Joaquin River upstream of Crows Landing (RM 109), a relic valley oak woodland with cottonwoods emerging over the oak canopy remains, and the delta deposit formed by Orestimba Creek is encroached with narrowleaf willow. In areas close to the channel, where frequently flooded agricultural land has been left fallow (RM 112, RM 108), riparian vegetation has begun to regenerate. Over the next two decades it is likely that a dense willow stand will cover them. Below the Merced River confluence, river migration is evident on aerial photographs. Migration could potentially introduce large woody debris into the channel, create fresh cut banks on the outside of meander bends, and deposit sediments on bars and floodplains creating new seed beds.

From the Merced River confluence to the San Joaquin River near Vernalis (RM 73), there are many remnant sloughs and oxbow channels. In many areas around sloughs, vegetation has been cleared; however, where sloughs fall within the Army Corp of Engineers designated floodway, forests of
C. Vegetation Resources in Ecological Zones

willows box elders, cottonwoods and valley oaks remain. The sloughs have created islands where relic valley oak stands and cottonwoods persist. The vegetation is continuous and structural diversity varies from a multistoried canopy with 100 percent closure and a well developed understory to dense willow thickets. Over the long term, large stands (>5 acres) are in decline, and the interior of these large riparian tracts is often dying. There is no replacement of individual trees when they die.

Summary

Human disturbance, hydrology and fluvial geomorphic processes affect riparian vegetation. Currently riparian vegetation in the San Joaquin Basin is fragmented and reduced to a band often no more than a tree wide on either side of a river. Changes in river stage and land use practices could elicit a quantifiable response from vegetation. Pulse flow timing, frequency, magnitude and duration within the San Joaquin River and each tributary, combined with each species different annual life history strategy, could facilitate some natural regeneration and recovery.

C.2 East San Joaquin Basin Ecological Zone

All of the San Joaquin Rivers major tributaries are located in the East San Joaquin Basin Ecological Zone (CALFED 1998). As is more fully discussed in the aquatic resources section, this zone is divided into three ecological units, the Stanislaus, Tuolumne and Merced, which are characterized by the rivers that flow through them.

C.2.1 Stanislaus River Ecological Unit

With the closure of New Melones Dam on the Stanislaus River in 1980, the U.S. Army Corp of Engineers purchased and created a wider floodway corridor downstream of the dam. Because of this wider floodway, the Stanislaus River has the widest riparian corridor and the greatest quantity of vegetation compared to the other ecological units. However, narrowleaf willow has encroached into the low water channel. The proposed project will affect riparian vegetation downstream of Goodwin Dam (RM 58) to the river’s confluence with the San Joaquin (RM 0). Between RM 36 and RM 40 the Stanislaus River’s channel bed undergoes a transition from a gravelbed to sandbed. White alders grow along the bankfull channel in the gravelbedded reach and this changes to box elder in the sand bedded reach.

The effects of flow regulation are most notable on this river. Narrowleaf willow has encroached within the active channel to the low water margin throughout the entire river corridor from Knight’s Ferry to the confluence with the San Joaquin. The youngest vegetation along the whole river is exclusively narrowleaf willow and box elder. On unvegetated sites only narrowleaf willow regenerates, while box elder is regenerating in the dense willow thickets due to its shade tolerance. Urbanization and agriculture are two human disturbances that have had the greatest effects on riparian vegetation reduction on the Stanislaus River. Urban development has decreased riparian...
C. Vegetation Resources in Ecological Zones

Vegetation width through the city of Riverbank and Ripon (but not to the extent that the Tuolumne River suffers through Modesto). Removal of riparian vegetation for agriculture probably has caused most significant reduction in riparian vegetation coverage and diversity along the channel downstream of Knight’s Ferry.

The net result of the designated floodway corridor, agriculture, flow regulation, and urban development has resulted in a riparian corridor that is wider than the other San Joaquin tributaries, but one that does not have a high species diversity, and suffers from extreme riparian vegetation encroachment into the low water channel.

The area around the confluence (RM 0) is comparable to a lush jungle contained between two levees. Three age classes of Fremont cottonwood stands are visible ranging from 10 to 75 years old. White mulberry is common in these older stands. Caswell State Park (RM 2.5-8.5) is considered the best remaining example of great valley cottonwood and valley oaks forests still in existence. Vegetation patterns are distinct within the riparian forests at Caswell State Park. At the center of Caswell there is a stand of valley oak growing in a stellate pattern with each arm of the star being mature Fremont cottonwood stands. Riparian stands are so evolved at Caswell State Park that Clematis and grape lianas drape from the canopy to the ground and there is 100 percent canopy closure in many areas.

Where Caswell Park ends (RM 8.5), cottonwood and valley oak sharply decrease and are fragmented due to agricultural encroachment. Riparian vegetation is characteristic of agriculturally affected reaches: one tree width on either side of the channel. Where relic, senescent stands do occur, they are confined to pre-regulation floodplains and terraces, and are surrounded by a sea of narrowleaf willow. Narrowleaf willow is regenerating on point bar deposits within the active channel, which prevents these deposits from mobilizing during high flows.

Urban encroachment through the city of Ripon (RM 13.5-16) has reduced riparian vegetation along the channel. Riparian vegetation is contiguous with other large (> 5 acres) stands downstream. Although riparian vegetation is wider than one tree, the densest vegetation is along the low water channel margin and is limited to 125 feet in width. Upstream of Ripon, the riparian corridor is narrow but contiguous, and the dominant species is narrowleaf willow. An occasional box elder emerges, and a few pockets of valley oak remain beyond a dense band of mature narrowleaf willow.

Between Ripon and Oakdale, the combined effects of urbanization, agriculture, gravel mining and flow regulation are most pronounced. At RM 28 an old orchard has been left fallow on the left bank. The old fallow orchard is imbedded in a degenerating forest with many gaps and a few large cottonwoods and valley oaks; however, narrowleaf willow is the only plant regenerating in the orchard. By RM 30 riparian vegetation is mostly narrow leaf willow with an occasional strip of overhanging valley oaks. Although narrowleaf encroachment continues to dominate riparian vegetation, there are a few mature or senescent Fremont cottonwoods and valley oaks. At RM 39 an inchannel gravel mining pits cleared virtually all of the original cottonwoods, valley oaks, and
willows from the area around the mine. The inchannel gravel mine now has narrowleaf willow growing along the levees, and the levee has failed with the inchannel pit now taking the majority of flow from the channel. The main channel below the levee breach has been almost completely filled in with narrowleaf willow.

From Oakdale to Knight’s Ferry, almost pure stands of narrowleaf willow line the low water channel, and giant reed infestations are common for the first time upstream of the Stanislaus River’s confluence with the San Joaquin River. In this reach, mature and senescent vegetation has been cleared or burned. Urban development in Oakdale has reduced the riparian vegetation to one or two trees in width. Upstream of Oakdale the riparian corridor begins to widen, but it is not densely vegetated like areas near the confluence. At Knight’s Ferry, for the first time since near the confluence, there is a large (>15 acre) riparian stand consisting of senescent cottonwoods with a few valley oaks.

Above Knights Ferry (RM 53), the river becomes confined in a gorge eroded by the river through a basalt lava flow. The character of the Stanislaus River from this point upstream to Goodwin Dam (RM 58) is unique. From the covered bridge at RM 54.5, riparian vegetation is restricted to small cracks and hollows in the bedrock, and is predominately arroyo willow and white alder. Narrow leaf willow encroachment occurs as soon as the river emerges from the basalt gorge and the banks become alluvial.

### C.2.2 Tuolumne River Ecological Unit

The Tuolumne river is 52 miles long between La Grange Dam (RM 52) and the confluence with the San Joaquin River (RM 0). The Tuolumne River’s channel bed changes from gravel dominated to sandbedded between RM 24 and RM 30, and a change in gradient also occurs in this reach. Because of the shift in substrate and gradient, white alder grades into box elder in the gravelbed to sandbed transition reach. The Tuolumne River is the only ecological unit within the project area with a major metropolitan city along its banks (Modesto). Downstream of Modesto, the river is confined between levees and agricultural activities. Upstream of Modesto, the river is affected by urban development, gravel mining, and agriculture.

From the confluence with the San Joaquin River to RM 12 there are few large (>5 acres) stands of riparian vegetation, with only a small percentage of these relic stands being valley oak. Over the past few decades, bank riprap has created a trapezoidal channel preventing channel migration and natural riparian regeneration that typically accompanies channel migration. Riparian regeneration that has occurred in this area is limited to pockets in the riprap, or on the upper edge of levees. Agriculture has eliminated any extensive riparian vegetation cover, and has reduced existing vegetation to one tree width through much of this area. Relic valley oak and cottonwood stands remain around old
C. Vegetation Resources in Ecological Zones

oxbow channels and represent the greatest cover and structural diversity between the city of Modesto and the river’s confluence with the San Joaquin River.

From RM 12 to 19.5, riparian vegetation is most affected by urban development associated with the growth of Modesto. Riparian vegetation consists of small (<2 acres) dense bands of narrowleaf willow, interspersed with senescent Fremont cottonwoods. Occasionally a valley oak delineates the break in slope between urban development and the active channel. A confined channel with no active meandering has allowed narrowleaf willow to form a dense band down to the low water channel. Relic stands of cottonwood and black willow have been burned or are degraded by human disturbance. Tuolumne River Regional Park, through the City of Modesto, has the largest stand of valley oaks; however, recent plantings do not include native tree species, and park management prevents any natural regeneration. Another effect of increasing urban development is that exotic plant species are common throughout the river corridor.

Upstream of Modesto to the city of Waterford (RM 19–31.6) there are few large stands (>5 acres) of valley oaks and cottonwoods, and regeneration is prevented by continual human activities and the change in flow regime by the New Don Pedro Project. Upstream from the city of Modesto RM 24-34), aggregate extraction adjacent to the channel and inchannel has left many solitary valley oaks or cottonwoods surrounded by exotic plants leading to decreased native hardwoods regeneration and diminished habitat quality.

Between RM 34 and 52 riparian vegetation exists along the channel and in hollows created by dredger tailings. Turlock Reservoir State Park (RM 37) preserves some of the best riparian vegetation structure and species composition along the entire river. Because of the park’s location adjacent to the Tuolumne River it floods often. This flooding, in combination with mowing and exotic species removal, help facilitate the regeneration and maintenance of the park. The location and the size of the state park is excellent because it preserves a large relic stand (> 5 acres) and will be a productive seed source for future restoration efforts between La Grange Dam and Waterford. In fact, the riparian corridor along the Tuolumne River near La Grange (RM 40-46) enjoys the most extensive vegetation coverage of anywhere on the Tuolumne River. Except in the hollows between dredger tailing piles, riparian vegetation is predominately willow shrubs that create a dense thicket within the bankfull channel, and a few isolated relic stands of senescent cottonwoods and valley oaks. In a few areas along this reach, cattle grazing has eliminated riparian regeneration and denuded the banks. The most recent riparian plant regeneration has occurred in the dredger tailing hollows, because groundwater is close and the effects of grazing are minimized. The understory and gaps within relic Fremont cottonwood and valley oak stands are being invaded by tree of heaven and giant reed. Upstream of the town of La Grange, the Tuolumne River is confined to a bedrock valley similar to the Stanislaus; riparian vegetation persists in hollows and cracks along the valley walls and does not cover any area greater than 5 acres.

C.2.3 Merced River Ecological Unit
The proposed project will affect the riparian vegetation along the Merced River between the confluence with the San Joaquin River (RM 0) and Merced Falls (RM 55). The gravelbed to sandbedded channel transition occurs between RM 25 and 30, and there is again a transition from white alder to box elder where this occurs. Riparian vegetation grows in a narrow band along the river due to the combined effects of flow regulation and agriculture. Where there are large riparian vegetation stands (>5 acres), they are old, intensively managed, and senescent. These senescent “islands” are linked together by a band of vegetation seldom more than a tree wide. Exotics have proliferated and benefited by the altered flow regime and human disturbance. Native hardwood species are dwindling, incapable of competing against the exotic species and human encroachment.

Near the confluence of the Merced with the San Joaquin River, there are many shallow depressions left by previous channel migration, creating a diverse topography that is frequently inundated. However, only valley grassland stands currently grow. George Hatfield Park (RM 1-2) contains the largest relic riparian stand in this lower portion of the river, a relic stand of valley oak surrounded by agricultural activities. The reduction in spring flows combined with the park’s mowing, has prevented any younger age classes of riparian vegetation or species from establishing within the park.

For the next 20 river miles upstream of George Hatfield Park, riparian vegetation is discontinuous. A few declining relic stands are connected by sporadically occurring narrowleaf willow shrubs and black willow trees. Agriculture has cleared all riparian vegetation to the upper edge of the bankfull channel, leaving discontinuous riparian vegetation with 100 to 500 feet gaps between individual trees. Just upstream of RM 11 for almost 2000 feet, there is no riparian vegetation except for a few spotty narrowleaf willows; riprap and agriculture have replaced vegetation. A vital seed source remains where native riparian vegetation has been left intact at the outside of meander bends. Unfortunately, when these declining relic stands die they will be replaced with grasslands. Currently there has been no visible valley oak or cottonwood regeneration, and what little regeneration that has occurred is restricted to two species: box elder and narrowleaf willow. Regeneration is confined to a narrow band no more than 100 feet in width, while older valley oak stands are isolated on terraces surrounded by agriculture.

McConnel State Park (RM 23.1) is a relic stand of valley oaks on the right bank of the Merced River. This park contains an old meander bend that pinched off leaving behind an oxbow with relic, pre-dam riparian vegetation. Sycamores, cottonwoods, and valley oaks form a closed canopy with connections between the different hardwood species. This is the first location of George Hatfield Park (RM 4) with a similar canopy structure. Between McConnel State Park and George Hatfield Park there are no sizable (>5 acre) stands with closed canopy and mixed hardwood species (i.e., not just a few valley oaks surrounded by grasses). Upstream of McConnel State Park, riparian vegetation returns to a single tree width and valley oaks remain in the middle of grape fields, hinting at riparian vegetation’s previous extent.
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The gravel bed to sand bed transition occurs around RM 26, and the oxbows tend to get bigger upstream of the channel bed substrate transition. Large stands of giant reed are established in the gravel bedded zone, and inchannel gravel mining has left the riparian vegetation fragmented and with no suitable area to regenerate. Dry Creek enters the Merced at RM 31.9, and there is a well developed mixed willow stand below the creeks confluence.

Above the Dry Creek confluence to Merced Falls (RM 32 to RM 55), riparian vegetation reaches its greatest width and has some of the highest species and structural diversity of anywhere along the Merced River. Below Snelling (RM 41), young trees are establishing on surfaces that are currently functioning as floodplains. Upstream of Snelling to Merced Falls, riparian vegetation has only been able to regenerate and establish in the hollows between dredger tailings.

Upstream of Dry Creek, riparian vegetation encroachment into the active channel is far more obvious. While the riparian corridor is generally wider through this reach, it is also more encroached and scruffy, with no tree species forming identifiable stands. There is some riparian regeneration apparent on 1993 aerial photographs, but the channel is still encroached. The regeneration probably occurred two decades ago, making the vegetation mature with no age class diversity.
C. Vegetation Resources in Ecological Zones

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   C.2 East San Joaquin Basin Ecological Zone ......................................................................... 3
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      C.2.2 Tuolumne River Ecological Unit .............................................................................. 5
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APPENDIX D
FEDERAL AND STATE LISTED SPECIES

INTRODUCTION

Table D-1 documents the evaluation of the proposed action for potentially significant impacts on each of the species or critical habitats identified by the USFWS as federal or state species of concern, and it provides a brief rationale for the evaluation. These species were identified from USFWS records for each of the USGS quadrangles that are crossed by the San Joaquin River (as far upstream as Mendota Pool, and as far downstream as Vernalis), or crossed by the Merced, Stanislaus, and Tuolumne rivers (up to and including the reservoir areas) (Table D-2).

Table D-1: THREATENED OR ENDANGERED SPECIES IDENTIFIED BY THE USFWS OR STATE AGENCIES AS POTENTIALLY OCCURRING IN THE PROJECT AREA

<table>
<thead>
<tr>
<th>Class</th>
<th>Species (common name)</th>
<th>Listing Status Federal/State</th>
<th>Potentially Significant Impacts?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish</td>
<td>delta smelt</td>
<td>FT/ST</td>
<td>No</td>
<td>Delta Smelt are not found in the project area, but are present in the Delta downstream of Vernalis and are potentially affected by the project in the April-May period at the beginning of the smelt spawning season. Flows from the San Joaquin River will be increased during this period, resulting in higher flows through the Delta. Since the primary mortality factors of concern for delta smelt are reduced through-Delta flows and entrainment at the pumps, the proposed action of increased flows during April-May and October are not expected to have any significant impact on delta smelt. Operation of the pumping plants will continue in compliance with the 1995 Biological Opinion for operation of the CVP and SWP.</td>
</tr>
<tr>
<td></td>
<td>Central Valley fall-run chinook salmon</td>
<td>FPT/SSC</td>
<td>No</td>
<td>The primary purpose of the project is to enhance survival of fall-run chinook salmon in the San Joaquin River basin using spring and fall pulse flows. Sudden decreases in flow may strand juveniles and large magnitude changes may dewater redds. Mitigation would be to implement ramping rates to ensure that adverse impacts are avoided. With mitigation, the impact to this species is less than significant.</td>
</tr>
<tr>
<td></td>
<td>Central Valley steelhead</td>
<td>FT/--</td>
<td>No</td>
<td>There is no conclusive evidence that steelhead are present in the Merced and Tuolumne rivers. However, proposed actions that benefit fall-run chinook salmon could benefit, to a lesser degree, Central Valley steelhead due to their similar life history and habitat requirements</td>
</tr>
</tbody>
</table>
### Table D-1: THREATENED OR ENDANGERED SPECIES IDENTIFIED BY THE USFWS OR STATE AGENCIES AS POTENTIALLY OCCURRING IN THE PROJECT AREA (CONT.)

<table>
<thead>
<tr>
<th>Class</th>
<th>Species (common name)</th>
<th>Listing Status Federal/State²</th>
<th>Potentially Significant Impacts?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish (cont)</td>
<td>Sacramento splittail</td>
<td>FPT/SSC</td>
<td>No</td>
<td>Splittail utilize areas of flooded vegetation for spawning in the spring. To the extent that the additional flows provided by the project contribute to greater wetted area and floodplain inundation, there will be benefits to splittail. Ramping rates included in the proposed action will minimize the potential for stranding of fish. No significant negative impacts of the project are anticipated.</td>
</tr>
<tr>
<td></td>
<td>Delta smelt</td>
<td></td>
<td>No</td>
<td>The proposed actions will not adversely affect any critical habitat features that are of importance to delta smelt.</td>
</tr>
<tr>
<td>Mammals</td>
<td>Fresno kangaroo ratt</td>
<td>FE/SE</td>
<td>No</td>
<td>To date, the only known occurrence of this subspecies is at the Alkali Sink Ecological Reserve (1988) and at the Kerman Ecological Reserve (1992), both in Fresno County. These areas will not be affected by the project, and therefore this species will not be impacted.</td>
</tr>
<tr>
<td></td>
<td>giant kangaroo rat</td>
<td>FE/SE</td>
<td>No</td>
<td>This species utilizes flat, sparsely vegetated areas with native annual grassland and shrubland habitats. It is not dependent on riparian habitats that are potentially affected by the project, and therefore will not be impacted by the project.</td>
</tr>
<tr>
<td></td>
<td>riparian (San Joaquin Valley) woodrat</td>
<td>FPE/SSC</td>
<td>No</td>
<td>Habitat includes riparian areas with a mixture of trees and shrubs with moderate canopy and a brushy understory. Impacts on this species are not expected to be significant because of measures that are incorporated to reduce impacts to riparian vegetation used by this species.</td>
</tr>
<tr>
<td></td>
<td>riparian brush rabbit</td>
<td>FPE/SSC</td>
<td>No</td>
<td>This species occupies dense thickets of riparian shrubs and weedy fields adjacent to shrubs. Impacts on this species are not expected to be significant because of measures that are incorporated to reduce impacts to riparian vegetation used by this species.</td>
</tr>
<tr>
<td></td>
<td>San Joaquin kit fox</td>
<td>FE/ST</td>
<td>No</td>
<td>Although San Joaquin kit fox are found in the project area, they are not a riparian species that could be potentially affected by the project.</td>
</tr>
</tbody>
</table>

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Table D-1: THREATENED OR ENDANGERED SPECIES IDENTIFIED BY THE USFWS OR STATE AGENCIES AS POTENTIALLY OCCURRING IN
## THE PROJECT AREA (CONT.)

<table>
<thead>
<tr>
<th>Class</th>
<th>Species (common name)</th>
<th>Listing Status Federal/State</th>
<th>Potentially Significant Impacts?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mammals (cont)</td>
<td>Tipton kangaroo rat</td>
<td>FE/SE</td>
<td>No</td>
<td>The current range of this subspecies is limited to small unconnected alkali habitat patches in Kings and Tulare counties, and scattered areas of Kern County between the Kern National Wildlife Refuge and the town of Delano. The alkali habitat used by this species will not be affected by the project, and therefore this species will not be impacted. In addition, the known occurrences of the species are located approximately 50 miles south of the project.</td>
</tr>
<tr>
<td>Reptiles</td>
<td>blunt-nosed leopard lizard</td>
<td>FE/SE</td>
<td>No</td>
<td>Although blunt-nosed leopard lizards are found in the project area, they are not a riparian species that could be potentially affected by the project.</td>
</tr>
<tr>
<td></td>
<td>giant garter snake</td>
<td>FT/ST</td>
<td>No</td>
<td>The habitat for this species includes sloughs, canals, and other small waterways. Giant garter snakes would not be adversely affected by increased flows, or minor flow alterations, in the mainstem San Joaquin River or its major tributaries.</td>
</tr>
<tr>
<td>Birds</td>
<td>Aleutian Canada goose</td>
<td>FT/--</td>
<td>No</td>
<td>Winters in the San Joaquin Valley, and forages on pastures, harvested fields, and wetlands. Does not heavily utilize riparian zones that could be affected by the project.</td>
</tr>
<tr>
<td></td>
<td>American peregrine falcon</td>
<td>FE/SE</td>
<td>No</td>
<td>Although peregrine falcons may be found in the project area, they are not a riparian species that could be potentially affected by the project.</td>
</tr>
<tr>
<td></td>
<td>bald eagle</td>
<td>FT/SE</td>
<td>No</td>
<td>Utilizes portions of the San Joaquin Valley as overwintering habitat. Flow alterations associated with the project are not expected to adversely affect foraging opportunities for this species, and therefore no significant impacts are anticipated.</td>
</tr>
<tr>
<td></td>
<td>bank swallow</td>
<td>~/ST</td>
<td>No</td>
<td>Nests in bluffs or banks adjacent to water where the soil consists of sand or sandy loam to allow digging. Proposed flows are not likely to result in loss or alteration of the bluffs and banks used for nesting by this species.</td>
</tr>
<tr>
<td></td>
<td>greater sandhill crane</td>
<td>~/ST</td>
<td>No</td>
<td>The open terrain near shallow lakes and freshwater marshes used by this species will not be affected by this project, and therefore no significant impacts are anticipated.</td>
</tr>
</tbody>
</table>

Table D-1: THREATENED OR ENDANGERED SPECIES IDENTIFIED BY THE USFWS OR STATE AGENCIES AS POTENTIALLY OCCURRING IN THE PROJECT AREA (CONT.)
<table>
<thead>
<tr>
<th>Class</th>
<th>Species (common name)</th>
<th>Listing Status Federal/ State²</th>
<th>Potentially Significant Impacts?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birds (cont)</td>
<td>Swainson’s hawk</td>
<td>--/ST</td>
<td>No</td>
<td>This species nests in oaks or cottonwoods in or near riparian habitats. Impacts on this species are not expected to be significant because of measures that are incorporated to reduce impacts to riparian vegetation used by this species.</td>
</tr>
<tr>
<td></td>
<td>willow flycatcher</td>
<td>--/SE</td>
<td>No</td>
<td>Nests in willows and other dense vegetation in riparian areas and wet meadows. Impacts on this species are not expected to be significant because of measures that are incorporated to reduce impacts to riparian vegetation used by this species.</td>
</tr>
<tr>
<td>Amphibians</td>
<td>California red-legged frog</td>
<td>FT/SSC</td>
<td>No</td>
<td>Uses permanent and ephemeral aquatic habitats such as creeks and ponds for breeding. The large river systems involved with this project do not provide suitable breeding habitat. If the rivers are used as dispersal habitat for this species, increased flows are not likely to result in impacts.</td>
</tr>
<tr>
<td>Invertebrates</td>
<td>Conservancy fairy shrimp</td>
<td>FE/--</td>
<td>No</td>
<td>The vernal pool habitat of this species will not be affected by increased flows in the San Joaquin River; therefore, no effects on this species are expected.</td>
</tr>
<tr>
<td></td>
<td>longhorn fairy shrimp</td>
<td>FE/--</td>
<td>No</td>
<td>The vernal pool habitat of this species will not be affected by increased flows in the San Joaquin River; therefore, no effects on this species are expected.</td>
</tr>
<tr>
<td></td>
<td>valley elderberry longhorn beetle</td>
<td>FT/--</td>
<td>No</td>
<td>Uses elderberry shrubs in riparian and oak savanna habitats. Impacts on this species are not expected to be significant because of measures that are incorporated to reduce impacts to riparian vegetation used by this species.</td>
</tr>
<tr>
<td>Plants</td>
<td>Chinese Camp brodiaea</td>
<td>FPE/SE</td>
<td>No</td>
<td>Highly localized serpentine endemic growing in foothills upstream of project area which will not be impacted by the project,</td>
</tr>
<tr>
<td></td>
<td>Vernal pool fairy shrimp</td>
<td>FT/--</td>
<td>No</td>
<td>The vernal pool habitat of this species will not be affected by increased flows in the San Joaquin River; therefore, no effects on this species are expected.</td>
</tr>
<tr>
<td></td>
<td>Vernal pool tadpole shrimp</td>
<td>FE/--</td>
<td>No</td>
<td>The vernal pool habitat of this species will not be affected by increased flows in the San Joaquin River; therefore, no effects on this species are expected.</td>
</tr>
</tbody>
</table>

Table D-1: THREATENED OR ENDANGERED SPECIES IDENTIFIED BY THE USFWS OR STATE AGENCIES AS POTENTIALLY OCCURRING IN THE PROJECT AREA (CONT.)
<table>
<thead>
<tr>
<th>Class</th>
<th>name)</th>
<th>State²</th>
<th>Impacts?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plants (cont)</td>
<td>Colusa grass</td>
<td>FT/SE</td>
<td>No</td>
<td>Vernal pool endemic which will not be affected by instream flows.</td>
</tr>
<tr>
<td></td>
<td>Fleshy owl’s clover</td>
<td>FT/SE</td>
<td>No</td>
<td>Vernal pool endemic which will not be affected by instream flows.</td>
</tr>
<tr>
<td></td>
<td>Greene’s tuctoria</td>
<td>FE/--</td>
<td>No</td>
<td>Vernal pool endemic which will not be affected by instream flows.</td>
</tr>
<tr>
<td></td>
<td>Hairy Orcutt grass</td>
<td>FE/SE</td>
<td>No</td>
<td>Vernal pool endemic which will not be affected by instream flows.</td>
</tr>
<tr>
<td></td>
<td>Hartweg’s golden sunburst</td>
<td>FE/SE</td>
<td>No</td>
<td>Highly localized species growing in foothills upstream of project area which will not be impacted by the project.</td>
</tr>
<tr>
<td></td>
<td>Hoover’s spurge</td>
<td>FT/--</td>
<td>No</td>
<td>Highly localized species growing in foothills upstream of project area which will not be impacted by the project.</td>
</tr>
<tr>
<td></td>
<td>Hoover’s woolly-star</td>
<td>FT/--</td>
<td>No</td>
<td>Grassland species; its habitat will not be affected by instream flows.</td>
</tr>
<tr>
<td></td>
<td>Layne’s butterweed</td>
<td>FT/--</td>
<td>No</td>
<td>Serpentine endemic growing in foothills upstream of project area which will not be impacted by the project.</td>
</tr>
<tr>
<td></td>
<td>Rawhide Hill onion</td>
<td>FPT/--</td>
<td>No</td>
<td>Highly localized serpentine endemic growing in foothills upstream of project area which will not be impacted by the project.</td>
</tr>
<tr>
<td></td>
<td>Red Hills vervain</td>
<td>FPT/--</td>
<td>No</td>
<td>Highly localized serpentine endemic growing in foothills upstream of project area which will not be impacted by the project.</td>
</tr>
<tr>
<td></td>
<td>San Joaquin woolly-threads</td>
<td>FE/--</td>
<td>No</td>
<td>Vernal pool endemic which will not be affected by instream flows.</td>
</tr>
<tr>
<td></td>
<td>San Joaquin Valley Orcutt grass</td>
<td>FT/SE</td>
<td>No</td>
<td>Vernal pool endemic which will not be affected by instream flows.</td>
</tr>
</tbody>
</table>

¹ Letter of June 11, 1998 from USFWS (David Harlow) to USBR Mid-Pacific Region Fresno Office

² FE=Federally listed as endangered 	 SE=State listed as endangered 
 FT=Federally listed as threatened 	 ST=State listed as threatened 
 FPE=Federally proposed for listing as endangered 	 SSC=State species of special concern 
 FPT=Federally proposed for listing as threatened
The Bureau of Reclamation (Reclamation) and the San Joaquin River Group Authority (Authority) distributed a Notice of Preparation of a Joint Environmental Impact Statement/Environmental Impact Report (EIS/EIR) on supplying water to meet the flow objectives for the proposed Vernalis Adaptive Management Plan (VAMP) on November 25, 1997 to about 160 agencies and individuals. The notice announced three public scoping meetings for January 6–8, 1998, and requested that comments on the content of the EIS/EIR be submitted by January 16, 1998. This appendix summarizes the comments received in both oral and written form on the content of the EIS/EIR.

### E.1 AGENCIES WHO COMMENTED

In addition to members of the Authority (districts and law firms representing districts), the following agencies sent representatives to the public scoping meetings and/or provided written comments (in italics):

**State Agencies:**
- Central Regional Water Quality Control Board
- Department of Water Resources, SWP Operations
- Department of Food and Agriculture
- State Water Resources Control Board

**Local Agencies:**
- Contra Costa Water District
- San Joaquin County
- San Joaquin Valley Unified Air Pollution Control District
- South Delta Water Agency
- Stanislaus County (by Michael G. Heaton)
- Stanislaus County Environmental Review Committee
- Stanislaus County Department of Environmental Resources
- Stanislaus County Planning Department
- Stockton East Water District (by Herum, Crabtree, Dyer, Zolezzi & Terpstra, LLP)
- Tuolumne Utilities District (by Michael G. Heaton)

In the following summary of comments, a comment received in writing by the same person giving the comment orally takes precedence over the oral comment. In other words, the comment received in writing is assumed to be a more accurate version of the same comment that is reported in the minutes. The comments are provided below in Section 2 as written in a letter or as close to what was stated (from the minutes) as possible with no editing that could affect the meaning or content.
E. Public Scoping

E.2 SUMMARY OF COMMENTS

Many of the questions asked were informational about VAMP or Reclamation programs. These informational questions are addressed in the minutes of the meetings and are not summarized here. Comments included here are those that affect the content or scope of the EIS/EIR.

E.2.1 Project Description

1. What are the most likely sources of water? Can you pump groundwater or purchase water from further downstream?

2. Is the EIS/EIR going to cover both the water acquisition program and VAMP itself? Presumably VAMP is not subject to CEQA and NEPA.

3. When you are putting VAMP together and the flows, are you looking also at X2?

E.2.2 Alternatives to Proposed Project

1. The New Melones operation is part of the base flow and will be providing a large portion of the flow down the river. It is the flow for the lower Stanislaus River. We also must look at the water quality requirements.

2. Recirculation of water using water released from the San Luis Reservoir and/or the Delta-Mendota Canal.

3. Releases of water from all available sources in the San Joaquin River Basin.

4. The EIS/EIR must include a range of alternatives which would avoid impacts on environmental resources related to agriculture, even if this to some degree impairs achieving the goals of the project.

5. What alternatives are available to the project and whether or not multi-use of water can be achieved rather than single purpose uses.

E.2.3 General Environmental Impacts

1. What happens during the remainder of the year, after the spring pulse flows? What are the trade-offs?
E. Public Scoping

2. The acquisition of environmental resources, such as water, and redirection of these resources to other uses constitutes a significant adverse impact on the existing environment, regardless of the new purpose or place of use.

3. CDFA supports relying on free market transactions with willing sellers rather than less voluntary approaches. However, the motives of sellers of environmental resources does not have any bearing on the requirements of CEQA to avoid, reduce, and mitigate significant adverse impacts on the environmental resources involved.

E.2.4 Specific Environmental Impacts

E.2.4.1 Water Resources (Supply/Quantity and Quality)


2. Impact on water supply availability to the Stockton East Water District from the New Melones Project.

3. What is the impact of VAMP on the long-term operations of New Melones Reservoir, and particularly, the impact of VAMP on the availability of Stanislaus River water for existing and reasonably foreseeable future Stanislaus River In-Basin needs? In other words, does the reallocation of Stanislaus River/New Melones water adversely impact the ability of local agencies such as TUD to develop future water supplies or impair the ability of local agencies to exercise their watershed, basin, or area of origin priorities? The analysis of this question would seem to depend on the relative priority of VAMP obligations as against Stanislaus River in-basin obligations.

4. To the extent applicable, there should be an analysis of the impact of reductions of use of surface water from the Stanislaus and Tuolumne rivers in Stanislaus County on groundwater usage in Stanislaus County. In other words, will the water acquisitions for VAMP be offset locally by increased groundwater pumping, and if so, what will be the impact on local groundwater resources?

5. How changes in flow schedules affect downstream water quality and quantity in the different year types.

6. How sales and transfers of water affect downstream water quality and quantity.

7. Water quality impacts in the Delta and upstream may be of interest. Modeling needs to be consistent with what the SWRCB requires.
8. We will have to analyze how VAMP may influence X2.

9. Impact on the New Melones Project’s ability to meet water quality objectives at Vernalis including the impacts associated with a different release pattern/timing of releases caused by the acquisition of water on the tributaries.

10. The effects on south Delta water quality, quantity, and flow of changes in export pumping rates including the effects on the ISDP (Interim South Delta Program).

E.2.4.2 Fish and Wildlife

1. Impact of modified flows on fish and wildlife resources in the San Joaquin river basin.

E.2.4.3 Land Uses/Socioeconomic/Public Services

1. Decisions related to exports may have an economic impact. Final CEQA documentation must support two findings: (1) that such transfer will not injure any rightful user of water, and (2) that it will not have any harmful effect on fish and wildlife.

2. Impact on land uses in San Joaquin County including agricultural uses from the acquisition of water on the San Joaquin River tributaries.

3. To the extent that VAMP water acquisitions result in reductions in surface water usage in Stanislaus county which are not offset by increased groundwater pumping, there should be an analysis of “third party” impacts of such reductions in surface water use, particularly the impacts on public and social services demands, reduced tax revenues and related impacts.

4. To the extent there are unavoidable impacts on environmental resources related to agriculture, there must be measures to reduce or mitigate these impacts to insignificant levels.

5. The economic effects of items 5 and 6 in Section 2.4.1 above.

6. How sales and transfers of agricultural water supplies affect and/or contradict other public policies such as zoning and the Williamson Act.

E.2.4.4 Air Quality

1. Based on the information provided, it appears that this project will have a less-than-significant impact on the ambient air quality. However, if any construction or earth
E. Public Scoping

moving activities are planned, this project would be subject to District Regulation VIII (Fugitive Dust Prohibitions).

E.2.4.5 Cumulative Impacts

1. What is the cumulative impact of VAMP on top of other transfer activities going on? Are we going to see more groundwater pumping?

2. There should be an analysis of the cumulative impacts of VAMP together with other water acquisition and water transfer projects on the San Joaquin system and particularly the Stanislaus River. The issue is what is the cumulative impact of the reallocation of surface water supplies for environmental purposes in the Delta on local agricultural production, economic development, groundwater resources and the local environment.

3. The cumulative effects on water quality and quantity of other ongoing and proposed projects.

E.2.4.6 Other Concerns

1. The legal prerequisites to flow changes and transfer of water.

2. The environmental documents would be inadequate if they do not examine from whom sale water is purchased. The effects of transfers may vary depending on what tributary they are made.

3. The document should include a complete description of the existing conditions (e.g., CVP effects on San Joaquin River and South Delta water quality and quantity). It should be made clear that current Bureau operations as well as those proposed in VAMP anticipate violations of the Bureau’s New Melones permit requirements to maintain Vernalis water quality.

4. It was stated that this EIS/EIR is for the “acquisition” of water for the VAMP fish experiments and is not for the experiments themselves per se. Since it is unknown whether of not there will be a separate EIS/EIR for the actual VAMP fish experiments, it would seem necessary for this EIS/EIR to address, in detail, the possible impacts that the fish experiments may have on South Delta water users including the SWP and CVP.

5. The EIS/EIR must not only analyze the impacts associated with the above resource areas, but must also fully analyze the related subsidiary effects of that taking the projected action will have on the related resources.
E. Public Scoping

APPENDIX E
REPORT ON PUBLIC SCOPING FOR THE EIS/EIR ON MEETING FLOW OBJECTIVES FOR VAMP, 1999–2009

E.1 AGENCIES WHO COMMENTED

E.2 SUMMARY OF COMMENTS

E.2.1 Project Description
E.2.2 Alternatives to Proposed Project
E.2.3 General Environmental Impacts
E.2.4 Specific Environmental Impacts
  E.2.4.1 Water Resources (Supply/Quantity and Quality)
  E.2.4.2 Fish and Wildlife
  E.2.4.3 Land Uses/Socioeconomic/Public Services
  E.2.4.4 Air Quality
  E.2.4.5 Cumulative Impacts
  E.2.4.6 Other Concerns
APPENDIX F
LOCAL GENERAL PLAN POLICIES

INTRODUCTION

This appendix provides excerpts from the general plans for the following counties: San Joaquin, Stanislaus, Merced, Fresno, Madera, Mariposa, and Tuolumne.

F.1 SAN JOAQUIN COUNTY

San Joaquin County contains the lower reaches of the San Joaquin River and the lower reach of the Stanislaus River at its confluence with the San Joaquin River near Vernalis, although the Vernalis community is located in adjacent Stanislaus County.

There is no specific land use designation for riparian areas. Land use categories that extend to the edge of the rivers include: public/institutional, resource conservation, industrial, commercial, residential, agricultural/urban reserve, and general agriculture.

San Joaquin County General Plan (1992)

Listed below are some of the objectives and policies contained in the Vegetation, Fish, and Wildlife Habitat Element that are relevant to the proposed action.

Objective 1. To protect and improve the County’s vegetation, fish, and wildlife resources.

Objective 2. To provide undeveloped open space for nature study, protection of endangered species, and preservation of wildlife habitat.

The County will strive to achieve these objectives using the following policies.

Policy 5 No net loss of riparian or wetland habitat or values shall be caused by development.

Policy 11 Fisheries shall be protected by:

(A) reducing the level of pesticides and fertilizers and other harmful substances in agricultural and urban runoff;

(B) designing and timing waterway projects to protect fish populations; and

(C) operating water projects to provide adequate flows for spawning of anadromous fish.
F. Local General Plan Policies

Policy 12 The County shall support restoration plans for anadromous fisheries and shall work with the California Department of Fish and Game and other agencies or organizations in developing such plans.

Policy 13 The County shall encourage the restoration and enhancement of once-productive degraded ecosystems, such as historic salmon runs on the Mokelumne and Calaveras Rivers.

Listed below are the most relevant objectives and policies in the Water Resources and Quality Element.

Objective 1. To ensure adequate quantity and quality of water resources for municipal and industrial uses, agriculture, recreation, and fish and wildlife.

Objective 5. To recognize the surface waters of San Joaquin County as resources of State and national significance for which environmental and scenic values must be protected.

Policy 10 The County shall support properly timed, sufficient flows in the rivers to maintain spawning grounds, fish migration, and resident fish populations.

Policy 12 No water should be exported to other areas of the State unless the current and future needs of San Joaquin County can be met.

Policy 13 Water diversion projects shall protect the fishery, wildlife habitat, and recreation; shall ensure adequate water for County agricultural, municipal and industrial uses; and shall guarantee adequate delta outflows for salinity repulsion.

F.2 STANISLAUS COUNTY

While the New Melones Lake and Don Pedro Reservoir are actually located in Tuolumne County, part of the Stanislaus River and most of the Tuolumne River are located in Stanislaus County. Both of these tributaries join the San Joaquin River in Stanislaus County.

There is no specific land use designation for riparian areas. Land use categories that extend to the edge of the rivers include: planned development, urban transition, low density residential, historical, estate, residential, and agriculture. City/County boundaries extend into the rivers.
F. Local General Plan Policies

Stanislaus County General Plan (1994)

Plan goals relevant to the proposed action are:

Goal 2. Conserve water resources and protect water quality in the County.

   Policy 5 Protect groundwater aquifers and recharge areas, particularly those critical for
   the replenishment of reservoirs and aquifers.


Goal 10. Protect fish and wildlife species in the County.

   Policy 29 Adequate water flows should be maintained in the County’s rivers to allow
   salmon migration.

The general plan also contains an Agricultural Element.

Goal 3. Protect the natural resources that sustain agriculture in Stanislaus County.

   Policy 3.6 The County shall encourage the conservation of water for both agricultural
   and urban uses.

F.3 MERCED COUNTY

While Lake McClure is in Mariposa County, most of the Merced River is located in Merced County,
where it joins the San Joaquin River. The Kesterson and San Luis National Wildlife Refuges are
located here, as is San Luis Reservoir.

Merced County provided the Open Space/Conservation and Agriculture Elements of their general
plan and indicated in their comment letter that these elements will not change in the current plan
revision.

Merced County Year 2000 General Plan (1990)

Plan objectives and policies from the Open Space/Conservation Element that are most relevant to the
proposed action are:

Objective 1.A Rare and endangered species are protected from urban development and are
recognized in rural areas.
F. Local General Plan Policies

Policy 9  Significant aquatic and waterfowl habitats should be protected against excessive water withdrawals which would endanger or interrupt normal migratory patterns.

Objective 2.B  Surface and groundwater resources are protected from contamination, evaporation, and inefficient use.

Policy 6  Methods to prevent the depletion of groundwater resources and promote the conservation and reuse of water should be encouraged.

Policy 7  The rehabilitation of irrigation systems and other waterworks to reduce the lost water, and improve the efficient use and availability of water should be promoted.

Plan objectives and policies from the Agriculture Element that are most relevant to the proposed action are:

Objective 4.A  Measures to protect and improve water quality are supported.

Policy 1  The County favors efforts to ensure adequate surface water supplies to deficient areas.

Policy 2  The County will encourage farmers to use irrigation methods which conserve water.

Policy 3  The County will work with other responsible agencies to ensure that sources of water contamination (including boron, salt, selenium and other trace element concentrations) do not enter agricultural or domestic water supplies, and will be reduced where water quality is already affected.

Merced County provided the Open Space/Conservation and Agriculture Elements of their general plan and indicated in their comment letter that these elements will not change in the current plan revision.

F.4  FRESNO COUNTY

The San Joaquin River flows through Fresno County, which also contains the Mendota Wildlife Refuge.
There is no specific land use designation for riparian areas. Land use categories that extend to the edge of the rivers include: regional parkland, open space, medium and medium high density residential, multi-use open space, and recreational open space.

**Fresno County General Plan (1976)**

Plan objectives contained in the River Influence Area Element that are relevant to the proposed action are:

Objective 2.01 Preserve and enhance the value of the river environment as a multiple use, open space resource.

Objective 2.02 Maintain the environmental and aesthetic qualities of the area.

Objective 2.03 Protect the quality and quantity of the surface water and groundwater resources.

Objective 2.05 Conserve and enhance the natural wildlife habitat.

Plan objectives contained in the Open Space Element that are relevant to the proposed action are:

Objective 2.03 Preserve and enhance areas of significant natural resources, the retention of which is necessary to maintain the environmental quality and economic potential of the area.

Plan objectives contained in the Natural Vegetation/Wildlife Element that are relevant to the proposed action are:

Objective 2.02 Manage vegetation and wildlife resources in a responsible and productive manner.

Objective 2.03 Protect the habitats of plants and wildlife from unnecessary activities of man.

The County will strive to achieve these objectives using the following policies.

- **Policy 3.02** Areas that have unusually high value for fish and wildlife propagation should be preserved in a natural state to the maximum possible extent.

- **Policy 3.03** The County should support State and Federal programs to acquire significant fish and wildlife habitat areas for permanent protection and/or public recreation use.
F. Local General Plan Policies

Policy 3.05  Wetlands, riparian habitat, and meadows are recognized as essential habitats for birds and wildlife and should be protected to the maximum extent practicable.

Policy 3.10  Significant aquatic habitats should be protected against excessive withdrawals which would endanger fish and wildlife or would interrupt normal migratory patterns.

F.5  MADERA COUNTY

Madera County contains the upper reaches of the San Joaquin River, including the Friant Dam and Millerton Lake. The Delta-Mendota Canal meets the San Joaquin River in the southwest region of the county. In the eastern region of the county the Madera Canal runs in a southeasterly direction, meeting the San Joaquin River just below Millerton Lake.

There is no specific land use designation for riparian areas. Land use categories that extend to the edge of the rivers include: agricultural exclusive, agriculture, open space, new growth area, low density residential, and light industrial/business park.

Madera County General Plan (1995)

Listed below are the goals and policies from the Land Use Element that are relevant to the proposed action.

Goal 1.A. To promote the wise, efficient, and environmentally-sensitive use of Madera County land to meet the present and future needs of Madera County residents and businesses.

The County will strive to achieve this objective using the following policy which addresses natural resources.

Policy 1.A.1.  The County shall promote the efficient use of land and natural resources.

Listed below are the relevant goals and policies in the Water Resources Element.

Goal 5.C.  To protect and enhance the natural quality of Madera County’s streams, creeks, and groundwater.

Policy 5.C.7.  The County shall protect groundwater resources from contamination and further overdraft by encouraging water conservation efforts and supporting the use of surface water for urban and agricultural uses wherever feasible.
Policy 5.C.8. The County shall support the policies of the San Joaquin River Parkway Plan to protect the San Joaquin River as an aquatic habitat and a water source.

Listed below are relevant goals and policies from the Wetland and Riparian Areas Element.

Goal 5.D. To protect wetland communities and related riparian areas throughout Madera County as valuable resources.

Policy 5.D.1. The County shall comply with the wetlands policies of the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, and the California Department of Fish and Game. Coordination with these agencies at all levels of project review shall continue to ensure that appropriate mitigation measures and the concerns of these agencies are adequately addressed.

Policy 5.D.7. The County shall support the management of wetland and riparian plant communities for passive recreation, groundwater recharge, nutrient catchment, and wildlife habitats. Such communities shall be restored, where possible.

Policy 5.D.8. The County shall support the goals and policies of the San Joaquin River Parkway Plan to preserve existing habitat and maintain, enhance, or restore native vegetation to provide essentially continuous riparian and upland habitat for wildlife along the river between Friant Dam and the Highway 145 crossing.

Listed below are the goals and policies adopted by Madera County to preserve fish and wildlife habitat.

Goal 5.E. To protect, restore, and enhance habitats that support fish and wildlife species so as to maintain populations at viable levels.

Policy 5.E.1. The County shall identify and protect critical nesting and foraging areas, important spawning grounds, migratory routes, waterfowl resting areas, oak woodlands, wildlife movement corridors, and other unique wildlife habitats critical to protecting and sustaining wildlife populations.

Policy 5.E.5. The County shall support the maintenance of suitable habitats for all indigenous species of wildlife through maintenance of habitat diversity.
Policy 5.E.7. The County shall support the preservation or reestablishment of fisheries in the rivers and streams within the county, whenever possible.

Listed below are the goals and policies relevant to the proposed action.

Goal 5.H. To preserve and enhance open space lands to maintain the natural resources of the county.

Policy 5.H.1. The County shall support the preservation and enhancement of natural land forms, natural vegetation, and natural resources as open space. To the extent feasible, the County shall permanently protect as open space areas of natural resource value, including wetlands preserves, riparian corridors, woodlands, and flood plains.

Policy 5.H.3. The County shall support the maintenance of open space and natural areas that are interconnected and of sufficient size to protect biodiversity, accommodate wildlife movement, and sustain ecosystems.

F.6 MARIPOSA COUNTY

Mariposa County contains the upper reaches of the Merced River, which include the McSwain Dam and the New Exchequer Reservoir.

There is no specific land use designation for riparian areas. Land use categories that extend to the edge of the rivers include: public domain, mountain general, public sites, mountain preserve, mountain transition, general forest, commercial resort, and town planning area.

Mariposa County General Plan (1989)

Listed below are the policies and goals from the Conservation Element that are relevant to the proposed action.

The overall guiding policy is as follows:

To provide a program for the conservation and development of natural resources in Mariposa County.

The following is one of the goals supporting this policy.

Goal D. To provide for the identification, delineation, description, and maintenance of vegetative types and related wildlife habitats in order to maintain the inherent diversity of both
F. Local General Plan Policies

vegetation and wildlife species in Mariposa County for the recreational, commercial, and aesthetic enjoyment of both present and future residents and visitors to the County.

The overall guiding policy of the Open Space Element is as follows:

To enhance the natural open space resources of Mariposa County to include preservation of natural resources, managed production of resources, outdoor recreational resources, and open space for public health and safety, for the benefit of present and future residents of the County and visitors to the area.

Some of the specific policies supporting this goal are:

Policy 1. To encourage the preservation of the County’s natural wildlife, wildlife habitat, and water resources through a combination of land use policies and development standards.

Policy 2. To establish policies and standards which provide for, and support, the managed production of natural resources in the County.

F.7 TUOLUMNE COUNTY

Tuolumne County contains the upper reaches of the Stanislaus and Tuolumne rivers. The Stanislaus River system includes the New Melones Reservoir, and the New Don Pedro Reservoir is part of the Tuolumne River system.

There is no specific land use designation for riparian areas. Generalized land use categories that extend to the edge of the rivers include: urban, nonurban residential/business, timberland, agriculture, and public.

Tuolumne County General Plan (1996)

Listed below are goals and policies contained in the Water Resources Element that are relevant to the proposed action.

Goal 4.L. Conserve the quality and quantity of the County’s water resources, while protecting the rights of the land owner.

Policy 4.L.8. Participate in the State and Federal sponsored CAL-FED program to develop comprehensive and long-term solutions to the problems of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (bay-delta) which is nationally recognized as both an important feature of the State’s
environment and an important component of the State’s water supply system by promoting improved management of watersheds in Tuolumne County to contribute to long-term bay-delta recovery and protection.

Policy 4.L.9. Recognize that clean water is essential to the public health, safety, and welfare; fosters economic development and job creation; protects the environment; maintains fish and wildlife; and supports recreation.

Goal 4.M. Conserve public water resource areas with high recreational value for future public use.

Policy 4.M.2. Provide public access to the County’s public waterways, lakes, and reservoirs in compliance with State statutes while protecting private property rights and maintaining the biological, scenic, and historical integrity of these features and lands adjacent to these features.
APPENDIX F LOCAL GENERAL PLAN POLICIES
F.1 SAN JOAQUIN COUNTY 1
F.2 STANISLAUS COUNTY 2
F.3 MERCED COUNTY 3
F.4 FRESNO COUNTY 4
F.5 MADERA COUNTY 6
F.6 MARIPOSA COUNTY 8
F.7 TUOLUMNE COUNTY 9
APPENDIX G
MITIGATION REPORTING PROGRAM

INTRODUCTION

The requirement for a mitigation monitoring or reporting program is introduced in Section 15091 of Title 14, California Code of Regulations, Chapter 3, Guidelines for Implementation of the California Environmental Quality Act. This section directs the public agency approving or carrying out the proposed project (San Joaquin River Group Authority) to make specific written findings for each significant impact identified in the Environmental Impact Report. When making the required findings, the agency shall also adopt a program for reporting on or monitoring the changes which it has either required in the project or made a condition of approval to avoid or substantially lessen significant environmental effects. These mitigation measures must be fully enforceable through permit conditions, agreements, or other measures.

Section 15097 was added to the CEQA Guidelines on October 23, 1998. It requires the public agency to adopt a program for monitoring or reporting on the revisions which it has required in the project and the measures it has imposed to mitigate or avoid significant environmental effects. Reporting or monitoring responsibilities may be delegated to another public agency or private entity. However, until mitigation measures have been completed, the lead agency (San Joaquin River Group Authority) remains responsible for ensuring that implementation of the mitigation measures occurs in accordance with the program.

The San Joaquin River Group Authority (SJRGA) may choose whether its program will monitor mitigation, report on mitigation, or both.

- Reporting generally consists of a written compliance review that is presented to the decision-making body or authorized staff person. A report may be required at various stages during project implementation or upon completion of the mitigation measure. It is suited to projects which have readily measurable or quantitative mitigation measures or which already involve regular review.

- Monitoring is generally an ongoing or periodic process of project oversight. It is suited to projects with complex mitigation measures which are expected to be implemented over a period of time.

This mitigation program report is comprised of a matrix followed by a description of the two principal mitigation measures: the annual Operations Plan and local conjunctive use, reclamation, and water efficiency projects. The mitigation program for the Final EIS/EIR is recommended to be a reporting program on the Operations Plan and the development of conjunctive use/water efficiency projects by members of the Authority.

G.1 MATRIX
G. Mitigation Reporting Program

The mitigation reporting program for meeting the flow objectives for the San Joaquin River Agreement is provided in the following matrix. The matrix includes all impacts in the EIS/EIR that were identified as significant (S) or potentially significant (PS). For impacts that are less than significant, mitigation is not required by CEQA. The text of each mitigation measure is taken from the Final EIS/EIR.

For each impact and mitigation measure, the matrix identifies the implementation action required, the timing requirements for implementation, and the agency responsible for ensuring that the action occurs. In most cases, the SJRGA and its member agencies and other signatories to the SJRA are responsible for ensuring that hydrologic and biologic data are utilized in the development and implementation of the annual Operations Plan and that conjunctive use and other water conservation projects are implemented by Merced and Oakdale Irrigation Districts.

G.2 ANNUAL OPERATIONS PLAN

The San Joaquin River Agreement (SJRA), Paragraph 6.6, states that by February 15 of each year of the Agreement, the U.S. Bureau of Reclamation (USBR) and California Department of Water Resources (CDWR) shall develop, in cooperation with the San Joaquin River Technical Committee (SJRTC), an operations plan that will describe how the VAMP will be implemented in that year. Appendix B of the SJRA, Planning and Operation Coordination for the Vernalis Adaptive Management Plan, describes the process for planning and implementing operations for implementing the VAMP flows. It is incorporated in its entirety into this mitigation reporting program by reference. The focus of Appendix B is the Spring Pulse Flow. A summary of the operations planning process and key participants is provided in Section 2.1 below.

Paragraph 11.1 of the SJRA also states that “the SJRTC will be an interagency effort to successfully implement the VAMP by undertaking the activities described in Paragraph 11.2 (and summarized here) and other technical activities that its members deem appropriate to meet the goals of this Agreement.” Implementation of the October flow and use of the other environmental water provided by Oakdale Irrigation District comes under this category of other technical activities. The SJRTC is to annually coordinate flow releases, export and Old River barrier operations, and the use of hatchery fish to implement the VAMP study. Other duties are: to determine best management of flow releases during the Pulse Flow Period to achieve Target Flows; to plan and oversee monitoring activities in coordination with the Interagency Ecological Program and existing monitoring programs on the San Joaquin tributaries; and to develop annually the Existing Flow calculation protocols.
## G. Mitigation Reporting Program

<table>
<thead>
<tr>
<th>Identified Impact</th>
<th>Mitigation Measures</th>
<th>Implementation Action</th>
<th>Timing Requirements</th>
<th>Reporting Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2.3.1 Water Deliveries Deliveries reduced to Merced Irrigation District during critically dry years and under below normal or dry hydrologic conditions under certain sequential hydrologic conditions. (PS)</td>
<td>Implementation of a conjunctive use program to augment surface water supplies.</td>
<td>Construction of conjunctive use project by Merced ID.</td>
<td>Annual progress reports with financial audit report.</td>
<td>Merced ID progress reports to SJRGA.</td>
</tr>
<tr>
<td>4.2.3.1 Water Deliveries Deliveries reduced to Oakdale Irrigation District during critically dry years. (PS)</td>
<td>Implementation of a conjunctive use program to augment surface water supplies.</td>
<td>Construction of conjunctive use project by Oakdale ID.</td>
<td>Annual progress reports with financial audit report.</td>
<td>Oakdale ID progress reports to SJRGA.</td>
</tr>
<tr>
<td>4.2.3.2 Water Storage Carryover water storage reduced for Lake McClure during all but wet hydrologic conditions. (PSU)</td>
<td>Partly mitigated by conjunctive use program.</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>4.3.3.1 Groundwater Overdrafting Groundwater could indirectly be used to replace surface water used for the flows from the Merced ID (up to 67,500 acre-feet, 12% of the typical annual production). (PS)</td>
<td>Implementation of conjunctive use, reclamation, and increased efficiencies would augment groundwater supplies.</td>
<td>Construction of conjunctive use project by Merced ID. Reclamation and increases in efficiencies of water use are underway.</td>
<td>Annual progress reports with financial audit report.</td>
<td>Merced ID progress reports to SJRGA.</td>
</tr>
<tr>
<td>4.3.3.2 Water Levels Groundwater from the Merced Groundwater Basin could be used to replace surface water for the flows (up to 67,500 acre-feet, 12% of the typical annual production).</td>
<td>Implementation of conjunctive use, reclamation, and increased efficiencies would augment groundwater supplies.</td>
<td>Construction of conjunctive use project by Merced ID.</td>
<td>Annual progress reports with financial audit report.</td>
<td>Merced ID progress reports to SJRGA.</td>
</tr>
</tbody>
</table>
### G. Mitigation Reporting Program

<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>(PS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.3.3.4 Subsidence Groundwater (up to 67,500 acre-feet) from the Merced Groundwater Basin could indirectly be used to replace surface water flows; there could be an impact on subsidence. (PS)</td>
<td>Limiting groundwater pumping in highly overdrafted areas, importing water, and developing or expanding recharge areas would reduce the impact.</td>
<td>Implement Water Supply Master Plan and AB3030 Groundwater Management Plan.</td>
<td>Annual progress reports with financial audit report. Projects are underway.</td>
<td>Merced ID progress reports to SJRGA.</td>
</tr>
<tr>
<td>4.5.3.3 Chinook Salmon Rapid changes in flows in the spring and fall may affect juvenile salmon and salmon redds. (PS)</td>
<td>Include ramping flows around the pulse and attraction flows.</td>
<td>SJRTC approves annual Operations Plan.</td>
<td>Implement in February-April of each year.</td>
<td>SJRTC reports to SJRGA, USBR, USFWS, and CDFG.</td>
</tr>
<tr>
<td>4.6.3.1 Agricultural Land Use Potential reduction of 104,500 acre-feet of Authority members’ water to irrigation customers could adversely impact cropping patterns and productivity. (PS)</td>
<td>Replacement of surface water by groundwater, including conjunctive use water or carryover storage.</td>
<td>Irrigation customers would receive alternative water from Districts or operate own private wells.</td>
<td>Annually, and depending on hydrologic conditions. For SJRGA members, annual progress reports with financial audit report.</td>
<td>Individual districts monitor groundwater levels through AB 3030 plans. Progress reports to SJRGA.</td>
</tr>
<tr>
<td>4.6.3.1 Agricultural Land Use Reduced deliveries by Merced ID could adversely affect agricultural production in the short term. (PS)</td>
<td>Implementation of conjunctive use program and groundwater pumping by individual farmers.</td>
<td>Construction of conjunctive use project by Merced ID. Farmers may operate private wells.</td>
<td>For Merced ID, annual progress reports with financial audit report. Use of private well water would occur</td>
<td>Merced ID progress reports to SJRGA.</td>
</tr>
</tbody>
</table>
### Identified Impact Mitigation Program

<table>
<thead>
<tr>
<th>Identified Impact</th>
<th>Mitigation Measures</th>
<th>Implementation Action</th>
<th>Timing Requirements</th>
<th>Reporting Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4.9.3.1 Reservoirs</strong>&lt;br&gt;Storage capacity decreased greater than 10% at Lake McClure in critical, dry, and below normal years during power peak production months, thus decreasing potential for hydropower generation. (PSU)</td>
<td>Not available.</td>
<td>None.</td>
<td>None.</td>
<td>None.</td>
</tr>
<tr>
<td><strong>4.9.3.2 Rivers</strong>&lt;br&gt;Flows decreased by more than 10% on Merced River in above normal years in June, thus decreasing potential for hydropower generation. (PSU)</td>
<td>Not available.</td>
<td>None.</td>
<td>None.</td>
<td>None.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Identified Impact</th>
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<th>Implementation Action</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>4.9.3.1 Reservoirs</strong>&lt;br&gt;Storage capacity decreased greater than 10% at Lake McClure in critical, dry, and below normal years during power peak production months, thus decreasing potential for hydropower generation. (PSU)</td>
<td>Not available.</td>
<td>None.</td>
<td>None.</td>
<td>None.</td>
</tr>
<tr>
<td><strong>4.9.3.2 Rivers</strong>&lt;br&gt;Flows decreased by more than 10% on Merced River in above normal years in June, thus decreasing potential for hydropower generation. (PSU)</td>
<td>Not available.</td>
<td>None.</td>
<td>None.</td>
<td>None.</td>
</tr>
</tbody>
</table>

Annually depending on hydrologic conditions.
G. Mitigation Reporting Program

G.2.1 PARTICIPANTS

The Hydrology Group of the SJRTC is responsible for the following tasks:

- Develop and exchange information concerning forecasted hydrologic conditions;
- Execute the protocols that establish the Test Flow Target and determine the San Joaquin River Group Supplemental Water (up to 110,000 acre-feet);
- Establish an operations plan for the coordination of flows; and
- Provide a post-analysis and report of operations.

The participants in the Hydrology Group are determined by the SJRTC and initially include, but are not limited to, the following: USBR, CDWR, and six members of the SJRGA (Modesto, Turlock, Merced, Oakdale, and South San Joaquin Irrigation Districts, and the Exchange Contractors). The Hydrology Group will coordinate with the SJRTC along with biologists and others involved in operations affecting San Joaquin River flows.

G.2.2 PLANNING PROCESS

G.2.2.1 Forecasting

No later than February 10, the Hydrology Group will develop a preliminary basin-wide Forecast Report of the San Joaquin River operations (without the effects of VAMP) for the February through June period. Forecasts will be provided for at least 90 percent and 50 percent probability of exceedence hydrologic runoff and water demand conditions. DWR runoff forecasts will be used as the basis of unimpaired runoff in the tributaries unless otherwise agreed. Each of the Hydrology Group participants is responsible for providing either reservoir operations plans or the information necessary to develop the appropriate reservoir operations plans for each affected tributary. Information regarding the planned operations of others affecting San Joaquin River flows to the Bay-Delta will also be acquired by the Hydrology Group.

The Forecast Report will be provided to the CALFED Operations Group, SJRA Biology Group, and local tributary groups. At a minimum, a revised Forecast Report will be provided the first week of March, mid-March, the first week of April and each week thereafter until the Operations Plan is employed. After the conclusion of the Spring Pulse Flows, the Hydrology Group will continue to share and update operations forecast information on a monthly basis so that the best available forecasts of San Joaquin River flows can be included in CVP/SWP operations plans.

G.2.2.2 Coordination with Biology Group

Although focused on test protocols that measure the survival of tagged hatchery salmon smolt, VAMP creates an opportunity to provide pulse flow conditions for smolts naturally spawned within
the San Joaquin River Basin. The Biology Group will heavily influence the scheduling of the Test Period. The VAMP Test Period of a continuous 31 days in April-May needs to coincide with the peak period of time when naturally spawned smolts are migrating out of the San Joaquin River Basin. Trade-offs in the scheduling of VAMP will be required to recognize the practicalities of hatchery operations, monitoring activities, barrier operation, and flow and export operational constraints.

The Biology Group is to provide its initial estimate of the preferred period for the VAMP flow beginning in February, coincident with the Hydrology Group’s Forecast Report, and provide an updated estimate coincident with each revised Forecast Report. Coincident with the mid-March Forecast Report, the Hydrology and Biology Groups will jointly identify the Tentative Test Period for use in subsequent planning efforts.

Concerning the release of water on the Merced River for the fall attraction flow and the release of Oakdale Irrigation District water from New Melones on the Stanislaus River, the timing of these releases will be adjusted to hydrologic conditions including water temperature. The Hydrology Group will coordinate with the Biology Group and the U.S. Fish and Wildlife Service (USFWS), CDFG, and National Marine Fisheries Service (NMFS) to forecast releases around the Spring Test Flow Target for ramping and to forecast the fall attraction flow release. Table G-1 summarizes existing and proposed stations for flow and water quality monitoring in the lower San Joaquin River Basin. Data from these stations will be used to define the release schedule.

G.2.2.3 VAMP Study Results

The Operations Plan will be developed annually and over the February-April period based on the hydrology forecast reports. It will consider the previous year’s fishery monitoring activities, including the results of the VAMP sampling activity during the 47-day April 15 - May 31 monitoring period and other results of the ongoing studies presented in Table G-2. VAMP not only documents the numbers of juvenile Chinook salmon but also other species collected. In addition, during the 47-day sampling period, temperature monitoring within the lower San Joaquin River from Mossdale to Chipps Island will be conducted. A documentation report will be prepared by December 1999 and in subsequent years.

G.2.3 OPERATIONS PLAN IMPLEMENTATION

The SJRGA members and USBR will carry out the Operations Plan using best efforts to make control point releases match the Operations Plan forecast of releases. Actual operations and hydrologic conditions will be tracked during the Test Period, and the information disseminated along with a projection of conditions anticipated for the remainder of the Test Period. The Hydrology Group will confer weekly to review schedules, beginning in late March. Storms, flood control, or other unforeseen events may require more frequent schedule changes. In order to maintain a stable flow,
G. Mitigation Reporting Program

an effort will be made to keep flows within a specified range above and below the target flows. In coordination with U.S. Fish and Wildlife Service (USFWS) and California Department of Fish
### Table G-2: FISHERIES MONITORING ACTIVITIES IN THE SAN JOAQUIN RIVER BASIN

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spawning</strong></td>
<td>Annual spawning surveys by CDFG to provide escapement estimates of fall-run chinook salmon. Weekly counts from October thru December (variable number of weeks per year). Includes estimates of redd counts and live fish counts.</td>
</tr>
<tr>
<td><strong>Seining</strong></td>
<td>No seine sampling currently being done.</td>
</tr>
<tr>
<td><strong>Smolts</strong></td>
<td>Rotary screw traps used to monitor fall-run salmon and steelhead smolt migration and survival. Up to three sampling locations; upper, middle, and lower river. Began in 1993 with lower river trap only. Expanded to three traps in 1995. Traps operated January thru June (if possible) by OID/SSJID and USFWS.</td>
</tr>
<tr>
<td><strong>Steelhead</strong></td>
<td>No specific sampling for steelhead is done in addition to rotary screw traps. However, CDFG initiated sampling in 1997 to collect steelhead for genetic analysis.</td>
</tr>
<tr>
<td><strong>CWT</strong></td>
<td>No CWT releases of fall-run chinook salmon have been made in the Stanislaus since approximately 1989.</td>
</tr>
<tr>
<td><strong>Other Species</strong></td>
<td>No specific sampling for other species done on a regular basis. Some snorkeling observations may be available. A predator population study may be proposed by USFWS.</td>
</tr>
<tr>
<td><strong>IFIM</strong></td>
<td>Most recent IFIM conducted by USFWS in 1993.</td>
</tr>
<tr>
<td><strong>Temperature Model</strong></td>
<td>Temperature model developed by USBR. Model has been designed to incorporate chinook salmon biological data to predict impacts to early life stages of salmon in the Stanislaus. Thermographs were placed at six locations along the river in January 1998 by S.P. Cramer &amp; Associates. A new temperature model is being developed by OID, SSJID, and others.</td>
</tr>
</tbody>
</table>
### RIVER BASIN (Cont.)

#### Tuolumne River

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spawning</td>
<td>Annual spawning surveys by CDFG to provide escapement estimates of fall-run chinook salmon. Weekly counts from October thru December (variable number of weeks per year). Includes estimates of redd counts and live fish counts. Surveys conducted annually since 1971.</td>
</tr>
<tr>
<td>Seining</td>
<td>Annual seine sampling at seven locations (five on Tuolumne River, two on San Joaquin River, above and below confluence) to determine density of fall-run salmon fry and smolts. Bi-weekly sampling from January to June. Sampling conducted by EA for TMID since 1986.</td>
</tr>
<tr>
<td>Smolts</td>
<td>Rotary screw traps used to monitor fall-run salmon smolt migration and survival. Up to three sampling locations; upper, middle, and lower river. Began in 1995 with lower river traps only. Traps operated by TMID and CDFG.</td>
</tr>
<tr>
<td>Steelhead</td>
<td>No specific sampling for steelhead, however annual spawning surveys, seining, and screw traps results provide some indirect monitoring during October to June.</td>
</tr>
<tr>
<td>CWT</td>
<td>Annual CWT releases of fall-run chinook from Merced River Fish Facility (occasional releases from out of basin hatcheries) by CDFG in spring, since 1986.</td>
</tr>
<tr>
<td>Other Species</td>
<td>No specific sampling for other species since summer flow studies conducted by EA for TMID from 1988-1994. Predator population study conducted by EA for TMID in 1989-1990. Seining provides some indirect monitoring during January to June.</td>
</tr>
<tr>
<td>IFIM</td>
<td>Most recent IFIM conducted by USFWS in 1992.</td>
</tr>
<tr>
<td>Temperature Model</td>
<td>SNTEMP model developed by EA for TMID; operates on a 5-day time step.</td>
</tr>
</tbody>
</table>

#### Table G-2: FISHERIES MONITORING ACTIVITIES IN THE SAN JOAQUIN RIVER BASIN (Cont.)

#### Merced River

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spawning</td>
<td>Annual spawning surveys by CDFG to provide escapement estimates of fall-run chinook salmon. Weekly counts from October thru December (variable number of weeks per year). Includes estimates of redd counts and live fish counts.</td>
</tr>
</tbody>
</table>

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G-10
live fish counts. In addition, approximately 50% of adult spawners are used annually by the Merced River Fish Facility for hatchery production of smolts. The hatchery has been in use since 1970 with a current production capacity of up to 1 million smolts.

<table>
<thead>
<tr>
<th>Seining</th>
<th>No seine sampling currently being done.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smolts</td>
<td>A single rotary screw trap near the mouth of the river is used to monitor fall-run salmon smolt migration and survival. Trap is operated by CDFG during spring months and began sampling in 1995.</td>
</tr>
<tr>
<td>Steelhead</td>
<td>No specific sampling for steelhead, however annual spawning surveys, hatchery observations, and screw trap results provide some indirect monitoring during October to June.</td>
</tr>
<tr>
<td>CWT</td>
<td>Annual CWT releases of fall-run chinook from Merced River Fish Facility (occasional releases from out of basin hatcheries) by CDFG in spring</td>
</tr>
<tr>
<td>Other Species</td>
<td>No known sampling for other species done on a regular basis</td>
</tr>
<tr>
<td>IFIM</td>
<td>Most recent IFIM conducted by USFWS in 1995.</td>
</tr>
<tr>
<td>Temperature Model</td>
<td>Data for temperature model collected by Jones &amp; Stokes for CDFG. Calibration and verification of model results not yet available.</td>
</tr>
</tbody>
</table>

**San Joaquin River above Vernalis**

| Seining       | USFWS has conducted seining in the river. Monitoring also is done for the river from Stockton to Highway 132 as part of the Interagency Ecological Program. |
and Game (CDFG), the Operations Group should develop and adopt a Best Management Practice (BMP) for supplying ramping guidelines (both up and down ramp) governing the release of attraction and pulse flows to ensure and maximize the protection of salmon.

G.3 CONJUNCTIVE USE AND WATER RECLAMATION/EFFICIENCY PROJECTS

The SJRGA is to be paid $4,000,000 annually (escalated annually by the Consumer Price Index) by the USBR and CDWR so long as the SJRGA and its members perform under the terms of the San Joaquin River Agreement (SJRA). The funds paid to the SJRGA are intended to be substantially used to enhance efficient water management within the districts including, but not limited to, water reclamation, conservation, conjunctive use, and system improvements. Use of these funds by the public agencies will be documented in each agency’s annual financial audit report. The funding is established for implementation of conjunctive use and other water efficiency projects that will mitigate potentially significant impacts to agricultural water users and to groundwater conditions.

The EIS/EIR identified two districts that may experience potentially significant reductions in water deliveries to their customers under below normal or dry/critically dry hydrologic conditions: Merced Irrigation District (Merced ID) and Oakdale Irrigation District (OID). The maximum amount of groundwater that could be pumped directly to ensure that each district meets its water obligation under the SJRA is 67,500 acre-feet for Merced ID and 15,000 acre-feet for OID. Because groundwater is typically used to replace much of the shortfall in surface water supplies, water delivery reductions resulting from the proposed project could result indirectly in an increase in groundwater pumping with subsequent potential impacts on overdraft, water levels, and subsidence in portions of the project area as discussed in Section 4.3 of the final EIS/EIR. Merced ID and OID service areas are the principally affected areas for which mitigation is required to reduce the impacts to water deliveries and groundwater conditions to less-than-significant levels. Their projects are described below.

In addition, the other willing sellers involved in the proposed project have implemented and/or are planning to implement water efficiency projects consistent with AB 3616 and in coordination with groundwater management plans (AB 3030) and current water supply plans (Modesto Irrigation District, Turlock Irrigation District, South San Joaquin Irrigation District, and San Joaquin River Exchange Contractors Water Authority).

G.3.1 MERCED IRRIGATION DISTRICT

The Merced Water Supply Plan (1995) calls for the stabilization of groundwater at 1992 levels. This is being accomplished by constructing and operating direct recharge facilities including a new conjunctive use project by the District. A pilot project for groundwater recharge involves three test basins. One recharge basin has been completed on City of Merced property near Farhen’s Park. For the conjunctive use project, a groundwater aquifer will be selected to act as a reservoir. In dry years, groundwater will be used to make up for the shortfall in surface water deliveries, and the aquifer will
be replenished during wet years with surface water from the Merced River. Studies to select a site have been completed with completion of the entire conjunctive use project within ten years. Most of the recharge of the Merced Groundwater Basin occurs from irrigation water diverted from the Merced River. Implementation of recharge facilities will replenish depleted groundwater supplies from ongoing activities as well as the direct and indirect impacts from the proposed project. Also, canal seepage contributes to recharging the Basin’s aquifers.

To reduce reliance on groundwater, Merced ID has implemented three programs to encourage groundwater pumpers to convert their systems to surface water: In-Canal Surface Water Incentive Program, On-Farm Low-Volume Incentive Program, and the Highlands Pilot Project (an agricultural water treatment plant). Expansion of these programs will also contribute to reductions in groundwater usage.

G.3.2 OAKDALE IRRIGATION DISTRICT

OID has several water efficiency projects underway and planned (OID/SSJID 1997).

- In conformance with the Memorandum of Understanding Regarding Efficient Water Management Practices by Agricultural Suppliers in California, OID is developing a Water Management Plan (WMP) which includes implementation of Efficient Water Management Practices (EWMPs). EWMPs include, but are not limited to: designation of a Water Conservation Coordinator, provision of water management services to water users, evaluation of institutional policies, and evaluation of groundwater pumps to improve efficiency.

- OID has already upgraded its tailwater recovery system so that captured return flows are available for use. The District is coordinating the operation of its tailwater reclamation pumps to increase the efficiency of the system and to further maximize the recovery system yield.

- OID is implementing a Supervisory Control and Data Acquisition system to closely monitor water delivery operations on a real time basis. Installation of the system began in 1996 and the District is currently adding approximately five monitoring/control sites per year.

- The District trains its Ditchtenders on the proper operation of its delivery system which includes training in water measurement as well as the proper documentation of where the water is being delivered.

- OID has purchased land for the installation of one regulating reservoir and is in the process of acquiring land for a second reservoir at the end of each main canal. These reservoirs will be used not only as re-regulating points but also for groundwater recharge.
G. Mitigation Reporting Program

- OID operates under its AB3030 Groundwater Management Plan (1996) which includes implementation of groundwater recharge and deep well pumping. The District has a conjunctive use plan that will allow for increases in groundwater use from surface water stored in aquifers.

Contacts:
Stanislaus River - Doug Demko, SP. Cramer and Associates
Tuolumne River - Tim Ford, Turlock Irrigation District
Merced River - Dave Vogel, Natural Resource Scientists
IFIM - Craig Fleming, U.S. Fish and Wildlife Service
G. Mitigation Reporting Program

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RESPONSES TO COMMENTS

INTRODUCTION

The Draft EIS/EIR was sent to the State Clearinghouse as required by CEQA (SCH# 98092062). The Clearinghouse submitted the document to selected state agencies for review. None of the state agencies provided comments to the Clearinghouse.

Comments received in writing are presented first, followed by transcripts of the two public hearings held in October 1998.

H.1. COMMENT LETTERS

Written comments were received from the following federal, state, regional, and local agencies and private organizations and individuals:

Federal Agencies

National Marine Fisheries Service
Environmental Protection Agency, Region IX
Fish and Wildlife Service

State

Department of Water Resources
Water Resources Control Board

Regional and Local

Central Delta Water Agency
Contra Costa Water District
Oakdale Irrigation District
Regional Council of Rural Counties
Sacramento Municipal Utility District
South Delta Water Agency
Stanislaus County Chief Executive Office
Stanislaus County Department of Planning and Community Development
Stanislaus County Sheriff’s Department
Stockton East Water District
H. Response to Comments

Organizations and Individuals

Earl Eckert  
Environmental Defense Fund  
Lorens M. Foard  
State Water Contractors

The following sections include a copy of each comment letter in the order presented above, followed by a response to that letter. Extensive exhibits provided with the letter from the South Delta Water Agency are not included with their letter, and they are on file with the lead agencies.
H. Response to Comments

H.2. PUBLIC HEARING TRANSCRIPTS

Transcripts of the two public hearings are attached. There were no formal public comments made at either meeting.
H. Response to Comments

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SECOND AMENDMENT TO THE SAN JOAQUIN RIVER AGREEMENT TO 
EXTEND TERM OF AGREEMENT

WHEREAS, on March 1, 1999, the San Joaquin River Group Authority and its member agencies (Modesto Irrigation District, Turlock Irrigation District, Merced Irrigation District, South San Joaquin Irrigation District, the Oakdale Irrigation District, the San Joaquin River Exchange Contractors Water Authority, and its member agencies, Central California Irrigation District, San Luis Canal Company, Firebaugh Canal Water District and Columbia Canal Company), the Friant Water Authority, the City and County of San Francisco (hereinafter referred to collectively as “the SJRGA”), the United States Bureau of Reclamation and the United States Fish and Wildlife Service (hereinafter referred to collectively as “DOI”), the California Department of Water Resources and the California Department of Fish and Game (hereinafter referred to collectively as “the State”), the State Water Contractors (“SWC”), Kern County Water Agency, Tulare Lake Basin Water Storage District, Santa Clara Valley Water District, San Luis-Delta Mendota Water Authority (“SLDMWA”), Westlands Water District, Metropolitan Water District of Southern California, and the Natural Heritage Institute (collectively referred to as “the Parties”) entered into an agreement known as “The San Joaquin River Agreement (SJRA);” and

WHEREAS, the SJRA expired by its own terms on December 31, 2009; and

WHEREAS, the “Amendment To The San Joaquin River Agreement To Extend Term Of Agreement” which was executed on January 1, 2010, extended the SJRA until December 31, 2010;

WHEREAS, the environmental analysis prepared for the SJRA (Meeting Flow Objectives for the San Joaquin River Agreement, 1999-2010) expires on December 31, 2010; and

WHEREAS, Paragraph 22.0 of the SJRA requires that any modification thereto be made in writing and signed by the parties against whom enforcement of such modification is sought.

NOW, THEREFORE, the SJRGA, DOI, State, SWC, SLDMWA and the other Parties hereby agree to modify the San Joaquin River Agreement as follows:

1. Paragraph 4.0 of the March 1, 1999, SJRA is modified to read: “This Agreement shall terminate on December 31, 2011, unless extended pursuant to Paragraph 5.1 or Paragraph 22, or terminated earlier pursuant to Section 13.”

2. Paragraph 5.3 of the SJRGA is modified as follows: (a) at the end of the first sentence, add: “Such a year shall be referenced as an “Off Ramp Year.”; (b) change the second sentence to read “The USBR has continuing obligations to meet San Joaquin River flows pursuant to the applicable Biological Opinions.”
3. Payment for 2011 will be made in accordance with Paragraph 6.1 of the SJRA.

4. Paragraph 6.3 is modified to add the language at the end of that section: “In the event that 2011 is an Off Ramp Year, as defined, payment for that year shall be made to the SJRGA”.

5. Paragraph 3.2 is modified to read as follows:

“‘Existing Flow’ – the forecasted flows in the San Joaquin River at Vernalis during the Pulse Flow Period that would exist absent (1) the VAMP, (2) flows provided by Reclamation from New Melones pursuant to the requirements of the 2009 National Marine Fisheries Service’s Final Biological Opinion for the Operations, Criteria and Plan Regarding Effects of Continued Long Term Operations of the Central Valley Project and State Water Project, or (3) water acquisitions, including but not limited to the following:

For 2011 only, San Joaquin River Restoration Flows will be considered neither part of the ‘existing flow’ nor part of the ‘compliance flow’.

6. In recognition of the OCAP-Biological Opinion Paragraph 5.4 is supplemented to include the following language:

“The operation of New Melones Reservoir for the period of June 1, 2009 through the date of final determination of the SJRGA’s VAMP contribution for 2011 will be post-assessed to estimate end of month reservoir storage as though it had been operated absent the National Marine Fishery Service’s (NMFS) Reasonable and Prudent Alternatives (RPAs). This post-assessed storage condition will then be used to estimate an adjusted NMI for a projection of New Melones Reservoir operations for the VAMP period, as though the 1997 IPO is in place. The projected non-VAMP operation of the tributaries combined with the projected 1997 IPO operation of New Melones Reservoir will be used to determine the Existing Flow for the VAMP period; that will be used to determine the VAMP Target Flow. And then that will determine the SJRGA supplemental water volume. The volume of SJRGA supplemental water will not be changed for the duration of VAMP operations.”

Reclamation is responsible for preparing for acceptance by the SJRGA the post-assessment and projection of New Melones Reservoir storage and operations under the 1997 IPO. The first post-assessment will be prepared and submitted by the 15th of the month following the execution of this agreement and subsequently by the 15th of the month following months until the date of final determination of the SJRGA’s VAMP contribution. The operator contact for the SJRGA will be Mike Archer and the operator contact for the USBR will be Paul Fujitani”.

7. In recognition of the OCAP Biological Opinion Paragraphs 5.5 and 5.6 are supplemented to include the following language:
“The SJRGA will be responsible for meeting its share of the VAMP Target Flows during the 31 day Tributary operations first and foremost, regardless of the CVP contribution from New Melones under the OCAP Biological Opinion RPAs. The Parties also recognize the RPA contributions may cause actual flows at Vernalis to exceed VAMP Target Flows during the 31-day period.”

8. The Parties agree to abide by all the terms and conditions of the March 1, 1999 SJRA, as modified herein, through December 31, 2011, unless the San Joaquin River Agreement is terminated earlier pursuant to Section 13 or otherwise extended.

9. Prior to December 31, 2011, the Parties may consider another extension to the SJRA. If the parties agree to further extensions of the SJRA, the Parties agree to negotiate in good faith any additional modifications or changes to the terms and conditions hereof, as well as to seek any and all necessary permits, approvals, authorities, and to complete all necessary documents, analyses and studies, including environmental studies, necessary to continue the performance of the SJRA.

10. This Second Amendment shall be in effect only if adequate NEPA coverage is in place that covers this Amendment.

11. This Second Amendment and all amendments and supplements to it may be executed in counterparts, and all counterparts together shall be construed as one document.

IN WITNESS WHEREOF, the parties hereto have executed this Amendment to be effective as of the latest day and the year listed hereafter, or January 1, 2011, whichever is earlier.

Dated: 11-22-10

By: [Signature]
San Joaquin River Group Authority
IN WITNESS WHEREOF, the parties hereto have executed this Amendment to be effective as of the latest day and the year listed hereafter, or January 1, 2011, whichever is earlier.

Dated: 1/3/2010

By: [Signature]

United States Fish and Wildlife Service
IN WITNESS WHEREOF, the parties hereto have executed this Amendment to be effective as of the latest day and the year listed hereafter, or January 1, 2011, whichever is earlier.

Dated: 12/20/10

By: ____________________________
    (Signature)

United States Bureau of Reclamation
IN WITNESS WHEREOF, the parties hereto have executed this Amendment to be effective as of the latest day and the year listed hereafter, or January 1, 2011, whichever is earlier.

Dated: _______________    By: __________________________________________

California Department of Water Resources
IN WITNESS WHEREOF, the parties hereto have executed this Amendment to be effective as of the latest day and the year listed hereafter, or January 1, 2011, whichever is earlier.

Dated: ______________ By: ______________________________________

California Department of Fish and Game
IN WITNESS WHEREOF, the parties hereto have executed this Amendment to be effective as of the latest day and the year listed hereafter, or January 1, 2011, whichever is earlier.

Dated: 12-20-10

By: __________________________

[Signature]

Modesto Irrigation District
IN WITNESS WHEREOF, the parties hereto have executed this Amendment to be effective as of the latest day and the year listed hereafter, or January 1, 2011, whichever is earlier.

Dated: 12-21-10

By: [Signature]

Turlock Irrigation District
IN WITNESS WHEREOF, the parties hereto have executed this Amendment to be effective as of the latest day and the year listed hereafter, or January 1, 2011, whichever is earlier.

Dated: 12/14/10  
By: [Signature]

[Merced Irrigation District]
IN WITNESS WHEREOF, the parties hereto have executed this Amendment to be effective as of the latest day and the year listed hereafter, or January 1, 2011, whichever is earlier.

Dated: Dec 14, 2010        By: [Signature]

South San Joaquin Irrigation District
IN WITNESS WHEREOF, the parties hereto have executed this Amendment to be effective as of the latest day and the year listed hereafter, or January 1, 2011, whichever is earlier.

Dated:  

By:  
San Joaquin River Exchange Contractors
IN WITNESS WHEREOF, the parties hereto have executed this Amendment to be effective as of the latest day and the year listed hereafter, or January 1, 2011, whichever is earlier.

Dated: 12/14/10  By: __________________________

Oakdale Irrigation District
IN WITNESS WHEREOF, the parties hereto have executed this Amendment to be effective as of the latest day and the year listed hereafter, or January 1, 2011, whichever is earlier.

Dated: 12-15-2010

By: [Signature]

[Print: Plant Water Authority]
IN WITNESS WHEREOF, the parties hereto have executed this Amendment to be effective as of the latest day and the year listed hereafter, or January 1, 2011, whichever is earlier.

Dated: ________________________________  By: ________________________________

San Luis & Delta-Mendota Water Authority
IN WITNESS WHEREOF, the parties hereto have executed this Amendment to be effective as of the latest day and the year listed hereafter, or January 1, 2011, whichever is earlier.

Dated: By: ________________________________

State Water Contractors