Grassland Bypass Project, 2010–2019

Environmental Impact Statement and Environmental Impact Report

Draft

December 2008

Prepared for:

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SCH #: 2007121110

DRAFT
ENVIRONMENTAL IMPACT STATEMENT/ENVIRONMENTAL IMPACT REPORT
GRASSLAND BYPASS PROJECT, 2010-2019

Lead Agencies:	U. S. Department of the Interior, Bureau of Reclamation (Reclamation), Mid-Pacific Region, Sacramento and Fresno, California; and San Luis and Delta-Mendota Water Authority (Authority), Los Banos, California
Cooperating Agencies:	U. S. Fish and Wildlife Service; U.S. Environmental Protection Agency; U.S. Geological Survey; Central Valley Regional Water Quality Control Board; California Department of Fish and Game

This Draft Environmental Impact Statement/Environmental Impact Report (Draft EIS/EIR) has been developed for the new Use Agreement for the proposed continuation of the Grassland Bypass Project, 2010–2019, (proposed 2010 Use Agreement) in accordance with the National Environmental Policy Act of 1969 (NEPA), as amended and the California Environmental Quality Act of 1970 (CEQA). The major Federal action significantly affecting the quality of the environment is the execution of the 2010 Use Agreement by Reclamation for the period January 1, 2010, through December 31, 2019. The CEQA action is the approval and implementation of the Grassland Bypass Project by the Authority (following certification of the Final EIS/EIR). The original Use Agreement, dated November 3, 1995, allowed the Authority to use a portion of the San Luis Drain (Drain) to convey agricultural drainwater through adjacent wildlife management areas to Mud Slough, a tributary to the San Joaquin River. The 1995 Use Agreement allowed for use of the Drain until September 30, 2001. The 2001 Use Agreement allowed continuation of the use of the Drain through December 31, 2009. The proposed 2010 Use Agreement would permit the Authority to continue the Grassland Bypass Project through December 31, 2019.

The purposes and objectives of the proposed continuation of the Grassland Bypass Project, 2010–2019 (Proposed Action) are:

- To extend the San Luis Drain Use Agreement in order to allow the Grassland Basin Drainers time to acquire funds and develop feasible drainwater treatment technology to meet revised Basin Plan objectives (amendment underway) and WDRs by December 31, 2019.
- To continue the separation of unusable agricultural drainage water discharged from the GDA from wetland water supply conveyance channels for the period 2010–2019.
- To facilitate drainage management that maintains the viability of agriculture in the Project Area and promotes continuous improvement in water quality in the San Joaquin River.

The Proposed Action is needed to assure that any future use of the Drain beyond 2009 is consistent with the long-term Westside Regional Drainage Plan and the San Luis Drainage Feature Re-evaluation (SLDFR) plan for drainage service. The process of negotiation with the resource agencies and affected stakeholders for the proposed 2010 Use Agreement provides for compliance with applicable water quality control programs including Basin Plan and WDR amendments.

The Proposed Action would continue the present drainwater conveyance using the Drain with discharge of a portion of the collected drainwater to Mud Slough. New features include negotiation with Reclamation and other stakeholders for a proposed 2010 Use Agreement for the Drain, to include an updated compliance monitoring plan, revised selenium and salinity load limits, an enhanced incentive performance fee system, a new WDR from the Regional Board, and mitigation for continued discharge to Mud Slough. In-Valley treatment/drainage reuse at the SJRIP facility would be expanded to 6,900 acres.

The Draft EIS/EIR examines two other alternatives: No Action and the 2001 Requirements Alternative. This other action alternative would continue the selenium load reductions and incentive fees of the 2001 Use Agreement.

Reclamation and the Authority will consider comments on the Draft EIS/EIR during the 60-day public review period. For further information regarding this Draft EIS/EIR or to provide comments, contact Ms. Judi Tapia, U. S. Bureau of Reclamation, South Central California Area Office, 1243 N Street, Fresno, CA 93721-1813, (559) 487-5138, fax: (559) 487-5397, jtapia@mp.usbr.gov; or Mr. Joseph C. McGahan, Regional Drainage Coordinator (for San Luis and Delta-Mendota Water Authority), Summers Engineering, Inc., P. O. Box 1122, Hanford, CA 93232-1122, (559) 582-9237, fax: (559-582-7632, jmcgahan@summerseng.com.

SCH#: 2007121110

US BUREAU OF RECLAMATION
AND
SAN LUIS & DELTA-MENDOTA WATER AUTHORITY

Grassland Bypass Project, 2010–2019

Environmental Impact Statement
and
Environmental Impact Report

DRAFT
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Executive Summary

ES.1 BACKGROUND

This document has been developed for the new Use Agreement for the proposed continuation of the Grassland Bypass Project, 2010–2019, (proposed 2010 Use Agreement) in accordance with the National Environmental Policy Act of 1969 (NEPA), as amended and the California Environmental Quality Act of 1970 (CEQA). The NEPA/CEQA process for this Environmental Impact Statement/Environmental Impact Report (EIS/EIR) was initiated in July 2007. The U.S. Bureau of Reclamation, Mid-Pacific Region (Reclamation) is the lead agency under NEPA, and the San Luis and Delta-Mendota Water Authority (Authority) is the lead agency under CEQA. The major Federal action significantly affecting the quality of the environment is the execution of the 2010 Use Agreement by Reclamation for the period January 1, 2010, through December 31, 2019. The CEQA action is the approval and implementation of the Grassland Bypass Project by the Authority (following certification of the Final EIS/EIR).

The original Grassland Bypass Project was for a maximum 5-year interim use of a portion of the San Luis Drain (Drain) by the Authority for conveyance of drainwater through the GWD and adjacent area. The original project was implemented in November 1995 through an “Agreement for Use of the San Luis Drain” (Agreement No. 6-07-20-w1319) between Reclamation and the Authority (1995 Use Agreement). A Finding of No Significant Impact (FONSI No. 96-01-MP, dated November 3, 1995) was adopted by Reclamation for the original project (Reclamation 1995), and environmental commitments set forth in the FONSI were made an integral component of the 1995 Use Agreement. The project became officially operational for purposes of the 5-year period on September 23, 1996. The 1995 Use Agreement and its renewal in 1999 allowed for use of the Drain for a 5-year period that concluded September 30, 2001. Continued use of the Drain after the term of the existing 1995 Use Agreement required a revised Use Agreement and additional environmental compliance with NEPA and CEQA. A new Use Agreement (Agreement No. 01-WC-20-2075) was completed on September 28, 2001, for the period through December 31, 2009, between Reclamation and the Authority, following completion of the Grassland Bypass Project Final EIS/EIR, May 2001, by Reclamation and the Authority (Reclamation 2001).

In March 1996, the Grassland Area Farmers (GAF) formed a regional drainage entity under the umbrella of the Authority to implement the Grassland Bypass Project and manage subsurface drainage within the Grassland Drainage Area (GDA). Participants included the Broadview Water District, Charleston Drainage District, Firebaugh Canal Water District, Pacheco Water District, Panoche Drainage District, Widren Water District, and the Camp 13 Drainers (an association of landowners located in the Central California Irrigation District). The GAF’s drainage area consists of approximately 97,400 gross acres of irrigated farmland on the west side of San Joaquin Valley and is known as the GDA. Discharges of subsurface drainage from this area contain salt, selenium, and boron.

ES.2 PROJECT PURPOSE AND NEED

The Grassland Bypass Project's subsurface drainage flows discharged to Mud Slough (North) were to have met water quality objectives by October 1, 2010 as required by the Regional Board's 1998 *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins Fourth Edition* (1998 Basin Plan) (Regional Board 1998a). The 1998 Basin Plan mandates a maximum concentration of selenium in Mud Slough (North) and the San Joaquin River below Sack Dam and a deadline for meeting water quality objective. Agricultural drainage water from the Grassland Drainage Area (GDA) is the major source of selenium in this slough and the river.

The 1998 Basin Plan established water quality objectives of 5 ppb (4-day average) selenium concentration in the San Joaquin River at the mouth of the Merced River. The objective is currently in effect for Above Normal and Wet Water Years and takes effect October 1, 2010, for Critical, Dry and Below Normal Years. The objective for Mud Slough (North) is also a 5 ppb (4-day average) and takes effect on October 1, 2010.

The GAF currently discharge agricultural drainage water from the GDA into Mud Slough with a daily average concentration of 54 ppb. At this time, the GAF do not have the funds or technology to reduce the concentration of selenium in the drainwater, and cannot do so by the October 2010 deadline.

The Grassland Bypass Project has provided the institutional framework to manage and control agricultural drainage in the GDA, greatly reducing the load of selenium discharged from the GDA, thus eliminating contamination in the Grasslands wetland water supply channels. Stakeholders, regulatory agencies, and environmental groups have endorsed the Project. Federal and state agencies have funded research and environmental monitoring to support the Project.

ES.3 PROJECT OBJECTIVES

The purposes and objectives of the proposed continuation of the Grassland Bypass Project, 2010–2019 (Proposed Action) are:

- To extend the San Luis Drain Use Agreement in order to allow the GBD time to acquire funds and develop feasible drainwater treatment technology to meet revised Basin Plan objectives (amendment underway) and WDRs by December 30, 2019.
- To continue the separation of unusable agricultural drainage water discharged from the GDA from wetland water supply conveyance channels for the period 2010–2019.
- To facilitate drainage management that maintains the viability of agriculture in the Project Area and promotes continuous improvement in water quality in the San Joaquin River.

In order to continue to discharge into Mud Slough (North) in the state's China Island Wildlife Area, the Authority would need to extend or amend a Memorandum of Understanding (MOU) with the California Department of Fish and Game (CDFG), Reclamation would need to extend the Use Agreement with the Authority for the continued use of the San Luis Drain after 2009, the Regional Board would need to amend the 1998 Basin Plan to delay the compliance date for objectives and issue revised WDRs permitting continuing discharges consistent with the amended Plan. Also, it is anticipated that at some point during implementation of the Proposed (or Alternative) Action, Reclamation and the Authority will need to remove existing and future sediments from the affected portion of the Drain. The Regional Board initiated CEQA scoping for amending the Basin Plan on September 25, 2008.

The Proposed Action is needed to assure that any future use of the Drain beyond 2009 is consistent with the long-term Westside Regional Drainage Plan and the San Luis Drainage Feature Re-evaluation (SLDFR) plan for drainage service. The process of negotiation with the resource agencies and affected stakeholders for the proposed 2010 Use Agreement provides for compliance with applicable water quality control programs including Basin Plan and WDR amendments.

ES.4 PUBLIC AND AGENCY INVOLVEMENT

The Bureau of Reclamation (Reclamation) and the San Luis and Delta-Mendota Water Authority (Authority) began discussions with stakeholders in early 2007 on an extension of the 2001 Use Agreement. Agencies and organizations participating in the development of the proposed 2010 Use Agreement met several times between July 2007 and April 2008 to develop terms and conditions dealing with selenium, salt, mitigation, and monitoring for the proposed 2010 Use Agreement. Participating stakeholder agencies and organizations are: Contra Costa County, Contra Costa Water District, Environmental Defense, The Bay Institute, U.S. Fish and Wildlife Service (Service), California Department of Fish and Game, Environmental Protection Agency, and the Central Valley Regional Water Quality Control Board (Regional Board).

Reclamation and the Authority distributed a Notice of Preparation of a joint EIS/EIR on the Continuation of the Grassland Bypass Project, 2010–2019, on December 20, 2007, to 205 agencies and individuals. On December 21, 2007, a Notice of Intent to prepare a joint EIS/EIR was published in the *Federal Register*. The notices announced the public scoping meeting and requested that comments on the content of the EIS/EIR and the project be submitted by January 25, 2008. Furthermore, notices were placed in two newspapers of general circulation in the project area: the *Merced Sun-Star* on December 22, 2007, and the *Fresno-Bee* on December 23, 2007. The scoping meeting was held at the San Luis & Delta-Mendota Water Authority boardroom on January 17, 2008, from 1:30 pm to 3:30 pm.

The Regional Board is preparing an amendment to the 1998 Basin Plan, under the selenium control program, to modify the effective date of the conditional prohibition of discharge of subsurface drainage to Mud Slough (North) for an additional nine years. The Regional Board held two public scoping meetings on the Basin Plan amendment in October-November, 2008, and is relying on this EIS/EIR for CEQA compliance for the Basin Plan amendment.

ES.5 ALTERNATIVES CONSIDERED AND PREFERRED ALTERNATIVE

The No Action Alternative is defined as what could be expected to occur in the foreseeable future (after December 31, 2009) if the Use Agreement for the San Luis Drain (Drain) is not approved. Under this alternative, the GAF would not have use of the Drain. Agricultural subsurface drainage would not be collected into a single drainage outlet (Grassland Bypass Channel) for conveyance to the Drain. The 2001 Use Agreement will have expired by December 31, 2010.

The No Action Alternative is a construct based not only upon failing to take the Proposed Action to use the Drain, but also upon continuing an ongoing program for drainage management, including the initial phases of the regional reuse facility. Even a partial program will require projects that are not currently planned or financed, at both the district and farmer level, in order to maintain viable agriculture over the long term. No Action is not equivalent to the December 2007 existing condition in which the 2001 Use Agreement is in effect in 2007.

For example, the GAF and district managers indicate that it is not realistic to assume that 100 percent of subsurface water generated by sumps will be recycled, due to physical constraints and to the mismatch in certain months between the volumes of water for which recirculation would be required and the capacity of cropped land and drainwater reuse facility to receive such water, without significant crop damage (Grassland Steering Committee 2000). Without the continuation of the Grassland Bypass Project, 2010–2019, and a management system that addresses all discharges, seepage into wetland habitats that would violate water quality standards would occur, and unmanageable ponding of high selenium water would occur at the lower elevations on private property. However, because no other practices or facilities are currently available to deal with drainage without a drainage outlet, the No Action Alternative is defined as a “maximum recycling scenario.”

The regional reuse facility (known as the San Joaquin River Water Quality Improvement Project [SJRIP]) has been partially constructed, and an expansion of the 4,000-acre facility by 2,900 acres was approved by Panoche Drainage District on August 21, 2007. At present, approximately 2,239 acres have been acquired, of which 2,009 acres have been added to the SJRIP. Therefore, under the No Action Alternative, the maximum recycling scenario begins the application of subsurface drainage water on salt-tolerant crops on just over 6,000 acres.

The estimated average drainage production of the region is currently 26,400 acre-feet per year. With the current source control activities, recycling, and drainage reuse, approximately 23,000 acre-feet per year could be managed. The remaining 3,400 acre-feet per year would have no point of discharge and could not be recirculated without additional projects. This would result in ponding of seleniferous water and a rise in groundwater in the lower portions of the region. Additionally, it is assumed that the existing drainage systems within the SJRIP would not be operated (as there would be no place to put this water) and, over time, the reuse capacity of the SJRIP would diminish as salt accumulated within the root zone and the ability of the SJRIP to support salt tolerant crops declined. Water table rise would occur along with seepage at the lower elevations that could enter wetland habitats. With drainwater focused at the reuse facility, agricultural production on other lands would continue in the short term. As the reuse capacity diminished, fields in the lower portion of the region would become waterlogged and unfarmable and would be abandoned. Once the reuse facility became inoperative, individual districts and farmers would have to recycle drainwater “on farm and within districts.” In short, the reuse facility needs additional actions to be taken to operate as designed over the long term. Under No Action, it would remain a partially constructed facility.

The Proposed Action is the continuation of the Grassland Bypass Project for the period 2010–2019 (Project) under the terms and conditions of the proposed “2010 Use Agreement for Use of the San Luis Drain.” The Grassland Bypass Project, 2010–2019, would continue to consolidate subsurface drainflows on a regional basis and utilize a portion of the Federal San Luis Drain to convey drainflows around wetland habitat areas after the 2001 Use Agreement expires. The

Project would continue to collect drainwater from the 97,400-acre GDA and place it into the Drain at a point near Russell Avenue (Site A – San Luis Drain near South Dos Palos, California). The drainage would continue to travel in the Drain to its northern terminus (Site B– San Luis Drain near Gustine, California). From here, the drainage would enter Mud Slough (North) for 6 miles before reaching the San Joaquin River at a location 3 miles upstream of its confluence with the Merced River. An adjacent area of 1,100 acres could be annexed to the GDA. The Proposed Action includes the new Use Agreement with its new terms and conditions for operation of the Grassland Bypass Project, 2010–2019.

Existing features of the 1996 and 2001 Grassland Bypass Projects that would continue under the Proposed Action include the following:

- The removal of agricultural drainwater from 93 miles of conveyance channels in the Grassland wetlands and wildlife refuges, except during high rainfall conditions. Any discharges to these conveyance channels would be in accordance with the existing Storm Water Plan, as modified consistent with the Use Agreement. These channels are shown on Figure 2-1.
- The use of the Grassland Bypass Channel, a 4-mile-long constructed earthen ditch and an existing drain that was modified to convey drainwater from the Panoche and Main Drain to the San Luis Drain at Russell Avenue. Drainwater from Charleston Drainage District, Pacheco Water District, and Panoche Drainage District would continue to be collected in the Panoche Drain. Drainwater from Firebaugh Canal Water District and the Camp 13 drainage area would continue to be conveyed in the existing Main Drain. Drainage collected from any adjacent lands added to the Project Area would be added to the Main Drain, the Panoche Drain, or the Grassland Bypass Channel within their existing design capacities. Broadview Water District and Widren Water District are no longer irrigated with surface water and do not contribute drainage to the Grassland Bypass Channel.
- The drainwater would continue to travel approximately 28 miles in the Drain to its northern terminus (Site B – San Luis Drain near Gustine, California). From that point, the drainwater would enter Mud Slough (North) for 6 miles before reaching the San Joaquin River at a location 3 miles upstream of its confluence with the Merced River.

The design for the original 1996 Grassland Bypass Project limited the flow to 150 cubic feet per second (cfs), primarily to prevent suspension of sediments. The Proposed Action would retain this designed flow capacity until all existing sediments are removed.

New features of the Proposed Action would include:

- Negotiation with U.S. Bureau of Reclamation (Reclamation) (and other stakeholders) for a proposed 2010 Use Agreement for the Drain, to include an updated compliance monitoring plan, revised selenium and salinity load limits, an enhanced incentive performance fee system, a new WDR from the Regional Board, and mitigation for continued discharge to Mud Slough.
- In-Valley treatment/drainage reuse at the SJRIP facility.
- Other drainage management actions to meet water quality objectives/load limits.

The only other reasonable alternative is known as the 2001 Requirements Alternative and is similar to the Proposed Action in all aspects except the selenium and salt loads discharged to Mud Slough would be limited to those in the 2001 Use Agreement (i.e., less stringent allowances). It does not include the Mud Slough mitigation component. This alternative does not avoid or substantially lessen any potentially significant impact of the Proposed Action but it is technically feasible. While the Alternative Action does not meet current Mud Slough selenium objectives for 2010, it does meet San Joaquin River objectives. In short, it represents a continuation of the 2001 Use Agreement "as is" until December 31, 2019.

The continuation of the Grassland Bypass Project, 2010–2019, is the preferred alternative because it meets more stringent selenium load requirements for discharges to Mud Slough and contains a Mud Slough mitigation component, while a continuation of the 2001 Use Agreement requirements would not have these environmental improvements.

ES.6 SUMMARY OF ENVIRONMENTAL EFFECTS

Table ES-1 provides a summary of all of the environmental effects for No Action, the continuation of Grassland Bypass Project, and the 2001 Requirements Alternative and whether mitigation measures are available to reduce the impact for the Action Alternatives. There is no mitigation for No Action. The existing condition of December 2007 (with current 2001 Use Agreement in effect for this point in time) sets the baseline against which the alternatives are evaluated for CEQA determinations of significance, while No Action (the reasonably foreseeable future with no Use Agreement) is the baseline for comparison of alternatives for NEPA. Impact statements are abbreviated; see Sections 4 through 13 for complete statements of impact. The Mitigation Monitoring and Reporting Program required by CEQA is provided in Section 15. Impact determinations used in the table for CEQA determinations of impact including beneficial impacts are:

- Significant adverse impact
- Significant adverse impact, unavoidable
- Potentially significant adverse impact
- Less-than-significant adverse impact
- No impact
- Beneficial impact (either significant or less than significant)

Determinations used for the NEPA comparison of alternatives are:

- Negative effect
- Neutral effect or minimal effect
- Positive effect

Table ES-1 Summary of Impacts

Resource	No Action Alternative Compared to Existing Condition	Proposed Action Compared to No Action	Proposed Action Compared to Existing Condition	Alternative Action Compared to No Action	Alternative Action Compared to Existing Condition
Surface Water Resources					
Selenium (Se) in Sloughs and San Joaquin River (SJR) Upstream of Merced River	*Significant Beneficial Impact* No change in Salt Slough or SJR upstream of Mud Slough; Se concentrations substantially lower in Mud Slough and San Joaquin River downstream of Mud Slough; Se water quality objectives (WQOs) are achieved for these reaches.	*Negative Effect* No change in Salt Slough or SJR upstream of Mud Slough; WQOs will not be met in Mud Slough and the SJR between Mud Slough and the Merced River. Se in GDA subsurface drainage continues to enter SJR downstream of Mud Slough but decreases over time.	*Significant Beneficial Impact* No change in Salt Slough or SJR upstream of Mud Slough; Reduction in Se concentrations in Mud Slough and SJR downstream of Mud Slough; WQOs are achieved more frequently for these reaches.	*Negative Effect* No change in Salt Slough or SJR upstream of Mud Slough; Se concentrations remain elevated in Mud Slough and SJR downstream of Mud Slough; WQOs are achieved less frequently for these reaches; WQO are achieved less frequently than the Proposed Action.	*Significant Beneficial Impact* No change in Salt Slough or SJR upstream of Mud Slough; Se concentrations lower in Mud Slough and SJR downstream of Mud Slough. WQOs achieved more frequently for these reaches; however, WQO are achieved less frequently than the Proposed Action.
Se in Wetlands During Storm Events	*Potentially Significant Adverse Impact* Se concentrations in wetland water supply channels increased due to uncontrolled flow of drainwater and stormwater into wetland supply channels.	*Positive Effect* Se concentrations in wetlands decreased due to routing of storm event and uncontrolled flows that do not exceed 150 cfs around wetlands.	*No Impact* Se concentrations essentially unchanged from existing condition due to routing of similar sized storm event flows around wetlands.	*Positive Effect* Se concentrations in wetlands decreased due to routing of storm event and uncontrolled flows that do not exceed 150 cfs around wetlands.	*No Impact* Se concentrations essentially unchanged from existing condition due to routing of similar sized storm event flows around wetlands.
Se in Wetlands During Dry Weather	*Potentially Significant Adverse Impact* Se concentrations in wetlands water supply channels increased due to uncontrolled flow without a drainage outlet.	*Positive Effect* Se concentrations in wetlands water supply channels decreased due to routing of seepage around wetlands, wetlands no longer receive uncontrolled flows.	*No Impact* Se concentrations essentially unchanged from existing conditions due to routing of drainage water around wetlands.	*Positive Effect* Se concentrations in wetlands water supply channels decreased due to routing of seepage around wetlands; wetlands no longer receive uncontrolled flows.	*No Impact* Se concentrations essentially unchanged from existing conditions due to routing of drainwater around wetlands.
Se in SJR Downstream of Merced River	*Significant Beneficial Impact* Se concentrations substantially lower in river; WQOs in the river are achieved.	*Negative Effect* Se concentrations in river increased due to drainwater. Se concentrations higher than WQO for some water years and year types.	*Significant Beneficial Impact* Se concentrations in river decrease as a result of reduced discharges of drainwater. WQOs in river are achieved more frequently.	*Negative Effect* Se concentrations in river increased due to drainwater. Se concentrations higher than WQO for some water years and year types; WQO are achieved less frequently than the Proposed Action.	*Significant Beneficial Impact* Se concentrations in river decrease as a result of reduced discharges of drainwater. WQOs in river are achieved more frequently; however, WQO are achieved less frequently than the Proposed Action.

Table ES-1 Summary of Impacts

Resource	No Action Alternative Compared to Existing Condition	Proposed Action Compared to No Action	Proposed Action Compared to Existing Condition	Alternative Action Compared to No Action	Alternative Action Compared to Existing Condition
Salinity in Sloughs/SJR Upstream of Merced River	*Less-than-Significant Beneficial Impact* Salinity concentrations in Mud Slough and SJR downstream of Mud Slough decrease; WQOs not assigned for these reaches.	*Negative Effect* Salinity concentrations in Mud Slough and SJR downstream of Mud Slough increase; WQOs not assigned for these reaches.	*Less-than-Significant Beneficial Impact* Salinity concentrations decrease in Mud Slough and the SJR downstream of Mud Slough as a result of reduced discharges of drainwater; WQOs not assigned for these reaches.	*Negative Effect* Salinity concentrations in Mud Slough and SJR downstream of Mud Slough increase; WQOs not assigned for these reaches.	*Less-than-Significant Beneficial Impact* Salinity concentrations in Mud Slough and SJR downstream of Mud Slough decrease as a result of reduced discharges of drainwater; WQOs not assigned for these reaches.
Salinity in SJR Downstream of Merced River	*Significant Beneficial Impact* Reduction in salt load would reduce salinity concentrations; WQOs are predicted to be achieved at Vernalis.	*Neutral Effect* Salinity concentrations at Vernalis increase; however, WQOs are predicted to be achieved at Vernalis.	*Significant Beneficial Impact* Salinity concentrations at Vernalis decrease as a result of reduced discharges of drainwater. Salinity WQOs are predicted to be achieved at Vernalis.	*Neutral Effect* Salinity concentrations at Vernalis increase; however, WQOs are predicted to be achieved at Vernalis.	*Significant Beneficial Impact* Salinity concentrations at Vernalis decrease as a results of reduced discharges of drainwater. Salinity WQOs are predicted to be achieved at Vernalis.
Boron in Sloughs/SJR Upstream of Merced River	*Less- than-Significant Beneficial Impact* Boron concentrations in Mud Slough and SJR downstream of Mud Slough decrease; WQOs do not apply to these reaches.	*Negative Effect* Boron concentrations in Mud Slough and SJR downstream of Mud Slough increase; however, WQOs do not apply for these reaches.	*Less-than-Significant Beneficial Impact* Boron concentrations decreased in Mud Slough and the SJR downstream of Mud Slough as a result of reduced discharges of drainwater; WQOs do not apply for these reaches.	*Negative Effect* Boron concentrations in Mud Slough and SJR downstream of Mud Slough increase; however, WQOs do not apply for these reaches.	*Less-than-Significant Beneficial Impact* Boron concentrations in Mud Slough and SJR downstream of Mud Slough decrease as a result of reduced discharges of drainwater; WQOs do not apply for these reaches.
Boron in SJR Downstream of Merced River	*Significant Beneficial Impact* Reduction in boron load would reduce boron concentrations; WQOs are predicted to be achieved for this reach.	*Neutral Effect* Boron concentrations in river increase; however, WQOs are predicted to be achieved for this reach.	*Significant Beneficial Impact* Boron concentrations in SJR decrease as a result of reduced discharges of drainwater; WQOs are predicted to be achieved for this reach.	*Neutral Effect* Boron concentrations in river increase; however, WQOs are predicted to be achieved for this reach.	*Significant Beneficial Impact* Boron concentrations in SJR decrease as a result of reduced discharges of drainwater; however, concentrations are higher than Proposed Action; WQOs are predicted to be achieved for this reach.
Sediment Accumulation in San Luis Drain	*No Impact* No additional sediment input or accumulation in the Drain.	*Neutral Effect* Additional sediment may accumulate. Accumulation to be monitored and addressed through management plan.	*Potentially Significant Adverse Impact - Less than Significant with Mitigation* Additional sediment may accumulate. Accumulation to be monitored and addressed through management plan.	*Neutral Effect* Additional sediment may accumulate. Accumulation to be monitored and addressed through management plan.	*Potentially Significant Adverse Impact - Less than Significant with Mitigation* Additional sediment may accumulate. Accumulation to be monitored and addressed through management plan.

Table ES-1 Summary of Impacts

Resource	No Action Alternative Compared to Existing Condition	Proposed Action Compared to No Action	Proposed Action Compared to Existing Condition	Alternative Action Compared to No Action	Alternative Action Compared to Existing Condition
Molybdenum in Sloughs/SJR Upstream of Merced River	*Significant Beneficial Impact* Molybdenum concentrations in Mud Slough and SJR downstream of Mud Slough decrease; WQOs achieved more frequently.	*Negative Effect* Molybdenum concentrations in Mud Slough and SJR downstream of Mud Slough increase; WQOs exceeded more frequently.	*Significant Beneficial Impact* Molybdenum concentrations decrease in Mud Slough and SJR downstream of Mud Slough as a result of reduced discharges of drainwater; WQOs are exceeded less frequently.	*Negative Effect* Molybdenum concentrations in Mud Slough and SJR downstream of Mud Slough increase. WQOs exceed more frequently for these reaches; WQO are achieved less frequently than the Proposed Action.	*Significant Beneficial Impact* Molybdenum concentrations in Mud Slough and SJR downstream of Mud Slough decrease as a result of reduced discharges of drainwater; WQOs exceeded less frequently for these reaches; however, WQO are achieved less frequently than the Proposed Action.
Molybdenum in SJR Downstream of Merced River	*Less-than-Significant Beneficial Impact* Molybdenum concentrations decrease. However, WQOs are already achieved under existing conditions.	*Neutral Effect* Molybdenum concentrations at Crows Landing increase. However, WQOs are predicted to be achieved.	*Less-than-Significant Beneficial Impact* Molybdenum concentrations at Crows Landing decrease as a result of reduced discharges of drainwater. Molybdenum WQOs are already achieved.	*Neutral Effect* Molybdenum concentrations at Crows Landing increase. However, WQOs are predicted to be achieved.	*Less-than-Significant Beneficial Impact* Molybdenum concentrations at Crows Landing decrease as a result of reduced discharges of drainwater. Molybdenum WQOs at Crows Landing are already achieved.
Groundwater and Soil Resources					
Drainwater production	*Significant Adverse Impact* Decrease in water table depth corresponds to an increase in drainwater production	*Positive Effect* In 2019, projected drainflow is about 45 percent of drainflow projected under No Action	*No Impact* In 2019, projected drainflow is similar to existing conditions	*Positive Effect* In 2019, projected drainflow is about 45 percent of drainflow projected under No Action	*No Impact* In 2019, projected drainflow is similar to existing conditions
Area affected by shallow water table	*Less-Than-Significant Adverse Impact* Minimal projected net increases in the area affected by a shallow water table (1 sq. mi.)	*Neutral Effect* Minimal projected net increases in the area affected by a shallow water table (1 sq. mi.)	*Less-Than-Significant Adverse Impact* Minimal projected net increases in the area affected by a shallow water table (1 sq. mi.)	*Neutral Effect* Minimal projected net increases in the area affected by a shallow water table (1 sq. mi.)	*Less-Than-Significant Adverse Impact* Minimal projected net increases in the area affected by a shallow water table (1 sq. mi.)
Bare-soil evaporation rate	*Significant Adverse Impact* Increase in bare-soil evaporation rate	*Positive Effect* 20 percent decrease in the bare-soil evaporation rate	*Less-Than-Significant Adverse Impact* Small increase in the bare-soil evaporation rate	*Positive Effect* 20 percent decrease in the bare-soil evaporation rate	*Less-Than-Significant Adverse Impact* Small increase in the bare-soil evaporation rate
Unmanaged Seepage And Other Discharges	*Significant Adverse Impact* Seepage into unlined ditches more than doubles and unmanaged flows would not be collected and impact adjacent areas	*Positive Effect* 90 percent decrease in seepage to unlined canals	*Significant Beneficial Impact* 75 percent decrease in seepage to unlined canals	*Positive Effect* 90 percent decrease in seepage to unlined canals	*Significant Beneficial Impact* 75 percent decrease in seepage to unlined canals

Table ES-1 Summary of Impacts

Resource	No Action Alternative Compared to Existing Condition	Proposed Action Compared to No Action	Proposed Action Compared to Existing Condition	Alternative Action Compared to No Action	Alternative Action Compared to Existing Condition
Groundwater and Soil Resources (continued)					
Soil Salinity *(GDA drained area/SJRIP reuse facility)*	*Significant Adverse Impact* 3 fold increase in soil salinity	*Positive Effect* Unsaturated-zone soil salinity increases in the GDA are substantially less	*Less-Than-Significant Adverse Impact* Unsaturated-zone soil salinity in the GDA doubles but soil remains productive	*Positive Effect* Unsaturated-zone soil salinity increases in the GDA are substantially less	*Less-Than-Significant Adverse Impact* Unsaturated-zone soil salinity in the GDA doubles but soil remains productive
Soil Selenium and Boron	*Significant Beneficial Impact* Reductions in selenium and boron concentrations	*Positive Effect* Selenium and boron concentrations are less	*Significant Adverse Impact/Unavoidable* Increase in selenium and boron concentrations	*Positive Effect* Selenium and boron concentrations are less	*Significant Adverse Impact/Unavoidable* Increase in selenium and boron concentrations
Groundwater Salinity *(GDA drained area/SJRIP reuse facility)*	*Significant Beneficial/ Less-Than-Significant Beneficial Impact* Groundwater salinity decreased slightly	*Positive Effect* Salinity decreases over time	*Significant Beneficial Impact* Salinity decreases over time	*Positive Effect* Salinity decreases over time	*Significant Beneficial Impact* Salinity decreases over time
Wetlands enhancement for continued discharge to Mud Slough	*No impact* There would be no wetlands enhancement	*Minimal/Neutral Effect* Short-term transient changes/No net salinity increases over long term.	*Less-Than-Significant Adverse Impact/No Impact* Short-term transient changes/No net salinity increases over long term.	*Neutral Effect* There would be no wetlands enhancement	*No Impact* There would be no wetlands enhancement
Biological Resources[1]					
Sensitive Fish Species in Mud Slough	*Beneficial Impact for splittail in wet years* Decrease in Se bioaccumulation outweighs loss of spatial habitat *No Impact for hardhead and steelhead*	*Negative Effect, for splittail in wet years* Se bioaccumulation may increase *Neutral for hardhead and steelhead*	*Beneficial Impact for splittail in wet years* Se bioaccumulation may decrease *No impact for hardhead and steelhead*	*Negative Effect, for splittail in wet years* Se bioaccumulation may increase *Neutral for hardhead and steelhead*	*No Impact for splittail, hardhead and steelhead* Se bioaccumulation similar, similar quantity of habitat
Sensitive Fish Species in the San Joaquin River near Crows Landing	*Potentially Beneficial Impact, less than significant* Se bioaccumulation decreased, minimal change in quantity of habitat	*Negative Effect* Se bioaccumulation increased, minimal change in quantity of habitat	*Beneficial Impact, less than significant* Se bioaccumulation decreased, minimal change in quantity of habitat	*Negative Effect* Se bioaccumulation increased, minimal change in quantity of habitat	*No Impact, less than significant* Se bioaccumulation similar, minimal change in quantity of habitat

[1] For summary of impacts to special status species, see Table 6-6 in Section 6.2.4.1.

Table ES-1 Summary of Impacts

Resource	No Action Alternative Compared to Existing Condition	Proposed Action Compared to No Action	Proposed Action Compared to Existing Condition	Alternative Action Compared to No Action	Alternative Action Compared to Existing Condition
Wetland Habitat	*Area 1 – Adverse, reduced iodine bush scrub habitat* *Area 2 – Adverse, Decrease in Water Quality.* *Area 3 – Beneficial,* Se bioaccumulation may decrease	*Area 1 – Positive, slight, less degradation* *Area 2 – Positive, improved Water Quality* *Area 3 – Negative.* Se bioaccumulation may increase	*Area 1 –No Impact* *Area 2 – No Impact* *Area 3 –Beneficial,* Se bioaccumulation may decrease	*Area 1 – Same as Proposed Action* *Area 2 – Same as Proposed Action* *Area 3 - Negative.* Se bioaccumulation may increase	*Area 1 – No Impact* *Area 2 – No Impact* *Area 3 - Beneficial*
Bioaccumulation	*Adverse Impact* Se bioaccumulation may increase in aquatic and associated upland communities upslope of the San Luis Drain terminus. *Beneficial Impact* *in* Mud Slough and associated upland communities, Se bioaccumulation may decrease	*Negative Effect* Se bioaccumulation may increase *Positive Effect* *f*or water birds in GDA, Se bioaccumulation may decrease	*Beneficial Impact* to aquatic habitat and associated upland habitats Se bioaccumulation may decrease *No Impact* on refuges and wetlands south of San Luis Drain terminus *Potentially Significant Adverse Impact – With Mitigation Less than Significant* for water birds in GDA	Similar to Proposed Action, but Se bioaccumulation levels off over time	Similar to Proposed Action, but Se bioaccumulation levels off over time
Land Uses					
Agricultural Land	*Significant Adverse Impact* Declining crop yield and retirement of land currently in agricultural production over the long term would conflict with County General Plan policies for the vitality and viability of agriculture	*Positive Effect* Cropped acreage within the GDA would not change substantially and would be consistent with County General Plan policies.	*No Impact* Cropped acreage within the GDA would not change substantially and would be consistent with County General Plan policies.	*Positive Effect* Cropped acreage within the GDA would not change substantially and would be consistent with County General Plan policies.	*No Impact* Cropped acreage within the GDA would not change substantially and would be consistent with County General Plan policies.
Wildlife Habitat and Refuges	*Potentially Significant Adverse Impact* Impacts to wildlife refuges from unmanaged flows of high Se water and soil salinity problems in adjacent areas would not be consistent with General Plan policies for preservation and protection of wildlife habitat and water resources.	*Neutral Effect* Land uses not expected to change and no inconsistencies with General Plan policies.	*No Impact* Land uses not expected to change and no inconsistencies with General Plan policies.	*Neutral Effect* Land uses not expected to change and no inconsistencies with General Plan policies.	*No Impact* Land uses not expected to change and no inconsistencies with General Plan policies.

Table ES-1 Summary of Impacts

Resource	No Action Alternative Compared to Existing Condition	Proposed Action Compared to No Action	Proposed Action Compared to Existing Condition	Alternative Action Compared to No Action	Alternative Action Compared to Existing Condition
Land Uses (continued)					
Recreation	*Potentially Significant Adverse Impact* Constraints on fishing from unmanaged flows of drainwater into the wetlands. Inconsistent with General Plan polices on recreation and open space.	*Positive Effect* Improvement to recreational fishing opportunities in Mud Slough and enhancement of wetlands and consistent with General Plan policies.	*Significant Beneficial Impact* Improvement to recreational fishing opportunities in Mud Slough and enhancement of wetlands and consistent with General Plan policies.	*Positive Effect* Improvement to recreational fishing opportunities in Mud Slough and adjacent wetlands and consistent with General Plan policies.	*Significant Beneficial Impact* Improvement to recreational fishing opportunities in Mud Slough and adjacent wetlands and consistent with General Plan policies.
Socioeconomic Resources					
Farm Profits	*Significant Adverse Impact* Total present value of farm profits over the 10-year period are reduced by 15 percent.	*Positive Effect* Revenues and profit declines are less	*Significant Adverse Impact, Unavoidable* Net farm profit would decline by 11 percent	*Positive Effect* Revenues and profit declines are less	*Significant Adverse Impact, Unavoidable* Net farm profit would decline by 11 percent
Regional Impacts	*Less-than-Significant Adverse Impact* Personal income would decline by $17.7 million; total industry output would decline by $26.6 million	*Positive Effect* Personal income, total industry output, and employment increases	*Less-than-Significant Adverse Impact* Personal income would decrease by $9.6 million and regional output would decline by $5.7 million	*Positive Effect* Personal income, total industry output, and employment increases	*Less-than-Significant Adverse Impact* Personal income would decrease by $9.5 million and regional output would decline by $5.7 million
Cultural Resources					
Historic Properties and Other Resources	*No Impact* No material alteration of built environment or ground disturbance	*Neutral at Present* Future expansion of facilities would not affect historical properties. Treatment plant may require additional investigation to determine presence of and impact to other cultural resources.	*No Impact at Present* Future expansion of facilities would not affect historical properties. Treatment plant may require additional investigation to determine presence of and impact to other cultural resources.	*Neutral at Present* Future expansion of facilities would not affect historical properties. Treatment plant may require additional investigation to determine presence of and impact to other cultural resources.	*No Impact at Present* Future expansion of facilities would not affect historical properties. Treatment plant may require additional investigation to determine presence of and impact to other cultural resources.

Table ES-1 Summary of Impacts

Resource	No Action Alternative Compared to Existing Condition	Proposed Action Compared to No Action	Proposed Action Compared to Existing Condition	Alternative Action Compared to No Action	Alternative Action Compared to Existing Condition
Energy Resources					
Power Consumption	*Less-than-Significant Adverse Impact* Marginally increased power consumption patterns for increased recirculation to recycle all drainwater	*Negative Effect* Average annual power consumption within the GDA would be increased by 21,735,630 kWh	*Less-than-Significant Adverse Impact* Average annual power consumption within the GDA would be increased by 21,735,630 kWh	*Negative Effect* Average annual power consumption within the GDA would be increased by 21,735,630 kWh	*Less-than-Significant Adverse Impact* Average annual power consumption within the GDA would be increased by 21,735,630 kWh
Requirements for Electricity Usage	*Less-than-Significant Adverse Impact* Would not strain electric power supplies in the region	*Minimal Effect* Would not strain electric power supplies in the region	*Less-than-Significant Adverse Impact* Would not strain electric power supplies in the region	*Minimal Effect* Would not strain electric power supplies in the region	*Less-than-Significant Adverse Impact* Would not strain electric power supplies in the region
Indian Trust Assets					
Presence of ITAs	No Impact No reservations, rancherias, or Public Domain Allotments.	Neutral No reservations, rancherias, or Public Domain Allotments.	No Impact No reservations, rancherias, or Public Domain Allotments.	Neutral No reservations, rancherias, or Public Domain Allotments.	No Impact No reservations, rancherias, or Public Domain Allotments.
Greenhouse Gases (GHG)					
Indirect Emissions of GHGs	*Less-than-Significant Adverse Impact* Marginally increased power consumption from recycling/operation of sumps	*Minimal Effect* Additional GHG emissions of 8,695 tonnes per year is less than 0.002 percent of state total	*Less-than-Significant Adverse Impact* Additional GHG emissions of 8,695 tonnes per year is less than 0.002 percent of state total	*Minimal Effect* Additional GHG emissions of 8,695 tonnes per year is less than 0.002 percent of state total	*Less-than-Significant Adverse Impact* Additional GHG emissions of 8,695 tonnes per year is less than 0.002 percent of state total
Direct Emissions of GHGs	*No Impact* No direct emissions due to no new construction	*Minimal Effect* GHGs emitted from diesel-powered construction equipment	*Less-than-Significant Adverse Impact* GHGs emitted from diesel-powered construction equipment	*Minimal Effect* GHGs emitted from diesel-powered construction equipment	*Less-than-Significant Adverse Impact* GHGs emitted from diesel-powered construction equipment

Table ES-1 Summary of Impacts

Resource	No Action Alternative Compared to Existing Condition	Proposed Action Compared to No Action	Proposed Action Compared to Existing Condition	Alternative Action Compared to No Action	Alternative Action Compared to Existing Condition
Environmental Justice					
Economic Resources	*Substantial Adverse Impact* Income and employment losses would affect Hispanics who are disproportionately represented in the Project Area	*Positive Effect* Income and employment decreases are less	*Not Applicable*	*Positive Effect* Income and employment decreases are less	*Not Applicable*
Aquatic/Recreation Resources	*No Impact* Fishing to supplement food sources would not disproportionately affect Hispanics	*Neutral Effect* Fishing and hunting to supplement food sources would not disproportionately affect Hispanics	*Not Applicable*	*Neutral Effect* Fishing to supplement food sources would not disproportionately affect Hispanics	*Not Applicable*

Table ES-2 compares the three alternatives with the Project purposes (Section ES.2). Both Action Alternatives meet the project purposes. In contrast, the No Action Alternative fails to meet three out of the four purposes. It does not keep drainwater out of the wetland channels. Also, the viability of agriculture would be adversely affected.

Table ES-2 Comparison of Alternatives with Project Purposes

Purpose & Need Statement	No Action Alternative	Grassland Bypass Project 2010-2019	2001 Requirements Alternative
Extend the San Luis Drain Use Agreement in order to allow the GBD time to acquire funds and develop feasible drainwater treatment technology to meet revised Basin Plan objectives and WDRs by December 30, 2019.	No – no additional drainwater treatment beyond current reuse facility	Yes – additional treatment and disposal of drainwater and sediment management of San Luis Drain	Yes – additional treatment and disposal of drainwater and sediment management of San Luis Drain
Continue the separation of unusable agricultural drainwater discharged from the GDA from wetland water supply conveyance channels	No – some drainwater would enter wetland channels	Yes – continued separation of drainwater from 93 miles of wetland channels; continued discharge to 6 miles of Mud Slough	Yes – continued separation of drainwater from 93 miles of wetland channels; continued discharge to 6 miles of Mud Slough
Facilitate drainage management that maintains the viability of agriculture	No – extraordinary efforts would be needed by individual farmers to reduce and recycle drainwater within the GDA; land taken out of production immediately due to ponding of drainwater on the surface and in the long term due to soil conditions	Yes – with GAF and Regional Drainage Coordinator, SJRIP reuse facility, Sediment Management Plan, and Compliance Monitoring Program; crop revenues increase from No Action	Yes – same as Grassland Bypass Project
Promote continuous improvement in water quality in the San Joaquin River in order to achieve zero discharge of subsurface drainage from irrigation	Yes – immediate improvement in water quality due to no direct discharge; No – some unmanaged subsurface drainage into wetland channels	Yes – according to Waste Discharge Requirements and control programs	Yes – same as Grassland Bypass Project

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ACRONYMS & ABBREVIATIONS

µg/g	micrograms per gram
µg/L	microgram(s) per liter
µmhos/cm	micromhos per centimeter
µS/cm	microSiemen(s) per centimeter
AB 32	Global Warming Solutions Act of 2006
ACS	American Community Survey
ARB	Air Resources Board
Authority	San Luis and Delta-Mendota Water Authority
BHR	brake horsepower
C_2H_4	ethane
C_3H_8	propane
C_4H_{10}	butane
C_5H_{12}	pentane
CAPCOA	California Air Pollution Control Officers Association
CCID	Central California Irrigation District
CDEC	California Data Exchange Center
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act of 1970
CESA	California Endangered Species Act
CFCs	chlorofluorocarbons
CFR	Code of Federal Regulations
cfs	cubic feet per second
CH_4	methane
CNDDB	California Natural Diversity Data Base
CNPS	California Native Plant Society
CO	carbon monoxide
CO_2	carbon dioxide
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CWA	Clean Water Act
Drain	San Luis Drain
dS/m	deciSiemens per meter
DWR	Department of Water Resources
EC	electrical conductivity
EIR	Environment Impact Report
EIS	Environmental Impact Statement

EO	Executive Order
EPS	emission performance standard
ESA	Federal Endangered Species Act
FONSI	Finding of No Significant Impact
GAF	Grassland Area Farmers
GBD	Grassland Basin Drainers
GDA	Grassland Drainage Area
GHG	greenhouse gas
GWD	Grassland Water District
GWP	Global Warming Potential
H_2O	water vapor
HBFCs	hydrobromofluorocarbons
HCFCs	hydrochlorofluorocarbons
HFCs	hydrofluorocarbons
HU	habitat utility
IFDM	Integrated Farm Drainage Management
I-O	input-output
IPCC	Intergovernmental Panel on Climate Change
ITAs	Indian Trust Assets
kW	kilowatt(s)
kWh	kilowatt hour(s)
lb/mw-hr	pound(s) per megawatt-hour
LSE	load serving entity
mg/L	milligram(s) per liter
mmhos	millimhos
mmhos/cm	millimhos per centimeter
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act of 1969, as amended
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NMVOCs	nonmethane volatile organic compounds
NN	number of nests
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NO_X	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRDC	Natural Resources Defense Council
NRHP	National Register of Historic Places

O_3	ozone
OH	hydroxyl radical
OPR	Office of Planning and Research
PCB	polychlorinated biphenyl
PFCs	perfluorocarbons
PG&E	Pacific Gas and Electric
PM	particulate matter
ppb	parts per billion
ppm	parts per million
ppmv	parts per million by volume
pptv	parts per trillion by volume
PUC	Public Utilities Commission
Reclamation	U.S. Bureau of Reclamation, Mid-Pacific Region
Regional Board	Central Valley Regional Water Quality Control Board
Rn	radon
ROD	Record of Decision
S_2F_{10}	disulfur decafluoride
SAR	Second Assessment Report
SB	Senate Bill
SDIP	South Delta Improvements Project
Se	selenium
Service	U.S. Fish and Wildlife Service
SF_6	sulfur hexafluoride
SFEI	San Francisco Estuary Institute
SJR	San Joaquin River
SJRIP	San Joaquin River Water Quality Improvement Project
SJRRP	San Joaquin River Restoration Program
SLDFR	San Luis Drainage Feature Re-evaluation
SMP	Sediment Management Plan
SO_2	sulfur dioxide
State Board	State Water Resources Control Board
T&E	threatened and endangered
TAR	Third Assessment Report
TDS	total dissolved solids
Tg	teragram(s)
TMDL	Total Maximum Daily Load
TMML	Total Maximum Monthly Load
UNFCCC	United Nations Framework Convention on Climate Change

USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
VAMP	Vernalis Adaptive Management Plan
VOCs	volatile organic compounds
WDR	Waste Discharge Requirement
WDRs	Waste Discharge Requirements
Western	Western Area Power Administration
Westside Plan	Westside Regional Drainage Plan
WQOs	water quality objectives

SECTION 1
Purpose of and Need for Action

This document has been developed for the new Use Agreement for the proposed continuation of the Grassland Bypass Project, 2010–2019, (proposed 2010 Use Agreement) in accordance with the National Environmental Policy Act of 1969 (NEPA), as amended and the California Environmental Quality Act of 1970 (CEQA). The NEPA/CEQA process for this Environmental Impact Statement/Environmental Impact Report (EIS/EIR) was initiated in July 2007. The Bureau of Reclamation, Mid-Pacific Region (Reclamation) is the lead agency under NEPA, and the San Luis and Delta-Mendota Water Authority (Authority) is the lead agency under CEQA.

1.1 HISTORY OF PROJECT

In 1985, the discovery of avian developmental abnormalities caused by selenium contamination in ponded agricultural subsurface drainage water at Kesterson Reservoir halted the use of drainwater as a water supply. Until that point, drainage from the Grassland Drainage Area (GDA) had shared the wetland conveyance system and had been a source of wetland water. The Grassland Water District (GWD) and neighboring agricultural districts in the GDA entered into an agreement whereby drainage entering the southern portion of the GWD through the Agatha Canal or the Camp 13 Ditch was rerouted. When one channel was carrying drainwater, the other was used to convey fresh water to the wetlands. Then the system was flipped over so that the wetlands along the other channel could receive fresh water. This “flip-flop system” required flushing of the channel for 24 hours, and the flushing was an inefficient use of fresh water. In some instances, the wetlands were constrained in taking delivery of fresh water. Use of the “flip-flop” system was halted in 1996 with the implementation of the original Grassland Bypass Project, and approximately 93 miles of channels utilized for refuge/wetland water deliveries no longer carried drainwater. The original Grassland Bypass Project was designed to improve water quality in the channels used to deliver water to wetland habitat areas

The original Grassland Bypass Project was for a maximum 5-year interim use of a portion of the San Luis Drain (Drain) for conveyance of drainwater through the GWD and adjacent area. The original project was implemented in November 1995 through an “Agreement for Use of the San Luis Drain” (Agreement No. 6-07-20-w1319) between Reclamation and the Authority (1995 Use Agreement). A Finding of No Significant Impact (FONSI No. 96-01-MP, dated November 3, 1995) was adopted by Reclamation for the original project (Reclamation 1995), and environmental commitments set forth in the FONSI were made an integral component of the 1995 Use Agreement. The project became officially operational for purposes of the 5-year period on September 23, 1996. The 1995 Use Agreement and its renewal in 1999 allowed for use of the Drain for a 5-year period that concluded September 30, 2001. Continued use of the Drain after the term of the existing 1995 Use Agreement required a revised Use Agreement and additional environmental compliance with NEPA and CEQA.

In March 1996, the Grassland Area Farmers (GAF) formed a regional drainage entity under the umbrella of the Authority to implement the Grassland Bypass Project and manage subsurface drainage within the GDA. Participants included Broadview Water District, Charleston Drainage

District, Firebaugh Canal Water District, Pacheco Water District, Panoche Drainage District, Widren Water District, and Camp 13 Drainers (an association of landowners located in the Central California Irrigation District). GAF's drainage area currently consists of approximately 97,400 gross acres of irrigated farmland on the west side of San Joaquin Valley and is known as the GDA. Discharges of subsurface drainage from this area contain salt, selenium, and boron.

Concurrent with establishment of the original Use Agreement, on November 3, 1995, a letter to the Central Valley Regional Water Quality Control Board (Regional Board) was signed containing the joint recommendations of the Authority, Reclamation, U.S. Environmental Protection Agency, and U.S. Fish and Wildlife Service (Service) with respect to a Basin Plan Amendment. In 1996, the Regional Board concluded its process for amending its Water Quality Control Plan, Third Edition, for the Sacramento and San Joaquin River addressing selenium in the San Joaquin River, Salt Slough, and Mud Slough (1996 Basin Plan) (Regional Board 1996). The 1996 Basin Plan was substantially consistent with the recommendations of the consensus letter. The Regional Board issued Waste Discharge Requirements (WDRs) for discharges from the Drain on July 24, 1998 (Regional Board 1998a). The WDRs established selenium discharge load values (selenium pounds, monthly and annually, resulting in a 15 percent reduction from the average historical load to the San Joaquin River by the 5th year) consistent with the consensus letter. The 1998 WDRs remained in effect through the term of the 1995 project until September 30, 2001. Success was achieved in meeting the selenium load limits prescribed in the 1998 WDRs. Additional reductions were required, however, to continue improvements to San Joaquin River water quality and meet selenium requirements established in the revised 1998 Basin Plan (Regional Board 1998a).

Following completion of a Final EIS/EIR (URS Corporation 2001), a new Use Agreement (Agreement No. 01-WC-20-2075) was completed on September 28, 2001, for the period through December 31, 2009, between Reclamation and the Authority acting on behalf of its members participating in the Grassland Basin Drainage Management Activity Agreement of March 7, 1996.[1] The 1998 WDRs were revised on September 7, 2001 (Order No. 5-01-234). Section 13 of the amended WDRs provides that in the event the Authority and Reclamation intend to discharge subsurface agricultural drainage water to Mud Slough (North) or any other surface water after December 31, 2009, they must submit a Report of Waste Discharge (Report) no later than January 1, 2009. The Report must address steps to meet the Total Maximum Monthly Load (TMML) limits outlined in the Order and a report of compliance with CEQA. The Report may present a technical argument for alternative load limits or an alternative approach to meet selenium water quality objectives. The Regional Board could continue or could amend the existing WDRs for a new Use Agreement and may incorporate requirements for other constituents, similar to the program requirements for the Irrigated Lands Program and/or implementation of Total Maximum Daily Load (TMDLs) for salt, boron, dissolved oxygen, and/or pesticides.

In September 1998, the GAF and the Authority developed a long-term drainage management strategy and plan of implementation. The *Long-Term Drainage Management Plan for the Grassland Drainage Area* was submitted to the Regional Board, as required by WDR Order 98-171, for public review on September 30, 1998 (GAF and Authority 1998), and updated July 1, 1999. The Drainage Management Plan outlined several steps and measures to achieve water

[1]This agreement authorizes the Authority and signatory parties to exercise their joint powers to connect the Grassland Bypass Channel to the San Luis Drain and to use the Drain to convey regional agricultural subsurface drainage water to the terminus of the Drain at Mud Slough (North).

quality objectives in the 1998 Basin Plan and included continuation of the Grassland Bypass Project. The 1998 plan was incorporated into the Westside Regional Drainage Plan (San Joaquin River Exchange Contractors Water Authority et al. 2003). The Westside Plan seeks to manage subsurface drainage and achieve a salt balance on productive lands through several mechanisms, including the application of drainage to salt-tolerant crops at a regional reuse facility to reduce the volume of water discharged into Mud Slough (North) and improve the water quality of that discharge. See Section 1.3.1 below.

1.2 PROPOSED ACTION

The continuation of the Grassland Bypass Project for the period 2010 to 2019 under the proposed 2010 Use Agreement would consolidate subsurface drainflows on a regional basis and utilize a portion of the federal San Luis Drain to convey drainflows around wetland habitat areas. See Section 2.2 for a complete description of the Proposed Action. Key components are summarized below.

Existing features of the Grassland Bypass Project that would continue under the Proposed Action include the following:

- The removal of agricultural drainwater from 93 miles of conveyance channels in the Grassland wetlands and wildlife refuges, except during high rainfall conditions. Any discharges to these conveyance channels would be in accordance with the existing Storm Water Plan as modified consistent with the Use Agreement.
- The use of the Grassland Bypass Channel, a 4-mile-long constructed earthen ditch and an existing drain that was modified to convey drainwater from the Panoche and Main drains to the San Luis Drain at Russell Avenue.
- The use of 28 miles in the San Luis Drain to its northern terminus (Site B – San Luis Drain near Gustine, California). From that point, the drainwater would enter Mud Slough (North) for 6 miles before reaching the San Joaquin River at a location 3 miles upstream of its confluence with the Merced River.

New features of the Proposed Action would include:

- Negotiation with Reclamation (and other stakeholders) for a proposed 2010 Use Agreement for the Drain, to include an updated compliance monitoring plan, revised selenium and salinity load limits, an enhanced incentive performance fee, a new WDR from the Regional Board, and mitigation for continued discharge to Mud Slough.
- In-Valley treatment/drainage reuse at the San Joaquin River Water Quality Improvement Project (SJRIP) facility.
- Other drainage management actions to meet water quality objectives/load limits.
- Utilizing and installing drainage recycling systems to mix subsurface drainwater with irrigation supplies under strict limits.
- Continuing current land retirement policies listed in the 1998 *Long-Term Drainage Management Plan for the GDA* (GAF and Authority 1998) and subsequent Westside Plan. Key among these is that land retirement should be voluntary.

- Implementing a compliance monitoring program with biological, water quality, and sediment components. Results of the monitoring program would be reviewed by an oversight committee as necessary and may be expanded in the proposed 2010 Use Agreement.
- Continuing the operation of a regional drainage management entity to perform management, monitoring, and funding of necessary control functions.
- A single WDR for the GDA.
- An active land management program to utilize subsurface drainage on salt-tolerant crops.
- Low-interest loans for irrigation system improvements, such as gated pipe, sprinkler, and drip irrigation systems.
- An economic incentive program including tiered water pricing and tradable loads.
- A no-tailwater policy that would prevent silt from being discharged into the Drain and promote the secondary benefits of irrigation water management.
- Implementing drainwater displacement projects such as using subsurface drainage for dust control on roadways.
- Meeting with landowners as necessary to implement projects and policies cited above.

1.3 PURPOSE OF AND NEED FOR ACTION

The Grassland Bypass Project's subsurface drainage flows discharged to Mud Slough (North) were to have met water quality objectives by October 1, 2010, as required by the Regional Board's 1998 *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins Fourth Edition* (1998 Basin Plan). The 1998 Basin Plan establishes selenium water quality objectives for the San Joaquin River (Regional Board 1998a). It requires a 5-part-per-billion (ppb) 4-day average selenium concentration in the San Joaquin River at the mouth of the Merced River. The objective is currently in effect for Above Normal and Wet water years and takes effect October 1, 2010, for Critical, Dry, and Below Normal Years. The objective for Mud Slough (North) is also a 5 ppb 4-day average and takes effect on October 1, 2010. Although the 1998 Basin Plan does not expressly prohibit the discharge of subsurface drainage water, selenium in any untreated subsurface agricultural drainage discharged from the GDA significantly exceeds the Mud Slough (North) objective that takes effect October 1, 2010. Thus, the GAF would need to achieve essentially zero discharge once the compliance date arrives. However, the GAF were not able to obtain adequate funding for treatment and disposal technology to fully implement zero discharge[2] by the 2010 deadline. It is anticipated that the proposed continuation of the Grassland Bypass Project for an additional 10 years would allow enough time to acquire funds to develop feasible treatment technology in order to meet the 1998 Basin Plan objectives and WDRs.

[2] An alternative to zero discharge is dilution, which would require achieving a ratio of 12:1 dilution water to discharge, or 240,000 acre-feet of dilution water for 20,000 acre-feet of discharge to achieve the 5 ppb 4-day average WQO for Mud Slough. This alternative is not practical for Mud Slough.

Consequently, the purposes and objectives of the proposed continuation of the Grassland Bypass Project, 2010–2019 (Proposed Action) are:

- To extend the San Luis Drain Use Agreement to allow the GAF time to acquire funds and develop feasible drainwater treatment technology to meet revised Basin Plan objectives (amendment underway) and WDRs by December 30, 2019.
- To continue the separation of unusable agricultural drainage water discharged from the GDA from wetland water supply conveyance channels for the period 2010–2019.
- To facilitate drainage management that maintains the viability of agriculture in the Project Area and promotes continuous improvement in water quality in the San Joaquin River.

The Proposed Action is needed to assure that any future use of the Drain beyond 2009 is consistent with the long-term Westside Regional Drainage Plan and the San Luis Drainage Feature Re-evaluation (SLDFR) plan for drainage service. The process of negotiation with the resource agencies and affected stakeholders for the proposed 2010 Use Agreement provides for compliance with applicable water quality control programs including Basin Plan and WDR amendments. Further explanation of these two needs is provided in sections below.

1.3.1 Westside Regional Drainage Plan and San Luis Drainage Feature Re-evaluation Plan

The Proposed Action is to not preclude other drainage management options from being implemented in the long term in the GDA. The Westside Regional Drainage Plan (Westside Plan) consists of a combination of both short- and long-term approaches to collectively achieve zero discharge of subsurface drainage from irrigation. Presently available mechanisms for the management and control of subsurface drainage discharges are inadequate to both maintain long-term viable agriculture and meet water quality objectives for selenium in 2010 (and salinity and potentially other constituents). The proposed continuation of the Grassland Bypass Project is needed in the short term (2010–2019) to allow time for additional research and evaluation of long-term treatment options and to secure funding to implement treatment and disposal of drainage and end products, primarily salt. The long-term options contained in the Westside Plan include the following:

- Meeting water quality objectives in the wetlands and the San Joaquin River system through treatment and/or in-valley disposal of drainage prior to discharge.
- Adaptive management and implementation of drainage projects including groundwater management, land retirement, and source control.
- Regional drainage reuse on salt-tolerant crops to maximize drainage volume reduction prior to discharge.
- Treatment of drainage water remaining after reuse to accomplish zero discharge.
- Disposal of salts remaining after treatment.

Furthermore, the Proposed Action needs to be consistent with Reclamation's Record of Decision (ROD) on the SLDFR (Reclamation 2007a), which incorporated major components of the

Westside Plan for the Grassland Drainage Area (e.g., Northerly Area), although implementation of the ROD has been delayed pending federal authorization.

1.3.2 Compliance with Water Quality Control Program

The Proposed Action's goal is to meet water quality objectives that are applicable to the 2010–2019 period. Water quality objectives are defined in the California Water Code as the limits or levels of water quality constituents or characteristics that are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area (Basin Plan). The Regional Board's 1996 and 1998 Basin Plan amendments established water quality objectives for selenium at three locations on the San Joaquin River system relevant to the Proposed Action, summarized in Table 1-1.

The 1997 through 2005 objectives were met by the 2001 Grassland Bypass Project. However, delays in completion of the SJRIP to reuse and treat all of the drainwater (40,000 acre-feet annually) mean that the October 1, 2010, objective cannot be met; amendments to the 1998 Basin Plan and WDRs are needed from the Regional Board.

Table 1-1 Selenium Water Quality Objectives and Performance Goals in the San Joaquin River

Waterbody/Water Year Type	January 10, 1997	October 1, 2002	October 1, 2005	October 1, 2010
Salt Slough and Wetland Water Supply Channels listed in Appendix 40 of Basin Plan	2 μg/L monthly mean[a]			
San Joaquin River below the Merced River; Above Normal and Wet water year types		5 μg/L monthly mean[b]	5 μg/L 4-day average[a]	
San Joaquin River below the Merced River; Critical, Dry, and Below Normal water year types		8 μg/L monthly mean[b]	5 μg/L monthly mean[b]	5 μg/L 4-day average[a]
Mud Slough (North) and the San Joaquin River from Sack Dam to the Merced River				5 μg/L 4-day average[a]

Source: Regional Board 1996, 1998a

[a] Selenium Water Quality Objectives
[b] Performance Goals

1.4 AUTHORITY FOR PROJECT

The proposed continuation of the Grassland Bypass Project, 2010–2019, would be implemented under an agreement between Reclamation and the Authority (Appendix A). Reclamation owns the Drain, which was constructed under the authority of the San Luis Act (Public Law 86-488).

1.5 RELATED PROJECTS

The proposed continuation of Grassland Bypass Project, 2010–2019, occurs within other regional efforts to manage agricultural subsurface drainage in the San Joaquin Valley. These efforts include the following plans and programs:

A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley, San Joaquin Valley Drainage Program (1990), September 1990 and ongoing San Joaquin Valley Drainage Implementation Program implementation activities

- Reclamation's San Luis Unit Drainage Program, SLDFR (Reclamation 2007a) and subsequent Concepts for Collaboration Drainage Resolution (Reclamation 2007b)
- *San Joaquin Basin Action Plan* (Central Valley Project Improvement Act [THIeXXXIV of public law 102-575](Reclamation et al. 1995)
- State and Regional Water Quality Control Programs including salt and boron TMDL allocations
- San Joaquin River Restoration Program (SJRRP)

All of these projects and programs are larger in scope than the Grassland Bypass Project. The GDA represents 97,400 acres existing with a possible expansion of 1,100 acres within a larger area that includes over 600,000 acres of irrigated farmland. Development of a regional solution to the agricultural drainage management problem continues. The proposed Grassland Bypass Project, 2010–2019, is a 10-year project that does not preclude implementation of any of the alternatives that may be considered by the above regional projects and programs.

The 1995 Water Quality Control Plan for the Bay/Delta established a salinity objective for the San Joaquin River at Vernalis (California State Water Resources Control Board 1995). Water Right Decision 1641 requires nonexceedance of 0.7 millimhos (mmhos) electrical conductivity (EC) April–August and 1.0 mmhos EC September–March. This amount translates to monthly averages for total dissolved solids of 455 mg/L for the low flow summer irrigation period (April through August) and 650 mg/L for the remaining months of the year.

Wetland habitat areas covered by the *San Joaquin Basin Action Plan* (Reclamation, Service, and CDFG 1995) require water supplies that contain less than 2 ppb selenium. The water conveyance system to the refuges in the Grassland Basin needs to prevent commingling of freshwater supply and drainage containing selenium. In the absence of the Proposed Project, the likely presence of agricultural drainwaters in the Grassland sloughs and channels and in Salt Slough would complicate, and at times prevent, delivery of otherwise available water supplies to approximately 51,700 acres of state, federal, and private wetlands. These permanent and seasonal wetlands contain a diversity of bird, animal, and plant species and are located on the Pacific Flyway, an important migratory bird corridor stretching 10,000 miles from Alaska to South America. Use of a segment of the Drain for agricultural drainage facilitates delivery of fresh water to the Grassland wetlands and minimizes the potential for uncontrolled drainage to enter the wetlands.

Consultation with the Service on the Grassland Bypass Project was reinitiated in 2008, with an updated Biological Opinion to be issued, which considers the effects of the ongoing 2001 Use Agreement. A separate consultation with the Service will be conducted for the Proposed Action. Effects to listed species and designated critical habitats resulting from implementation of interim contract renewals for Panoche Water District and San Luis Water District, including downstream water quality effects, are the subject of a Biological Opinion from the National Marine Fisheries Service (NMFS) (expected to be released in December 2008). Panoche Water District and a portion of San Luis Water District are included in the GDA. A separate consultation with NMFS will be conducted for the Proposed Action.

The Regional Board has amended the 1998 Basin Plan to establish salinity and boron water quality objectives in the Lower San Joaquin River. The Regional Board adopted TMDL allocations applicable to those constituents along with a compliance schedule. The continuation of the Grassland Bypass Project, 2010–2019, would facilitate this control program by virtue of the regional drainage entity and drainage control actions associated with the Project. Generally, management measures that control drainage would also control these other constituents.

The San Joaquin River Restoration Program (SJRRP) is a comprehensive, long-term program to restore flows to the San Joaquin River from Friant Dam to the confluence with the Merced River, ensure irrigation supplies to Friant Water Users, and restore a self-sustaining Chinook salmon fishery in the river. The SJRRP is to implement the Stipulation of Settlement in the *Natural Resources Defense Council, et al., v. Kirk Rodgers, United States Bureau of Reclamation, et al., Case No. S-88-1658-LKK/GGH, United States District Court, October 23, 2006* (San Joaquin River Settlement Agreement). Stage 2 calls for the release of interim flows into the San Joaquin River and monitoring programs such that spring-run and fall-run Chinook salmon can be reintroduced to the river by December 31, 2012 (SJRRP 2007).

SECTION 2
Alternatives Including Proposed Action

This chapter describes potential alternatives for management of subsurface agricultural drainage from the Grassland Drainage Area (GDA) over the period January 2010 through December 2019. Review of potential alternatives has been conducted by agencies involved in the management and preparation of this Environmental Impact Statement/Environmental Impact Report (EIS/EIR). This group has identified the specific alternatives considered to be "reasonable" and, therefore, they are discussed in the environmental consequences/impacts sections of the document. The No Action Alternative is described first in Section 2.1, and this section includes maps showing the location of the Project Area and key features of the alternatives. The Proposed Action (Alternative 3 – Continuation of the Grassland Bypass Project, 2010–2019) and Alternative Action are discussed in Sections 2.2 and 2.3, respectively. Section 2.4 explains why other alternatives have been rejected from further impact evaluation.

INTRODUCTION

The Project Area is the area that could be affected substantially by actions taken within the GDA. It is located on the western side of San Joaquin Valley, and Project features are located primarily in the counties of Merced and Fresno. The inclusion of the San Joaquin River to Crows Landing for compliance monitoring adds Stanislaus County to the Project Area. See Figure 2-1, Project Location Map. The socioeconomic analysis includes Madera County along with Fresno and Merced as the primary "zone of influence."

2.1 NO ACTION

The No Action Alternative is defined as what could be expected to occur in the foreseeable future (after December 31, 2009) if the Use Agreement for the San Luis Drain (Drain) is not approved. Under this alternative, the Grassland Area Farmers (GAF) would not have use of the Drain. Agricultural subsurface drainage would not be collected into a single drainage outlet (Grassland Bypass Channel) for conveyance to the Drain. It is the baseline for evaluation of environmental effects under the National Environmental Policy Act (NEPA). In contrast, existing conditions are the environmental setting present in December 2007 when the Notice of Preparation of an EIS/EIR was issued. Key is that existing conditions would include the subsurface drainage discharges and effects on Mud Slough and the San Joaquin River that currently exist, not a "without Grassland Bypass Project" situation. It is a point in time baseline used for measuring impacts under the California Environmental Quality Act (CEQA).

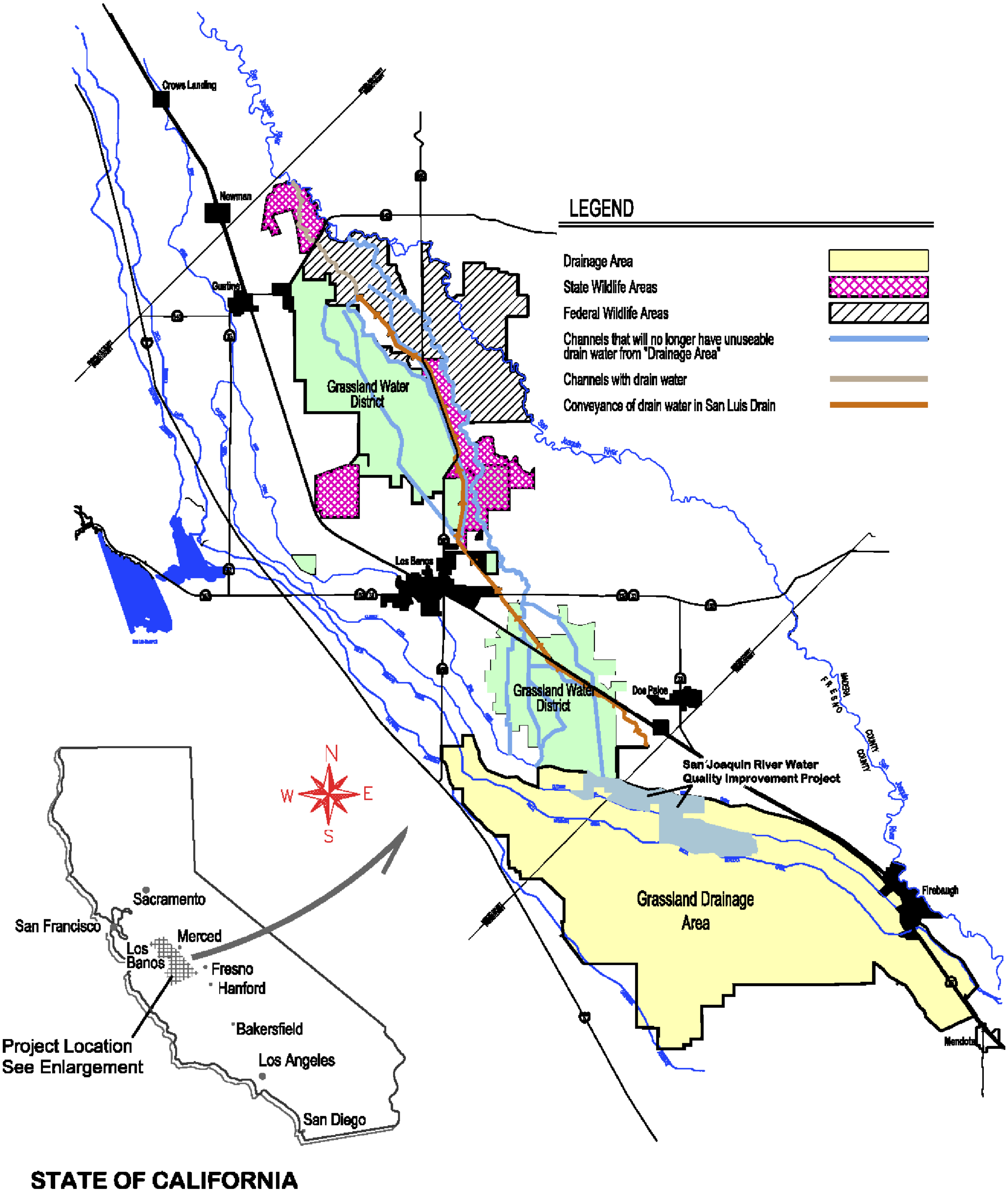
2.1.1 Characteristics/Associated Actions

The No Action Alternative is a construct based not only upon failing to take the Proposed Action to use the Drain, but also upon continuing an ongoing program for drainage management, including the initial phases of the treatment/drainage reuse facility known as the San Joaquin River Water Quality Improvement Project (SJRIP). Even a partial program will require projects that are not currently planned or financed, at both the district and farmer level, in order to maintain viable agriculture over the long term.

For example, the GAF and district managers indicate that it is not realistic to assume that 100 percent of subsurface water generated by sumps will be recycled, due to physical constraints and to the mismatch in certain months between the volumes of water for which recirculation would be required and the capacity of cropped land and drainwater reuse facility to receive such water, without significant crop damage (Grassland Steering Committee, pers. comm., 2000). Without the continuation of the Grassland Bypass Project, 2010–2019, and a management system that addresses all discharges, seepage into wetland habitats that would violate water quality standards could occur, and unmanageable ponding of high selenium (Se) water would occur at the lower elevations on private property. However, because no other practices or facilities are currently available to deal with drainage without a drainage outlet, the No Action Alternative is defined as a "maximum recycling scenario." Further, Panoche Water District within the GDA has committed to the National Marine Fisheries Service that, on an interim basis, it will manage all flows from within its boundaries that cannot be accommodated at SJRIP by recirculation under the No Action (i.e., no continuation of Grassland Bypass Project) Alternative.

The regional reuse facility (SJRIP) has been partially constructed, and an expansion of the 4,000-acre facility by 2,900 acres was approved by Panoche Drainage District on August 21, 2007. At present, approximately 2,230 acres in the expansion area have been acquired. Therefore, by the end of 2007, approximately 6,009 acres were incorporated into the facility for salt-tolerant cropping. Therefore, under the No Action Alternative, the maximum recycling scenario begins the application of subsurface drainage water on salt-tolerant crops on just over 6,200 acres.

The estimated drainage production of the region is currently 26,400 acre-feet per year. With the current source control activities, recycling, and drainage reuse, approximately 23,000 acre-feet per year could be managed. The remaining 3,400 acre-feet per year would have no point of discharge and could not be recirculated at the facility without additional projects. This would result in ponding of seleniferous water and a rise in groundwater in the lower portions of the region. Additionally, it is assumed that the existing drainage systems within the SJRIP would not be operated (as there would be no place to put this water) and, over time, the reuse capacity of the SJRIP would diminish as salt accumulated within the root zone and the ability of the SJRIP to support salt-tolerant crops declined. Water table rise would occur along with seepage at the lower elevations. With drainwater focused at the reuse facility, agricultural production on other lands would continue in the short term. As the reuse capacity diminished, fields in the lower portion of the region would become waterlogged and unfarmable and would be abandoned. Once the reuse facility became inoperative, individual districts and farmers would have to recycle drainwater "on farm and within districts."



ENTRIX

Source: Summers Engineering, October 2008

FIGURE 2-1
PROJECT LOCATION MAP

2.1.1.1 Physical Environment

The following primary assumptions regarding the physical environment in the Project Area are explained for the No Action Alternative and are subsequently modeled for the environmental impact analyses:

- Entry to the Drain would be blocked at the Grassland Bypass Channel. The Grassland Bypass Channel may also be blocked where it crosses the Main Canal. Blocking of other drains may occur at the Outside Canal. Blocking these channels/drains will prevent drainage from leaving the GDA and entering the Bypass Channel.
- The Drain would be blocked at its terminus at Mud Slough. Seepage from adjacent ponds in Grassland Water District and local wildlife refuges would fill portions of the Drain with saline water.
- Farmers would continue to operate their sumps as occurs presently, but drainage from the sumps would be recycled either on farm or within districts or at the SJRIP reuse facility and not discharged beyond the GDA. The total amount of applied irrigation water would not increase over Central Valley Project contract amounts, as the recycled water on farm would replace some of the need for fresh irrigation water supplies. This assumption minimizes the potential for water table level changes and the potential for drainage discharges into wetland channels. The SJRIP lands do not currently have an outside water supply. Continued application to areas without subsurface drains could result in water table rise and seepage into ditches within the GDA.
- Prior to the original 1996 and subsequent 2001 Grassland Bypass Projects, stormwater from rainfall within the GDA and from upslope streams was discharged into the wetland channels. When the 2001 Grassland Bypass Project was implemented, this stormwater could be managed, within certain limits, within the Bypass Project channels. Without the continuation of the Grassland Bypass Project, this stormwater runoff could pond within the lower portions of the GDA. Some of this water would infiltrate to groundwater, and some may stay ponded for an extended period. The ponded stormwater may overflow into the Delta-Mendota Canal, Firebaugh Canal Water District main lift canal, and Contra Costa Irrigation District canals. Stormwater may also be discharged under extreme conditions (i.e., 1998), when ponding threatened irrigation canals and discharge to the wetlands was needed to prevent damage.

Additional assumptions for modeling surface-water impacts are explained in Section 4.2.2.2.

2.1.1.2 Regulatory and Management Environment

The following assumptions regarding the regulatory/drainage management environment (human environment) in the Project Area are associated with the No Action Alternative:

- The GDA districts entered into a joint powers agreement to form a regional drainage entity (under the umbrella of the San Luis & Delta-Mendota Water Authority [Authority]) to facilitate regional drainage management. In the absence of a new Use Agreement for the proposed Grassland Bypass Project (proposed 2010 Use Agreement), the overarching drainage entity would no longer undertake the coordination and management of discharges from the GDA and would no longer implement negotiated or regulatory requirements for the discharges permitted under the second Agreement for use of the San Luis Drain (Agreement No. 01-WC-20-2075). The regional entity likely would remain in place to coordinate use of the existing, partially constructed reuse area, subject to applicable laws. However, once the effects of lack of an outlet lead the reuse area to become inoperative, there would be no incentive to continue the organized regional effort. Under such a scenario, regulators may have to work with at least seven districts or entities and potentially up to approximately 170 individual farmers to control any unplanned discharges. The owners and operators of the individual drainage systems would be the principal parties responsible for management of the drainage. An issue is whether this drainage from multiple districts/individuals would be managed effectively and completely as recycled water with no direct drainage discharge consistent with regulatory processes and negotiated agreements after the December 2009 (end of current 2001 Use Agreement) time period. The Authority would remain active to manage the incomplete reuse facility as long as possible until the facility goes out of production and is closed due to rising water table and diminishing production of the salt-tolerant crops.

- It is assumed that the districts and farmers in the GDA may need additional regulatory coverage if the current Grassland Bypass Project is terminated. It is likely all drainwater from sumps would be recycled either on farm or at the reuse facility, and none would be a planned discharge. However, some unmanaged discharge, ponding, and seepage would occur. This unmanaged discharge would be from high rainfall conditions into existing drains in the GDA and the appropriate entity (if any) to be regulated would be difficult to determine. This process likely would result in ongoing efforts to control drainage as described below.
  - For any discharges, the Central Valley Regional Water Quality Control Board (Regional Board's), regulatory process could consist of the following actions:
    - Permits would be needed for any repeated drainage discharges to wetlands. Districts and farmers would participate in the Irrigated Lands Regulatory Program.
    - A Waste Discharge Requirement (WDR) would be needed for each district that would provide drainage management systems and for individual farmers who would not be using district drains but engaging in direct discharges to wetlands. The WDRs would include monitoring/reporting requirements.
    - For any drainers not in compliance with WDRs, enforcement orders would be initiated to cease discharging.
    - In cases of noncompliance that are not corrected through enforcement orders and fines, the Regional Board would refer the case to the Attorney General and request a court order.
    - For discharge not under the control of any entity there would be no legal entity for the WDRs.
  - The farmers and districts in the GDA would continue with short-term drainage management actions that include drainwater recycling, drainwater displacement, tiered water pricing, improved irrigation methods and application, and drainwater treatment at the SJRIP. Drainage management activities and programs currently in place that are assumed to continue as management actions under the existing regulatory system consist of the following:

- **Water quality and flow monitoring program:** This activity would be needed; however, the monitoring program as part of the 2001 Grassland Bypass Project would likely not continue in its present form except at the SJRIP facility and for so long as it remained operational. Regulatory agencies would likely have to monitor separately to assure compliance with water quality objectives.
- **Active land management program:** This program is a proactive effort to manage subsurface drainage (such as alternating cropping, temporary fallowing, etc.), assuming a drainage outlet is available, i.e., the continuation of the Grassland Bypass Project. Without such an outlet, there would likely be less analysis of new methods and a reliance on methods that are detrimental to crop production.
- **Low interest loans:** Individual districts would continue to implement low-interest loans for irrigation system improvements, such as gated pipe, sprinkler, and drip irrigation systems.
- **Economic incentive programs:** Individual districts would continue current programs to encourage reduced applications of pre-irrigation or early crop irrigation water through use of sprinklers or other technologies. Other incentives such as the Se load trades would not continue without a drainage outlet and a regional entity to manage them.
- **No tailwater policy:** The primary purpose of this policy is to prevent silt from discharging into the Drain and to promote the secondary benefits of irrigation water management. Without the drainage outlet, the tailwater would more likely be managed in conjunction with the subsurface drainwater to achieve lower salt concentrations in the water to be managed. The no tailwater policy will likely not stay in effect; tailwater is discharged into the same drains as tile drainage, increasing the total volume that would need to be managed.
- **Drainwater reuse:** Districts would continue displacement projects such as using drainwater to grow salt-tolerant crops and using subsurface drainage for dust control on roadways.

– The farmers and districts in the GDA would expand upon the actions listed above with the following reasonably foreseeable activities and management actions:

- **Recirculation:** Most of the districts would continue to collect subsurface drainage but would reuse/recirculate this drainage onto irrigated areas in the long term to a greater extent than at present. The drainwater would be blended with freshwater deliveries in the canals or other facilities but would greatly exceed levels that are damaging to crops. If farmers must apply the recycled water to minimize the production of drainage, it could be substituted for fresh water and no overall increase in applied water would occur. However, the recycled water could be in addition to current surface supplies, insofar as farmers seek to blend to a better water quality or to supplement inadequate surface-water supplies, despite the effect on drainage production.
- **Cropping patterns:** Crop types would shift from salt-sensitive crops (such as tomatoes, melons, and other vegetables) to those that are salt-tolerant (cotton and alfalfa seed) with expanded recycling. However, crop yields for all crops, except cotton, are expected to decline because of the buildup in soil and water salinity.

- **Land retirement:** The GDA currently has policies on land retirement that would continue. These policies are listed in the Westside Regional Drainage Plan for the Grassland Drainage Area (Westside Plan) (San Joaquin River Exchange Contractors Water Authority et al. 2003). A key policy among them is that land retirement must be voluntary, i.e., based on land purchases from willing sellers (and then discontinuing irrigated agriculture).

2.1.2 Location

Potential impacts resulting from the No Action Alternative would be concentrated in three areas as shown on Figure 2-1, Project Location Map (and later in Figure 2-4, Reuse Area and Key Hydrologic Features):

- The first of these areas is the 97,400-acre source zone known as the GDA, located in the Central Valley of California, specifically in Merced and Fresno counties. The GDA extends from the northern tip of the Charleston Drainage District on the north at State Highway 165 to the southern tip of the Firebaugh Canal Water District on the south near State Highway 180 and the community of Mendota.
- The second area consists of 93 miles of wetlands channels, Salt Slough, and the San Joaquin River from the confluence of Salt Slough downstream to Mud Slough. This area is located within the Grassland Water District and state/federal wildlife management areas and would be directly affected by the No Action Alternative.
- The third area consists of the San Luis Drain from Russell Avenue on the south to its northern terminus at Mud Slough, 6 miles of Mud Slough upstream of its confluence with the San Joaquin River, and the San Joaquin River downstream from Mud Slough to Crows Landing. These waterways would be directly affected by the No Action Alternative.

2.1.3 Required Approvals and Permits

Under the No Action Alternative, the owners and operators of the individual drainage systems would be the principal parties responsible for management of the drainage resulting from applied irrigation (and excluding storm events). Panoche Drainage District, Firebaugh Canal Water District, and other participating members of the GDA would continue the SJRIP reuse facility, but there would be no drainage management entity as currently exists coordinating and managing discharges or for implementing monitoring and reporting requirements throughout the Project Area. All of the drainage from sumps is assumed to be recycled. Permits from the Regional Board would not be needed due to no points of discharge or any direct drainage discharges to wetlands. However, the Regional Board could require monitoring and reporting to ensure that no direct discharges would occur and to manage unplanned or accidental discharges to determine the responsible parties.

2.2 PROPOSED ACTION

The Proposed Action is the continuation of the Grassland Bypass Project for the period 2010-2019 (Project) under the terms and conditions of the proposed “2010 Use Agreement for Use of the San Luis Drain.” The Grassland Bypass Project, 2010–2019, would continue to consolidate subsurface drainflows on a regional basis and utilize a portion of the federal San Luis

Drain to convey drainflows around wetland habitat areas after the 2001 Use Agreement expires. The Project would continue to collect drainwater from the 97,400-acre GDA, and from an 1,100-acre area adjacent to the GDA that may annex to the GDA, and place it into the Drain at a point near Russell Avenue (Site A – San Luis Drain near South Dos Palos, California). The drainage would continue to travel in the Drain to its northern terminus (Site B[1] – San Luis Drain near Gustine, California). From here, the drainage would enter Mud Slough (North) for 6 miles before reaching the San Joaquin River at a location 3 miles upstream of its confluence with the Merced River. The Proposed Action includes the new Use Agreement with its new terms and conditions for operation of the Grassland Bypass Project, 2010–2019 (Appendix A).

To continue to discharge into Mud Slough (North) in the state's China Island Wildlife Area, the Authority would need to extend or amend a Memorandum of Understanding with the California Department of Fish and Game (CDFG), the Bureau of Reclamation (Reclamation) would need to extend the Use Agreement with the Authority for the continued use of the San Luis Drain after 2009, the Regional Board would need to amend the 1998 Basin Plan to delay the compliance date for objectives and issue the revised WDRs permitting continuing discharges consistent with the amended Plan. Also, it is anticipated that at some point during implementation of the Proposed (or Alternative) Action, Reclamation and the Authority will need to remove existing and future sediments from the affected portion of the Drain. The Regional Board initiated CEQA scoping for amending the Basin Plan on September 25, 2008.

2.2.1 Characteristics/Associated Actions

2.2.1.1 Existing Features of Proposed Action

Existing features of the 1996 and 2001 Grassland Bypass Projects that would continue under the Proposed Action include the following:

- The removal of agricultural drainwater from 93 miles of conveyance channels in the Grassland wetlands and wildlife refuges, except during high rainfall conditions. Any discharges to these conveyance channels would be in accordance with the existing Storm Water Plan, as modified consistent with the Use Agreement. These channels are shown on Figure 2-1.
- The use of the Grassland Bypass Channel, a 4-mile-long constructed earthen ditch and an existing drain that was modified to convey drainwater from the Panoche and Main Drain to the San Luis Drain at Russell Avenue. Drainwater from Charleston Drainage District, Pacheco Water District, and Panoche Drainage District would continue to be collected in the Panoche Drain. Drainwater from Firebaugh Canal Water District and the Camp 13 drainage area would continue to be conveyed in the existing Main Drain. Drainage collected from any adjacent lands added to the Project Area would be added to the Main Drain, the Panoche Drain, or the Grassland Bypass Channel within their existing design capacities. Broadview Water District and Widren Water District are no longer irrigated and do not contribute drainage to the Grassland Bypass Channel under normal conditions.[2]

[1] Sites A and B are shown on Figure 4-1 in Section 4.1.1.1.
[2] These districts remain within the GDA sphere of influence. Any drainage generated from any irrigation with groundwater or from rainfall would have to be managed by the GAF.

- The drainwater would continue to travel approximately 28 miles in the Drain to its northern terminus (Site B – San Luis Drain near Gustine, California). From that point, the drainwater would enter Mud Slough (North) for 6 miles before reaching the San Joaquin River at a location 3 miles upstream of its confluence with the Merced River.

The design for the original 1996 Grassland Bypass Project limited the flow to 150 cubic feet per second, primarily to prevent suspension of sediments. The Proposed Action would retain this designed flow capacity, which may not be achieved until all existing sediments are removed. See Section 2.2.1.2.3 and Appendix B for the proposed Sediment Management Plan (SMP).

2.2.1.2 New Features of Proposed Action

New features of the Proposed Action may or would include:

- Negotiation with Reclamation (and other stakeholders) for a proposed 2010 Use Agreement for the Drain, to include an updated compliance monitoring plan, revised Se and salinity load limits, an enhanced incentive performance fee system, a new WDR from the Regional Board, and mitigation for continued discharge to Mud Slough
- In-Valley treatment/drainage reuse at the SJRIP facility
- Other drainage management actions to meet water quality objectives/load limits[3]

2.2.1.2.1 Proposed 2010 Use Agreement

SELENIUM AND SALT LOAD REDUCTIONS

The proposed 2010 Use Agreement requires continuing Se load reductions to meet implementation dates of applicable water quality objectives. The applicable Se load limit for calendar year 2009 (based on the current applicable total maximum monthly load [TMML]) is 2,557 pounds for a Critical year type. In comparison, the load value in the existing 2001 Use Agreement for calendar year 2005 in Critical water years was 3,996 pounds. Such a large reduction requires implementation of additional methods of drainage management.

Proposed Se load values are shown in Figure 2-2 where the following values are proposed over the 10-year term of the proposed 2010 Use Agreement:

- Year 1 (January to September 2010): Monthly load values equal to an average of the 2009 monthly load values and TMML monthly load values for each water year type
- Years 2–5 (October 2010 to December 2014): Load values equal to TMML load values
- Years 6–8 (January 2015 to December 2017): Load values on a glide path to 2018/2019 to very low loads
- Years 9–10 (January 2018 to December 2019): Annual loads at approximately highest month in water year type. (Critical-150 pounds, Dry/Below Normal-300 pounds, Above Normal-450 pounds, Wet-600 pounds). Monthly loads equal to monthly TMML loads

[3] Several of these continue actions from the 2001 Use Agreement.

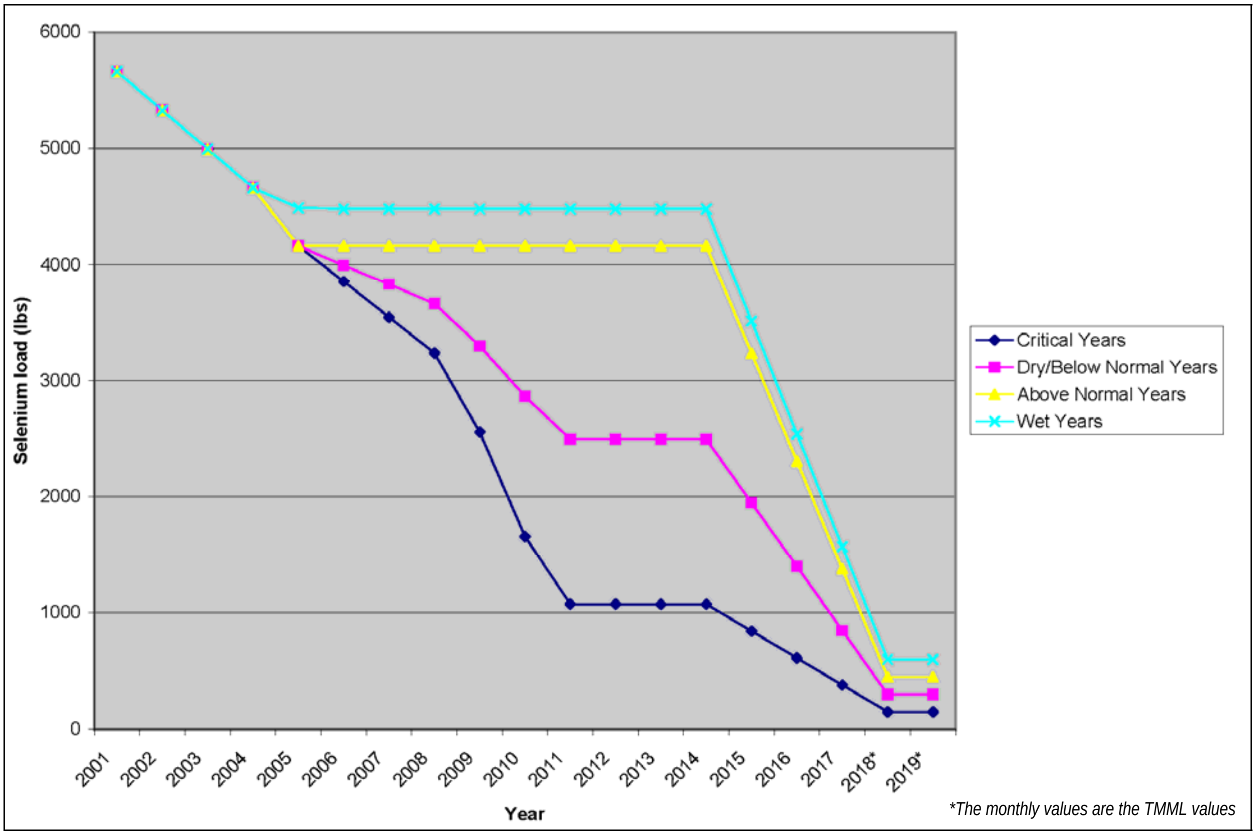


Figure 2-2 Proposed Selenium Annual Load Values

Salt is to be managed similar to the 2001 Use Agreement wherein Se loads are the management constraint and salt loads decline with declines in Se.

PERFORMANCE INCENTIVE SYSTEM

The proposed 2010 Use Agreement expands upon incentive fees contained in the 2001 Use Agreement to encourage the GAF to not exceed the load values.

Table 2-1 Proposed Incentive Fees

	Year 1	Years 2-5	Year 6	Year 7	Year 8	Year 9	Year 10
Incentive Fee Caps							
Annual Incentive Fee Cap	$300,000	$300,000	$400,000	$400,000	$500,000	$600,000	$600,000
Monthly Incentive Fee Cap	$300,000	$300,000	$400,000	$400,000	$500,000	$600,000	$600,000
Total Incentive Fee Cap	$600,000	$600,000	$800,000	$800,000	$1,000,000	$1,200,000	$1,200,000
Monthly & Annual Incentive Fees per Lb ($/Lb)							
Critical Year Type	$903.61	$1,395.35	$1,731.60	$1,731.60	$2,164.50	$4,000.00	$4,000.00
Below Normal Year Type	$523.56	$601.20	$728.60	728.60	$910.75	$2,000.00	$2,000.00
Above Normal Year Type	$360.58	$360.58	$431.03	$431.03	$538.79	$1,333.33	$1,333.33
Wet Year Type	$334.82	$334.82	$412.37	$412.37	$515.46	$1,000.00	$1,000.00

A fee based on the pounds of Se discharged over the targeted loads by water year type and the maximum annual fees are shown in Table 2-1. Also, when the Se loads discharged are less than the targeted loads, monthly incentive fee credits would be applied as follows over the term 2010-2019:

- Years 1–8
  - Monthly incentive fee credits for discharging less than the specified monthly Se or salinity loads will be determined based upon a year-end review and must be used in the same year.
  - If the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins, 1998 (Basin Plan) Se objectives are met in San Joaquin River (at Crows Landing) during the month credit will be applied, available credits can be applied up to the total Se or salinity exceedance for that month.
  - If Basin Plan Se objectives are not met in San Joaquin River (at Crows Landing) during the month credit will be applied, Se or salinity credits cannot be applied for that month.
  - If application of credits is authorized in more than 1 month under the criteria above, GAF can utilize credits in the month(s) of their choice.
- Years 9–10
  - Monthly credits will not apply in years 9 and 10.

The proposed 2010 Use Agreement includes provisions to allow the incentive fees collected and placed into the Drainage Incentive Fee Account to be applied to programs or actions that will reduce drainage production in the region. If no such actions exist for use of funds collected in 2018 or 2019, the funds can be considered for projects to enhance fish or wildlife values in the GDA or adjacent areas.

MUD SLOUGH MITIGATION

Because the Proposed Action would continue to discharge Se to Mud Slough after 2010, mitigation for this impact to Mud Slough is for the GAF to provide additional wetland habitat. The concept is to expand permanent wetlands in the area of Mud Slough to provide benefits to species such as waterfowl, shorebirds, and terrestrial wildlife, including special status species such as the giant garter snake, San Joaquin Valley kit fox, and tricolored blackbirds. This habitat would be located on U.S. Fish and Wildlife Service (Service) lands and CDFG lands.

Two proposals by the CDFG and Service to expand wetland habitat by 31.6 and 76.8 acres are explained below, and the CDFG proposal is shown on Figure 2-3. The Service has not confirmed a specific site at present.

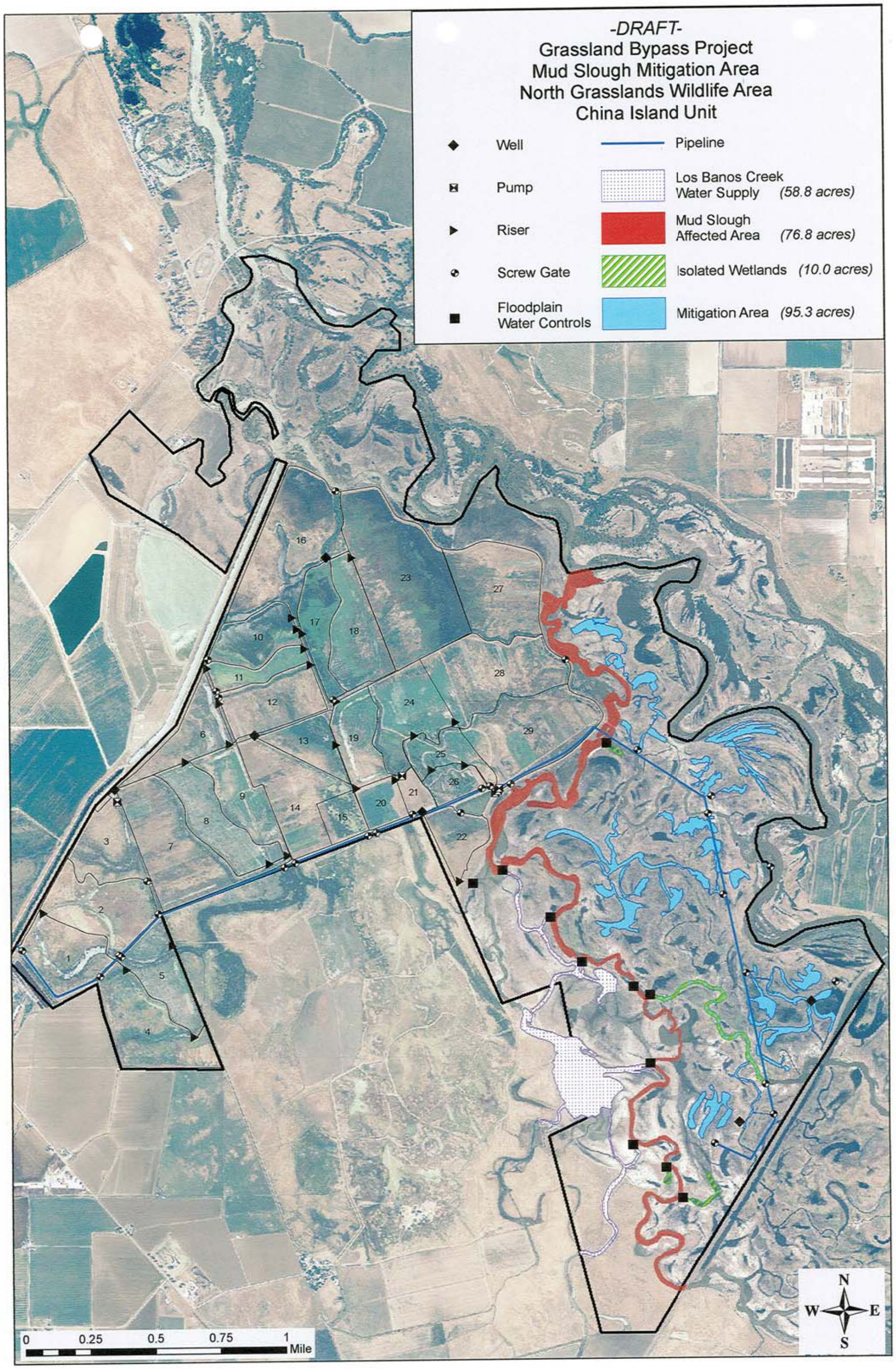


Figure 2-3 Mud Slough Mitigation Area, North Grasslands Wildlife Area, China Island Unit, for Grassland Bypass Project, 2010–2019.

- CDFG Mitigation Proposal: Supply year-round water to a series of ponds between Mud Slough and the San Joaquin River. Water would be delivered through an existing pipeline and turned out into natural swales to create wetland habitat. The water surface area of the ponds would be approximately 95.3 acres. Mud Slough affected area in China Island is 76.8 acres. As a result of the applied water, vegetation would emerge in and around the ponds. Water would likely be developed locally from wells.
- Service Mitigation Proposal: Create year-round wetlands on Service lands (to be identified). This option establishes 31.6 acres of year around wetland marsh habitat. It may create wetland slough habitat in a drainage ditch next to the Schwab Unit (BG001). This could create a broad yet linear habitat that could provide slough mitigation habitat. The Service proposal has not been fully developed. If obstacles prevent the implementation of this option, then an alternate mitigation site would be found of approximately 31.6 acres of year-round wetland habitat. Mud Slough affected area within San Luis Unit is 24 acres. Water would likely be developed locally from wells.

The proposals were developed by the GAF working with Service and CDFG staffs to determine the habitat needs within their respective wetland complexes. Ownership of all capital improvements on agency land would remain with the agencies after the term of the Use Agreement.

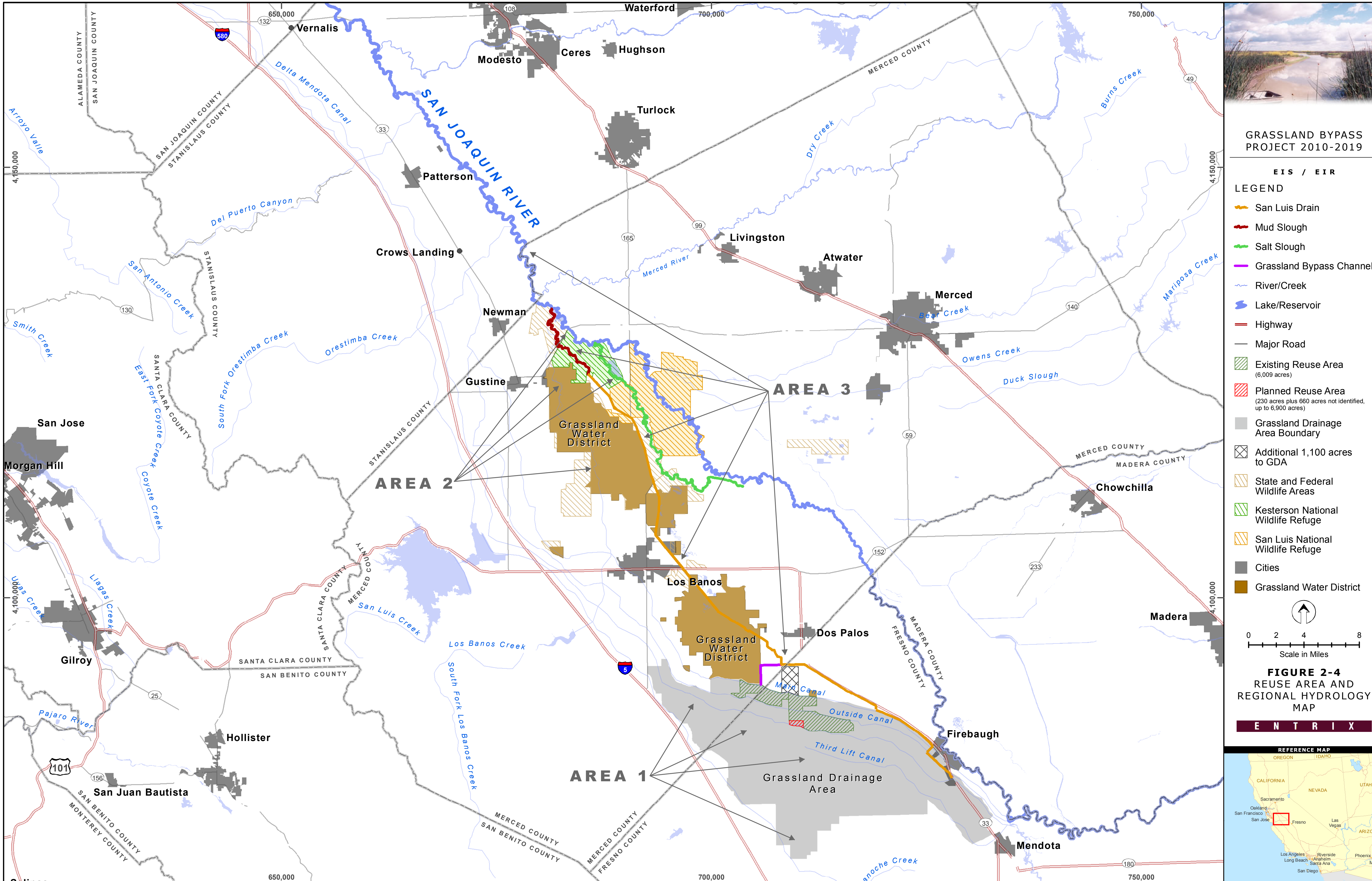
Both proposals are under consideration, and both proposals would be implemented for a total acreage of 108.4.

2.2.1.2.2 In-Valley Treatment/Drainage Reuse

The Proposed Action would include expansion of the SJRIP. Each phase of the facility would significantly reduce the quantity of drainwater discharged to the San Joaquin River on a schedule designed to comply with interim performance goals and implementation dates of applicable water quality objectives.

The SJRIP facility would be implemented on up to 6,900 acres of land within the GDA. Figure 2-4 shows the location of the existing facility within the GDA and key hydrologic and geographic features and subareas in the Project Area. This component of the Project already dedicates specific lands for the irrigation of salt-tolerant crops with subsurface drainwater to reduce the volume; would treat the concentrated drainwater to remove salt, Se, and boron; and would dispose of the removed salts “in valley” to prevent them from discharging to the San Joaquin River. The treatment systems would also potentially produce a product water-sufficient in quality for reuse on agricultural lands within the GDA. At completion, the facility is planned to handle all of the drainwater produced in the GDA (up to 29,500 acre-feet annually)[4] and not managed with on farm source control and would include three phases, described in more detail below:

[4] This estimate is based on a drainage model that assumes all 6,900 acres were developed with the drains and 4.25 acre-feet per acre of applied drainage and a depth to groundwater of 6.6 feet, then the reuse area plus treatment facility could handle up to 29,500 acre-feet annually.



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- Phase I: Purchase of land and planting to salt-tolerant crops
- Phase II: Installation of subsurface drainage and collection systems, and an initial treatment/salt disposal system
- Phase III: Completion of construction of treatment removal/salt disposal system

The SJRIP would be comprised of the following phases, and undeveloped elements are covered programmatically in this EIS/EIR:

PHASE I

Subsurface agricultural drainwater from the GDA would be used to irrigate salt-tolerant crops on land ideally situated for this purpose. The land is adjacent to the collected drainwater from the GDA, so the water can easily be captured and placed on the land. Salt-tolerant crops would be planted for irrigation with salty subsurface drainwater reducing the volume of, and after subsequent phases, eliminating the discharge of such water to the San Joaquin River. Ongoing monitoring of soil and water constituents would be performed to protect groundwater and to assure that no irreversible changes occur to any of the project areas. In Phase I of the SJRIP, 6,900 acres of such land were acquired, of which 3,800 acres were planted with salt-tolerant crops and placed into use as of 2007. By November 2008, 4,300 acres were planted (incorporating an additional 500 acres on the western side of Russell Avenue). Table 2-2 illustrates volumes of water applied and drainage reductions achieved through this effort (McGahan, pers. comm., 2008a).

Table 2-2 Volumes of Reused Drainwater Applied and Drainage Reductions Achieved through Implementation of SJRIP Phase I

Water Year	Reused Drainwater Applied/ Drainage Reductions Achieved (acre-feet)	Displaced Selenium (pounds)	Displaced Boron (pounds)	Displaced Salt (tons)
1998*	1,211	329	NA	4,608
1999*	2,612	321	NA	10,230
2000*	2,020	423	NA	7,699
2001	2,850	1,025	61,847	14,491
2002	3,711	1,119	77,134	17,715
2003	5,376	1,626	141,299	27,728
2004	7,890	2,417	193,956	41,444
2005	8,143	2,150	210,627	40,492
2006	9,139	2,825	184,289	51,882
2007	11,233	3,441	210,582	61,412

Source: Initial Study for SJRIP Phase I, Part 2 (URS 2007a)

NA = Not Available
*Panoche Drainage District drainage reuse project prior to SJRIP

Parcels included in the reuse area for the Proposed Action are adjacent to or within easy access of the channels containing collected drainwater from the GDA, so the water can easily be captured and placed on the land. In general, the parcels lie at the drainage area’s lower elevations, enabling collected water to be applied without excessive pumping costs. Most of the target lands have been permanently acquired (6,009 acres) without any applicable surface-water supply. Open drains may not be needed for the reuse operation on lands that are purchased and will be evaluated for closure, netting and/or piping. Application of drainwater will be controlled and managed to prevent water table rise. Perimeter drains will be installed to capture water prior to offsite migration. Groundwater monitoring will be conducted to confirm migration is not occurring. If needed, additional drainage management measures would be implemented. The purpose of these actions would be to minimize exposure of wildlife to the drainage water. (URS 2007a)

PHASE II

To continue to apply the salty water to the lands developed in Phase I, it will be necessary to install subsurface drainage systems. Installation of tile drainage systems will be required to maintain salt balance in the root zones and to maintain the productivity of the reuse area on a long-term basis. Such installation would not be a prerequisite for commencement of reuse, would be prioritized based upon available funding and the needs of particular crops, and would be expected to proceed throughout Phase II. Currently (and for the foreseeable future) any tile water captured within the reuse areas is blended back with the reuse area irrigation supply and used on whatever crop is located downslope. Salt, Se, and other drainage constituents would be collected in the water coming out of the subsurface drainage systems, continue to be recirculated and utilized on site or, during any continuation of the Grassland Bypass Project, be discharged subject to load reduction obligations.

An initial phase of treatment, originally envisioned as part of Phase II, would remove the salt and the Se and much of the other constituents from the water, leaving usable water for agriculture or possibly other beneficial uses. The treatment system would be designed to tie in at any point in the reuse system. The salt would be deposited in an approved manner based on the quality of the material and not discharged to the San Joaquin River, resulting in additional reductions in salt and Se discharges to the river.

By late 2007, Phase II was partially implemented with the installation of subsurface drains on approximately 1,700 acres within the 3,800-acre planted area. On-site tile drainage water is returned to the irrigation system or discharged. The Proposed Action would expand the drains and sequential reuse to the full acquired and planned acreage, up to 6,900 acres.

The irrigation of salt-tolerant crops on the expanded area was evaluated in an Initial Study, and a Mitigated Negative Declaration was approved by Panoche Drainage District in August 2007. CEQA compliance was included on a programmatic basis in the 2001 Grassland Bypass Project EIS/EIR. Site-specific environmental analysis has been/will be performed for each installation, as necessary. No treatment has been implemented to date, although a pilot treatment project has been approved with its own CEQA review and is expected to remain in effect for 1 year. It is currently unclear whether any treatment would be developed separate from Phase III. For the Proposed Action, additional Phase II installation of subsurface drainage systems and recirculation back into the reuse area irrigation system would likely apply only to permanently acquired parcels.

PHASE III

This final phase would be necessary to provide for maximum improvement to water quality in the San Joaquin River, to meet the ultimate reductions needed to meet future water quality objectives, and to sustain long-term viability (20 years or more) of the reuse area's salt balance without an out-of-valley drainage outlet, and sustained agricultural production. This phase would include expansion of the pilot treatment/salt disposal (under Phase II) with construction of full-scale treatment/salt disposal facilities, as well as waste disposal units. Phase III is now expected to include both treatment and disposal facilities, with or without the production of usable water. This phase was also included, on a programmatic basis, in the 2001 Grassland Bypass Project EIS/EIR.

The implementation date for Phase III is presently unknown, in part because inadequate funds have been available for development of economically viable treatment/salt disposal alternatives. The goal of treatment is to remove the salt from the drainage system, maintain a salt balance for continued agricultural production in the region, and provide appropriate salt disposal. Development of viable treatment methods has been the subject of much research over the past 20 years. Recently, Panoche Drainage District and Reclamation have conducted pilot studies on the use of the reverse osmosis and other membrane separation technologies to reclaim salts. In addition, several biological systems have been piloted for their ability to remove Se from drainage water and/or brine waste streams resulting from membrane treatment for salt removal. While technologies have been successful in reaching treatment goals, costs are typically high, requiring additional improvements before implementation. Panoche Drainage District and Firebaugh Canal Water District have recently awarded a contract, following an extensive selection process, to implement a 1-year pilot project to treat an approximately 20gallon-per-minute inflow, expected to begin in May 2009. The process utilizes chemical precipitation to soften the water, followed by membrane technology to remove constituents, with recovery of 85-90 percent reusable water. Phase III would be applied only to permanently acquired parcels and would be subject to separate review under CEQA (URS 2007a).

If Phase III is not fully implemented because treatment is not feasible, then the reuse area would operate as long as possible and more drainage would be recirculated on-farm with resulting impacts on production.

2.2.1.2.3 Sediment Management Plan

The SMP for use of the San Luis Drain is presented in Appendix B. It addresses potential options for disposal of sediments dredged from the Drain in order to maintain desired flow rates. Since the sediments contain high concentrations of Se, the long-term accumulation of sediment in the Drain may pose a disposal problem. The purpose of this SMP is to identify applicable human health, ecologic risk, and hazardous material standards for Se, and then to specify appropriate disposal or reuse actions for the dredged sediments.

Prior to or following each dredging event, sediment cores will be collected from the Drain to characterize the level of Se in the dredged material if necessary to supplement existing data.[5] The cores will consist of discrete sediment samples collected from the Drain check area(s) to be dredged in accordance with the methods outlined in the SMP. The samples will be submitted to a certified laboratory and analyzed for Se. Results of sampling will be compared to the sampling risk criteria for hazardous waste, ecological risk, and human health risk.

Sediments that contain Se concentrations below hazardous waste criteria but exceed ecological risk criteria may be applied for reuse to lands zoned for residential or industrial development, and upland open areas outside of the rainy season. Sediments that are below the ecological risk

[5] Under the Grassland Bypass Project Compliance Monitoring Program, this sampling has been completed and results reported annually.

criteria may be applied with unrestricted use. Possible agricultural lands for sediment disposal have been identified in close proximity to the Drain, and no sediment disposal to residential or industrial lands is proposed. The SMP also includes post-application monitoring protocol for all land application sites.

2.2.1.3 Other Drainage Management Actions

Other drainage management actions that would occur with implementation of the Proposed Action would include the following:

- Utilizing and installing drainage recycling systems to mix subsurface drainwater with irrigation supplies under strict limits.
- Continuing current land retirement policies listed in the 1998 *Long-Term Drainage Management Plan for the GDA* (GAF and Authority 1998) and subsequent Westside Plan. Key among these is that land retirement should be voluntary.
- Implementing a compliance monitoring program with biological, water quality, and sediment components. Results of the monitoring program would be reviewed by an oversight committee as necessary and may be expanded in the proposed 2010 Use Agreement.
- Continuing the operation of a regional drainage management entity to perform management, monitoring, and funding of necessary control functions.
- A single WDR for the GDA.
- An active land management program to utilize subsurface drainage on salt-tolerant crops.
- Low-interest loans for irrigation system improvements, such as gated pipe, sprinkler, and drip irrigation systems.
- An economic incentive program including tiered water pricing and tradable loads.
- A no-tailwater policy that would prevent silt from being discharged into the Drain and promote the secondary benefits of irrigation water management.
- Implementing drainwater displacement projects such as using subsurface drainage for dust control on roadways.
- Meeting with landowners as necessary to implement projects and policies cited above.

2.2.2 Location

Potential impacts resulting from the Proposed Action would be concentrated in three areas (see Figures 2-1 and 2-4):

- The first of these is the 97,400-acre source zone known as the GDA and the 1,100-acre potential annexation area, located in the Central Valley of California, specifically in Merced and Fresno counties.
- The second area consists of 93 miles of wetlands channels, Salt Slough, and the San Joaquin River from the confluence of Salt Slough downstream to Mud Slough. Under the proposed continuation of the Grassland Bypass Project, 2010–2019, agricultural drainage from the

GDA would not enter these waterways except when the Drain overflows during high storm events.

- The third area consists of the Drain from Russell Avenue on the south to its northern terminus at Mud Slough, 6 miles of Mud Slough upstream of its confluence with the San Joaquin River, and the San Joaquin River downstream from Mud Slough to Crows Landing. These waterways would convey agricultural drainage from the GDA, and, thus, would be directly affected by the Proposed Action.

2.2.3 Required Approvals and Permits

A proposed 2010 Use Agreement would be needed between Reclamation and San Luis and Delta-Mendota Water Authority (the Authority) for use of the Drain, effective for the period January 1, 2010, through December 31, 2019.

The Regional Board and State Water Resources Control Board (State Board) will need to approve a Basin Plan Amendment to defer the compliance deadlines for the water quality objectives in Mud Slough and the San Joaquin River between Mud Slough and the confluence with the Merced River. The basic basin planning procedure is as follows: scoping, environmental study, staff report, Regional Board hearing, and Regional Board adoption. The Regional Board will prepare revised WDRs for the proposed 2010 Use Agreement. The revised WDRs require State Board approval, Office of Administrative Law approval, and U.S. Environmental Protection Agency approval. If the Basin Plan Amendment is not final by October 1, 2010, the prohibition of discharge becomes effective in Mud Slough (North) and the San Joaquin River from Sack Dam to the mouth of the Merced River unless water quality objectives are met. If the GAF do not comply with the prohibition/objective, the California Water Code gives the Regional Board the authority to take a variety of different enforcement actions to achieve compliance. The Regional Board would consider the circumstances at the time to determine which enforcement action is appropriate.

The Proposed Action would not involve new construction or significant alteration of canals and other drainage facilities. Phase I, land acquisition and planting of salt-tolerant crops, does not involve significant land alteration. Phase II of the facility would involve the installation of subsurface drainage and collection systems and a pilot treatment facility, while Phase III would complete construction of treatment and salt disposal systems. Otherwise, the Proposed Action would rely on existing canals and waterways and lands currently in agricultural production for expansion of the SJRIP facility to 6,900 acres.

The treatment process and the specific facility location have not been selected. Additional NEPA/CEQA impact analysis would be required to implement the treatment component (beyond drainage reuse on the 6,900 acres at the SJRIP).

The Proposed Action is a major component of the Authority's long-term drainage management plan now incorporated into the Westside Plan (San Joaquin River Exchange Contractors Water Authority et al. 2003). Other components not specifically proposed as part of the Proposed Action and evaluated herein could require separate or supplemental NEPA/CEQA analysis and relevant permits. Phase I, Part 1 of the SJRIP reuse facility has been evaluated under CEQA, and Panoche Drainage District adopted a Negative Declaration on September 19, 2000. Phase I, Part

2 has also been evaluated, and Panoche Drainage District adopted a Mitigated Negative Declaration for acquisition of additional land on August 21, 2007.[6]

A permit from the Regional Board may be required for removal of accumulated sediments in the Drain and disposal to agricultural lands. Sediment removal is being addressed in a SMP. See Section 2.2.1.2.3 and Appendix B.

Under the Federal Endangered Species Act, Sections 7 and 10, informal/formal consultations with the Service would be required.

2.3 ALTERNATIVE ACTION

The only other reasonable alternative is known as the 2001 Requirements Alternative and is similar to the Proposed Action in all aspects except the Se and salt loads discharged to Mud Slough would be limited to those in the 2001 Use Agreement (i.e., less stringent allowances). This alternative does not avoid or substantially lessen any potentially significant impact of the Proposed Action but is technically feasible.

2.3.1 Characteristics/Associated Actions

2.3.1.1 Existing Features of Alternative

Existing project features that would continue under this alternative include all of those for the Proposed Action described in Section 2.2.1.1 except the load values and incentive fees would be those associated with the 2001 Use Agreement.

2.3.1.2 Features of Alternative Action

The 2001 Use Agreement conditions would continue through 2019 with the same environmental commitments contained in the Agreement, including Se and salt load values and incentive fees. Unlike the Proposed Action, the Alternative Action would not enhance the performance incentive system and would not provide for Mud Slough mitigation.

While the Alternative Action does not meet Mud Slough Se objectives for 2010, it does meet San Joaquin River objectives. Figure 2-5 shows the annual Se load values for this Alternative Action. In short, it represents a continuation of the 2001 Use Agreement "as is" until December 31, 2019.

2.3.1.3 Other Drainage Management Actions

Other drainage management actions that would occur with implementation of this alternative would include the actions listed for the Proposed Action (Section 2.2.1.3).

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[6] Both 2000 and 2007 CEQA documentation are incorporated by reference into this EIS/EIR.

2.3.2 Location

The 2001 Requirements Alternative project area is the same as shown for the Proposed Action on Figures 2-1 and 2-4.

2.3.3 Required Approvals and Permits

These approvals and permits are similar to those described for the Proposed Action in Section 2.2.3.

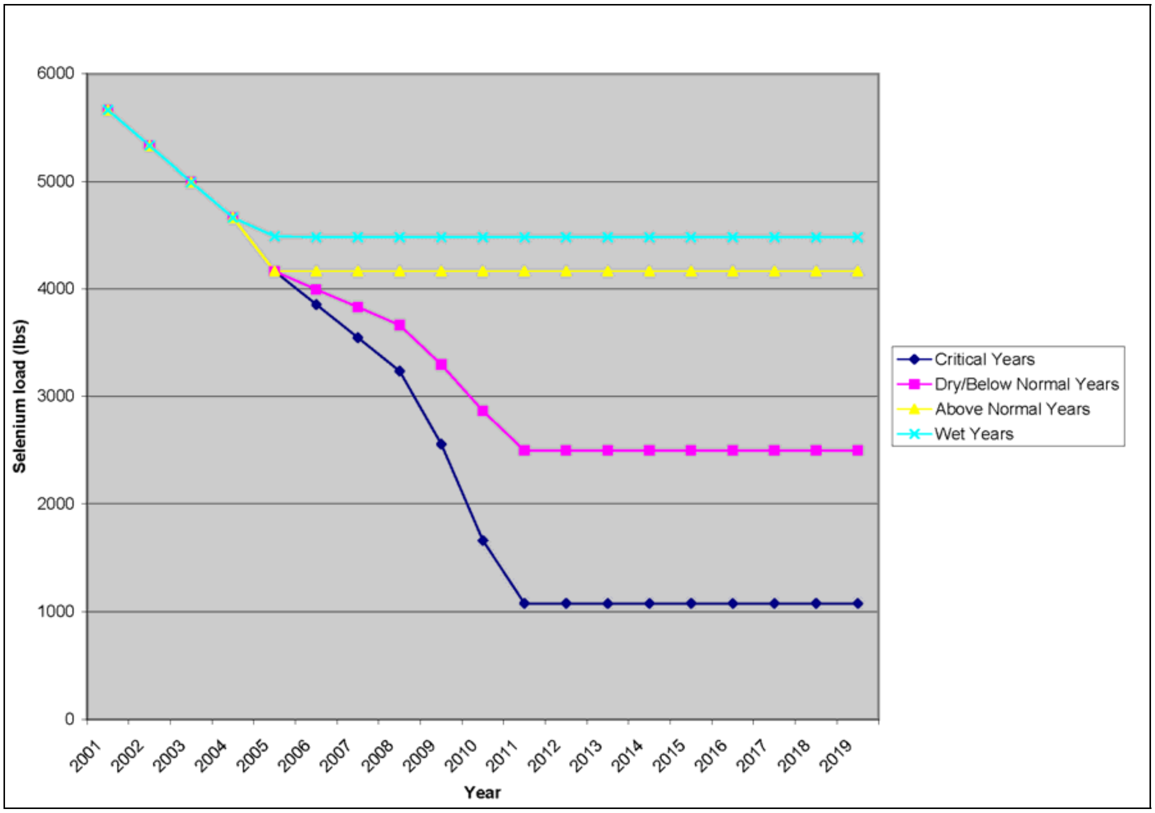

Figure 2-5 Alternative Selenium Annual Load Values

2.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

Reasonable alternatives to the Proposed Action were identified through a review of the feasibility of all potential alternatives. To be considered feasible, alternatives should be capable of accomplishing project purposes and needs in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors. The review began with re-evaluating alternatives developed for the 2001 Grassland Bypass Project and concluded with consideration of options based on partial completion of the 2001 project.

As discussed earlier in this document, the Grassland Bypass Project has been in place for approximately 15 years, and significant investments and progress has been made in addressing the environmental concerns associated with agricultural drainage discharges from the GDA within the San Joaquin River watershed. In recognition of the progress that has been made to reduce discharges, and is likely to be made with an extension of the Drain Use Agreement, and continued development of drainwater treatment technology, and the fact that prior environmental processes resulted in the selection of the original 1996 and subsequent 2001 Grassland Bypass Projects, this document focuses on the continuation of the existing program (with certain changes), rather than a re-analysis of the overall approach to drainage management.

However, to ensure that all possible alternatives were considered, alternatives to the 2010 Grassland Bypass Project have been re-evaluated along with consideration of options based on partial completion of the 2001 Project. The updated Alternatives Report is summarized in the sections below and incorporated by reference into this EIS/EIR. The following sections provide a description of alternatives considered but eliminated from further consideration.

2.4.1 Project Alternatives

For the 2001 Grassland Bypass Project Final EIS/EIR, 18 potential drainage options or alternatives were identified and evaluated. These options were subjected to a screening process and classified into three types:

- Options for use of the Drain that could be incorporated into the 2001 Use Agreement
- Stand-alone alternatives that do not require use of the Drain
- Tools for implementation in combination with the 2001 Use Agreement, or with stand-alone alternatives

Table 2-3 illustrates how each of the alternatives relates to these categories of options, alternatives, and tools. Some alternatives are both alternatives and tools depending on the extent to which they would be implemented (small scale vs. large scale), either alone or in combination with other alternatives/tools. For example, land retirement on a small scale is a drainage management tool; on a large scale, it is a stand-alone alternative. To be a viable alternative to the Proposed Action, each of these alternatives was evaluated in terms of use as full-scale options or stand-alone alternatives, rather than as tools that could be used to supplement other alternatives.

Alternatives 2 through 19 were re-evaluated in 2008 to prepare for the continuation project EIS/EIR, and two options under Alternative 3 were evaluated. Alternative 20 was added at the request of Regional Board staff. A detailed explanation and evaluation of each alternative is contained in the Alternatives Report (which is incorporated into this EIS/EIR by reference and summarized herein).

Table 2-3 Summary of Alternatives and Tools for Implementation

Alternative	Use Agreement		Other Alternatives	
	Option	Tool	Stand-Alone	Tool
2. "Flip-Flop" System			Y	
3. Grassland Bypass, 2010–2019 (Proposed Action)	Y			
4. 1990 Project	Y			
5. San Luis Drain to Salt Slough	Y			
6. San Luis Drain to Mud + Salt Sloughs	Y			
7. San Luis Drain + Other Entry	Y			
8. Eastside Bypass Channel			Y	
9. Construct New Channel to San Joaquin River above Merced River			Y	
10. Conservation + Source Control		Y	Y	Y
11. In-Valley Treatment + Disposal		Y	Y	Y
12. Complete San Luis Drain + Out-of-Valley Discharge			Y	
13. Extend San Luis Drain to San Joaquin River below Merced River	Y	Y		
14. New Drain to San Joaquin River below Merced River			Y	
15. Land Retirement		Y	Y	Y
16. Real-Time Operations		Y		Y
17. Groundwater Management		Y	Y	Y
18. Rainbow Plan	Y			Y
19. Water Deprivation			Y	
20. IFDM (Red Rock Ranch)		Y		Y

2.4.2 Screening of Alternatives

The criteria used for determining the feasibility of reasonable alternatives are listed below. Criteria based on primary purpose/need/objectives are described in Items 1 through 4. Criteria based on economic, social, and environmental goals are listed as Items 5 through 9.

2.4.2.1 Criteria Based on Purpose and Need/Project Objectives

Criteria based on the project's purpose and need (NEPA) and objectives (CEQA) have primary importance under NEPA and CEQA. Alternatives that do not substantially meet the project purpose and need/objectives can be eliminated from further evaluation on these criteria alone. The following criteria closely follow the wording of the purpose and need and objectives contained in Sections 1.2 and 1.3.

1. Separate agricultural drainage from wetland water supplies

    1a. Maintain availability of channels to convey fresh water to wetlands

    1b. Minimize adverse impacts to wetland habitat

2. Operate for the period 2010–2019. The 2001 Use Agreement expires on December 31, 2009. A reasonable alternative (either under the 2001 Use Agreement or as a stand-alone project) needs to be physically implementable by January 1, 2010 (which includes meeting permit requirements, completing the NEPA/CEQA process, and initiating construction activities), and remain feasible through December 2019. Some alternatives that would not be available

by 2010 could be implemented early during the period and may be reasonable on a case-by-case basis when combined with other alternatives or measures.

3. Maintain the viability of agriculture in the Project Area

    3a. Maintain salt balance

    3b. Maintain operational economics

4. Promote continuous improvements in water quality (Se and salts) 2010–2019 in the San Joaquin River system relating to discharges from the GDA:

    4a. Mud Slough

    4b. Salt Slough

    4c. San Joaquin River

    4d. Other channels

See Section 1.3.2 (Table 1-1) and Section 4.1.2.2 for water quality objectives applicable now and in the foreseeable future that are part of this criterion. These objectives are contained in the Regional Board's 1998 Basin Plan and include standards for Se concentration in several waterways (Regional Board 1998a).

2.4.2.2 Other Criteria

Other criteria point to potential impacts that could make an alternative infeasible. Although not as significant in terms of CEQA and NEPA requirements, they are important to meeting other compliance requirements (such as the Federal Endangered Species Act) and to other interested parties.

5. **Impacts to third parties.** Does the alternative have impacts that can be mitigated (e.g., economic, social, recreational, cultural, environmental justice) to third parties, a type of indirect impact?

6. **Impacts to threatened and endangered species, migratory birds, or wetland habitats/floodplains.** Could/would the alternative potentially lead to adverse impacts to existing or candidate species listed/proposed as threatened or endangered under the Federal or California Endangered Species Act including impacts to habitats such as wetlands and/or floodplains that may support these species?

    6a. Terrestrial species

    6b. Aquatic species

7. **Different from proposed action.** Is the alternative a distinctly different approach from the proposed action? Minor variations would be considered subalternatives rather than separate

options under the Agreement for use of the San Luis Drain (Agreement No. 6-07-20-W1319) (1995 Use Agreement) or stand-alone alternatives.

8. **Implementation cost.** Cost alone cannot be used to exclude an alternative, but major construction of new facilities that would require substantial new debt obligations by existing agencies is assumed to proportionately affect project feasibility. For example, if treatment and disposal costs are greater than can be supported by agricultural revenues from 2010-2019, then feasibility is questionable. A low implementation cost is considered positive.

2.4.2.3 Evaluation Approach

A matrix was prepared for screening the alternatives, including the Proposed Action (Alternative 3 - Grassland Bypass Project, 2010–2019). The scoring system used in the process consisted of the following:

+	a potentially positive effect or "pass" relative to the criterion
O	neutral or no impact
—	a potentially negative effect or "fail" relative to the criterion
?	unknown effect or insufficient information presently available
Y	Yes
N	No

To determine the feasibility and, therefore, reasonableness of the 19 alternatives in comparison to existing conditions, two types of criteria were used: purpose/need and other. Criteria 1 to 4, based on the purpose and need/project objectives were given the greatest weight. NEPA and CEQA require that reasonable alternatives substantially meet the project purpose and need/project objectives. Therefore, the alternatives must have a neutral or positive score relative to these criteria to remain for further analysis. The remaining criteria, 5 through 8, helped to further refine the alternatives meeting Criteria 1 to 4. Alternatives passing on Criteria 1 to 4 but scoring "no" for Criterion 7 were combined with the larger Proposed Action alternative, or dropped as not sufficiently different from the Proposed Action to be a stand-alone alternative.

2.4.2.4 Evaluation Results

Table 2-4 is a matrix that shows the results of the scoring for each alternative when scored as an option under the proposed 2010 Use Agreement or a stand-alone alternative. In the section below, the results of the evaluation are explained in summary form. In many cases, the scoring reflects a comparison to the 2007 Existing Condition baseline.

Table 2-4 Alternatives Screening

Alternative	Purpose and Need Criteria							Other				
				4. Water Quality Objectives					6. Impacts to T&E Species			
	1.	2.	3.	4a.	4b.	4c.	4d.	5.	6a.	6b.	7.	8.
	Separate Channels	2010–2019	Viability of Agriculture	Mud Slough.	Salt Slogh	San Joaquin River	Other Channels	Impacts to Third Parties	Terrestrial	Aquatic	Different from Proposed Action	Implementation Cost
1. No Use Agreement	No Action Alternative											
2. "Flip-Flop" System	–	N	+	+	–	0	–	–	0	–	+	+ Low
3A. Grassland Bypass 2001 UA	+	Y	+	0	0	0	0	+	0	0	0	0
3B. Grassland Bypass 2010 UA	+	Y	+	0	0	0	0	+	0	0	0	0
4. 1990 Project	–	Y	+	+	–	0	–	–	0	–	+	+ Low
5. San Luis Drain to Salt Slough	+	N	+	+	–	0	0	–	–	–	+	– High
6. San Luis Drain to Mud+Salt Sloughs	+	N	+	+	–	0	0	–	–	–	+	– High
7. San Luis Drain + Other Entry Point	+	Y	+	0	0	0	0	+	0	0	–	+ Low
8. Eastside Bypass Channel	+	?	+	+	+	–	+	–	–	–	+	– High
9. Construct New Channel to San Joaquin River above Merced	0	N	+	+	+	0	+	0	–	–	+	– High
10. Conservation+ Source Control	–	Y	–	+	–	+	–	–	+	0	+	– Moderate
11. In-Valley Treatment+ Disposal	+	N	+	+	+	+	0	+	+	+	+	– High
12. Complete San Luis Drain + Out-of-Valley Discharge	+	N	+	+	+	+	–	0	–	–	+	– High
13. Extend San Luis Drain to San Joaquin River below Merced	+	N	+	+	+	0	0	0	–	–	+	– Moderate
14. New Drain to San Joaquin River below Merced	+	N	+	+	+	0	0	0	–	–	+	– High
15. Land Retirement	–	Y	–	+	–	–	–	–	+	0	+	– High
16. Real-Time Operations	Tool only; not a complete alternative											
17. Groundwater Management	–	Y	0	+	–	+	–	–	0	0	+	– Moderate
18. Rainbow Plan	0	Y	+	0	0	0	0	+	0	0	–	– Moderate
19. Water Deprivation	–	Y	–	0	–	0	–	–	0	0	+	+ Low
20. IFDM (Red Rock Ranch)	+	Y	+	0	0	0	0	–	0	–	+	– High

Notes:

+ = Potentially positive effects or "pass"
0 = Potentially neutral or no effect
– = Potentially negative effects or "fail"
? = Unknown or not enough information presently available

Shaded cell indicates that criterion eliminates options.

Alternatives other than 3A and 3B do not meet the project purpose and need; are not sufficiently different from the Proposed Action (3B); and/or have drawbacks due to implementation schedule, uncertainties about technology, or potential for other adverse impacts. Other measures listed were determined to be tools and not sufficient to serve as a project alternative.

In 2001, Alternative 13, Extend San Luis Drain to San Joaquin River below Merced River, was selected as the only other reasonable alternative to the Grassland Bypass Project, 2010–2019. Called the Mud Slough Bypass Alternative, it was similar to the 2001 Proposed Action (Alternative 3A) in all aspects except the discharge location. It would avoid using Mud Slough to convey drainwater, a major difference. Instead, a pipeline or canal would be constructed that would connect to the end of the Drain at Mud Slough and convey the drainwater approximately 15 miles to discharge directly to the San Joaquin River below its confluence with the Merced River. This alternative met the CEQA requirement to avoid or substantially lessen any potentially significant impact of the 2001 Proposed Action. Prior to conducting the detailed impact analyses, the project proponents identified Mud Slough as an area of potential impact due to the discharge of drainwater at this location.

However, the Mud Slough Bypass Alternative was determined to be infeasible in 2008 for the following reasons:

- With Reclamation's completion of the San Luis Drainage Feature Re-evaluation (SLDFR) plan formulation, EIS, and Record of Decision, any extension of the Drain is not practical. The SLDFR concluded that an In-Valley solution, not discharge to the San Joaquin River, was the preferred option for providing drainage service. (Reclamation 2007a)
- Further discussions with affected parties on drainage service alternatives resulted in the "Concepts for Collaboration Drainage Resolution," which address 17 additional options for regional drainage solutions including financial arrangements. These additional concepts are another set of tools and include Concept 2, Means of Providing Drainage. Concept 2 incorporates the Westside Plan and, therefore, the Grassland Bypass Project, 2010–2019. (Reclamation 2007b)

Alternative 20. Integrated Farm Drainage Management (IFDM) is an integrated system of irrigation of salt-tolerant crops including trees with drainage water to manage salt. An example of this system is Red Rock Ranch near Five Points, California. This project incorporates a system of traditional irrigation integrated with sequential recovery and blending of drainage water to irrigate increasingly salt-tolerant crops, trees, and halophytes prior to terminal drainage discharge to a small solar evaporator.

The main reasons for not using IFDM for the GDA are:

- Because it is a series of small scale projects, the benefits of economies of scale are lost. Rather than a handful of pumping facilities for one large area to treat drainage, the GAF would need a handful of facilities for each area.
- Monitoring of individual IFDM facilities is not practical. The on-farm concept would spread reuse areas throughout the 97,400-acre GDA. As each one would have potential water quality and wildlife impacts, they would likely need to be monitored, which would be significantly more expensive in time, manpower, and cost than monitoring a regional facility.

- The topography of the GDA (and basis for design of the Grassland Bypass Project) causes all of the drainage to flow to one location, making it convenient to manage at one location.
- As each IFDM system would be owned and operated by the individual grower, it would be difficult to keep each system operating at a consistent level. Growers' individual resources and technical ability vary considerably, which will directly relate to their ability to manage the IFDM system. This variance would cause the district to either
  - police the system and force growers to expend resources they do not have, or
  - develop a downstream (regional) system to catch whatever overflow occurs.
- The GDA is already heavily invested in a regional system. This would not be 100 percent incompatible with IFDMs in some locations, but it would not make much sense to pursue individual IFDMs on an areawide basis given the expenditures already made in the current SJRIP facility.

Alternatives that remained for consideration as reasonable alternatives are:

- Alternative 3. Continuation of the Grassland Bypass Project, 2010–2019
  - This alternative is represented by two options. One option (3A) is to continue the Project for another 10 years under the terms and conditions of the 2001 Use Agreement. The other (3B) is to modify the terms and conditions for a new 2010 Use Agreement and is the Proposed Action.

Substantial investment ($59.8 million as of 2008) has been spent or committed in the In-Valley treatment/drainage reuse facility known as the SJRIP. Both options recognize partial completion of the facility and substantial progress in reducing Se loads and drainage volumes discharged. Alternative 3A, called the 2001 Requirements Alternative, would continue the present 2001 Use Agreement past 2009 without revision to its terms and conditions, in particular, the Se load values. Alternative 3B is the Proposed Action. At issue is whether Alternative 3A is substantially different from the Proposed Action. Given that the Se load values are a fundamental component of the proposed 2010 Use Agreement, alternative load requirements would be sufficiently different to have the 2001 Requirements Alternative selected as a reasonable alternative action to the Proposed Action.

2.5 ENVIRONMENTALLY SUPERIOR ALTERNATIVE

CEQA requires that an EIR identify the environmentally superior alternative other than the No Project Alternative. The Proposed Action (Alternative 3B) is the environmentally superior alternative because it would result in greater environmental benefits (avoidance of water quality and biological impacts) to the San Joaquin River and includes mitigation for water quality impacts on Mud Slough. The slough is potential habitat for the giant garter snake and other sensitive species. It is the preferred alternative due to its water quality and wetland enhancement over the long term.

2.6 SUMMARY COMPARISON OF ALTERNATIVES

Table 2-5 compares the three alternatives with the Project purposes (Section ES.2). Both Action Alternatives meet the project purposes. In contrast, the No Action Alternative fails to meet three out of the four purposes. It does not keep drainwater out of the wetland channels. Also, the viability of agriculture would be adversely affected.

Table 2-5 Comparison of Alternatives with Project Purposes

Purpose & Need Statement	No Action Alternative	Grassland Bypass Project 2010-2019	2001 Requirements Alternative
Extend the San Luis Drain Use Agreement in order to allow the GAF time to acquire funds and develop feasible drainwater treatment technology to meet revised Basin Plan objectives and WDRs by December 30, 2019.	No – no additional drainwater treatment beyond current reuse facility	Yes – additional treatment and disposal of drainwater and sediment management of San Luis Drain	Yes – additional treatment and disposal of drainwater and sediment management of San Luis Drain
Continue the separation of unusable agricultural drainwater discharged from the GDA from wetland water supply conveyance channels	No – some drainwater would enter wetland channels	Yes – continued separation of drainwater from 93 miles of wetland channels; continued discharge to 6 miles of Mud Slough	Yes – continued separation of drainwater from 93 miles of wetland channels; continued discharge to 6 miles of Mud Slough
Facilitate drainage management that maintains the viability of agriculture	No – extraordinary efforts would be needed by individual farmers to reduce and recycle drainwater within the GDA; land taken out of production immediately due to ponding of drainwater on the surface and in the long term due to soil conditions	Yes – with GAF and Regional Drainage Coordinator. Reuse SJRIP Facility, Sediment Management Plan, and Compliance Monitoring Program	Yes – same as Grassland Bypass Project
Promote continuous improvement in water quality in the San Joaquin to achieve zero discharge of subsurface drainage from irrigation	Yes – immediate improvement in water quality due to no direct discharge; No – some unmanaged subsurface drainage into wetland channels	Yes – according to Waste Discharge Requirements and control programs	Yes – same as Grassland Bypass Project

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SECTION 3

Project Area and Scope of Analysis

This section presents a general description of the physical environment of the continuation of the Grassland Bypass Project, 2010–2019, Project Area and vicinity and the resources to be evaluated in subsequent Sections. The existing condition of resources sets the baseline against which the alternatives are evaluated for CEQA, while the No Action Alternative is the baseline for NEPA. The Project Area is located on the western side of San Joaquin Valley, which is a gently sloping, nearly unbroken alluvial plain about 250 miles long and an average 45 miles wide. San Joaquin Valley is characterized by a mild, dry climate. This temperate climate combined with the productive soils and the application of irrigation water have resulted in one of the world's most productive agricultural areas. (SJVDP 1990)

As described in Section 2, Alternatives Including Proposed Action, the immediate Project Area is comprised of the 97,400-acre Grassland Drainage Area (GDA) the potential addition of a 1,100-acre area to the GDA, the Grassland Water District and state/federal wildlife management areas with 93 miles of wetland channels, 28 miles of the San Luis Drain from Russell Avenue in the south to its northern terminus at Mud Slough, 6 miles of Mud Slough, and 6.5 miles of the San Joaquin River downstream from Mud Slough to Crows Landing. The Project Area vicinity includes Salt Slough, the San Joaquin River from Crows Landing to Vernalis, and adjacent lands in the three counties of Stanislaus, Merced, and Fresno. The economic analysis uses a three-county "zone of influence" to describe the agricultural community: Madera, Merced, and Fresno.

3.1 RESOURCES TO BE EVALUATED

Each of the subsequent Sections 4 through 13 present detailed descriptions of the resources that could be potentially affected by the No Action; continuation of the Grassland Bypass Project, 2010–2019; and the 2001 Requirements Alternatives.

The resources described in subsequent sections are those that were determined to be potentially affected by the proposed 2010 Use Agreement and related drainage management activities and facilities. These resources are Surface Water Resources (Section 4), Groundwater and Soil Resources (Section 5), Biological Resources (Section 6), Land Uses (Section 7), Socioeconomic Resources (Section 8), Cultural Resources (Section 9), Energy Resources (Section 10), and Greenhouse Gasses (Section 12). Consistent with NEPA, Indian Trust Assets and Environmental Justice are discussed in Sections 11 and 13, respectively.

The following impacts and issues are mentioned briefly under the resources evaluated in the subsequent sections, including cumulative effects: public health, demographics, and growth inducement.

3.2 RESOURCES NOT EVALUATED

The following resources were determined to be unlikely to be affected by the proposed 2010 Use Agreement and completion of the SJRIP drainwater reuse/treatment facility, so they are not discussed in separate Sections:

- **Aesthetics**. Aesthetics impacts are typically assessed on the basis of a change in the visual character of the project site from specific viewsheds. Since neither the Proposed nor Alternative Actions would change the dominant features of the project site, a full evaluation of aesthetics was not deemed necessary for the EIS/EIR. However, this issue would need to be addressed in the environmental documentation for Phase 3 of the SJRIP facility.
- **Air Quality.** Air quality impacts are typically assessed when a proposed action has the potential to either generate new or exacerbate existing sources of air pollutants. Since neither the Proposed Action nor the Alternative Action would introduce new or worsen existing sources of air pollutants, a full evaluation of air quality impacts was not deemed necessary for the EIS/EIR. However, this issue would need to be addressed in the environmental documentation for Phase 3 of the SJRIP facility.
- **Noise, Public Services.** Noise impacts are typically assessed when a proposed action has the potential to either generate new or exacerbate existing sources of noise as measured at sensitive receptors within the project vicinity. Since neither the Proposed Action nor the Alternative Action would introduce new or worsen existing noise-generating activities to the project site beyond short-term construction of a collection system or a canal/pipeline, a full evaluation of noise impacts was not deemed necessary for the EIS/EIR.
- **Transportation/Circulation.** Transportation/circulation impacts for nontransportation-related projects are typically assessed when a proposed action has the potential to increase the number of daily trips made to and/or from the project site. Since neither the Proposed Action nor the Alternative Action are expected to change the number of daily trips made to or from the project site, a full evaluation of transportation impacts was not deemed necessary for the EIS/EIR. However, this issue may need to be addressed in the environmental documentation for Phase 3 of the SJRIP facility.

When the SJRIP reaches the point of final treatment process and salt disposal determination and subsequent facility/system design and construction, additional CEQA/NEPA analysis on the site- and design-specific aspects of the facility would be conducted to determine whether additional analysis is needed for such potential impacts as aesthetics, air quality, construction noise and traffic, cultural resources and disposal or reuse of any treatment by-products.

SECTION 4
Surface Water Resources

This chapter describes water resources in the Project Area and the potential for impacts to those resources from No Action, Proposed Action, and Alternative Action Alternatives.

4.1 AFFECTED ENVIRONMENT

4.1.1 Background

4.1.1.1 Area of Potential Impacts

The area of interest for potential direct impact on water resources consists of the lower San Joaquin River Basin located in western San Joaquin Valley from Vernalis in the north to Mendota Pool in the south (Figure 4-1). The reach of the San Joaquin River upstream of they Merced River has no or almost no natural flow during most months of the year as a result of upstream diversions at Friant Dam. Discharges from the Project Area enter this reach in the northern portion, at the mouth of Mud Slough and, therefore, have no impact in the segment between Mendota Dam and Mud Slough. The Project Area is characterized by an arid climate with annual evaporation rates exceeding precipitation rates. Through the use of imported irrigation supply water, however, the region has become one of the most productive agricultural areas in the world. Conversely, irrigated agriculture development has historically led to water quality problems in the lower San Joaquin River to the extent that it has been listed as an impaired waterbody by the California State Water Resources Control Board (State Board) under Section 303(d) of the Federal Clean Water Act (CWA) (State Board 1999a, 2006a).

4.1.1.2 Hydrogeologic Setting and Drainage

The soil composition, hydrogeology, and precipitation in the Project Area have resulted in water quality problems in the San Joaquin River due in significant part to agricultural development. Soils on the western side of the valley originate from geologically uplifted marine sediments that make up the Coast Range. These soils are very productive agriculturally but are high in salts and trace elements, such as arsenic, boron, molybdenum, and selenium (Se), in certain locations. The salts and trace elements were concentrated in the historic marine sediments.

The hydrogeology of the area is such that a layer of clay, known as Corcoran Clay, has divided the groundwater system into two major aquifers, a confined aquifer below it, and a semiconfined aquifer above it (Page 1983, SJVDP 1990). Poor drainage conditions, a direct result of the region’s unique hydrogeological features, result in high water tables while high levels of evapotranspiration increase salt concentrations in the soil. Application of irrigation water dissolved the salts and trace elements found in the soil accelerating their movement into the shallow groundwater (Gilliom 1989, SJVDP 1990). Approximately half the soluble salts in the crop root zone are derived from the soil (SJVDP 1990). Agricultural drains were subsequently installed to lower the water table, but the outcome has been drainwater with high constituent concentrations discharging to the lower San Joaquin River.

Drainage from the Project Area originates from the Grassland Drainage Area (GDA). The GDA, comprised of approximately 97,400 acres of irrigated farmland, extends from Charleston Drainage District in the north at State Highway 165 to the Firebaugh Canal Water District in the south near State Highway 180 and the community of Mendota (Figure 4-1). The drainwater from the GDA is managed by the Grassland Area Farmers (GAF), the regional drainage entity formed under the umbrella of the San Luis and Delta-Mendota Water Authority (the Authority) responsible for the implementation of the Grassland Bypass Project.

4.1.1.3 History of Grassland Area Farmers Drainage Management

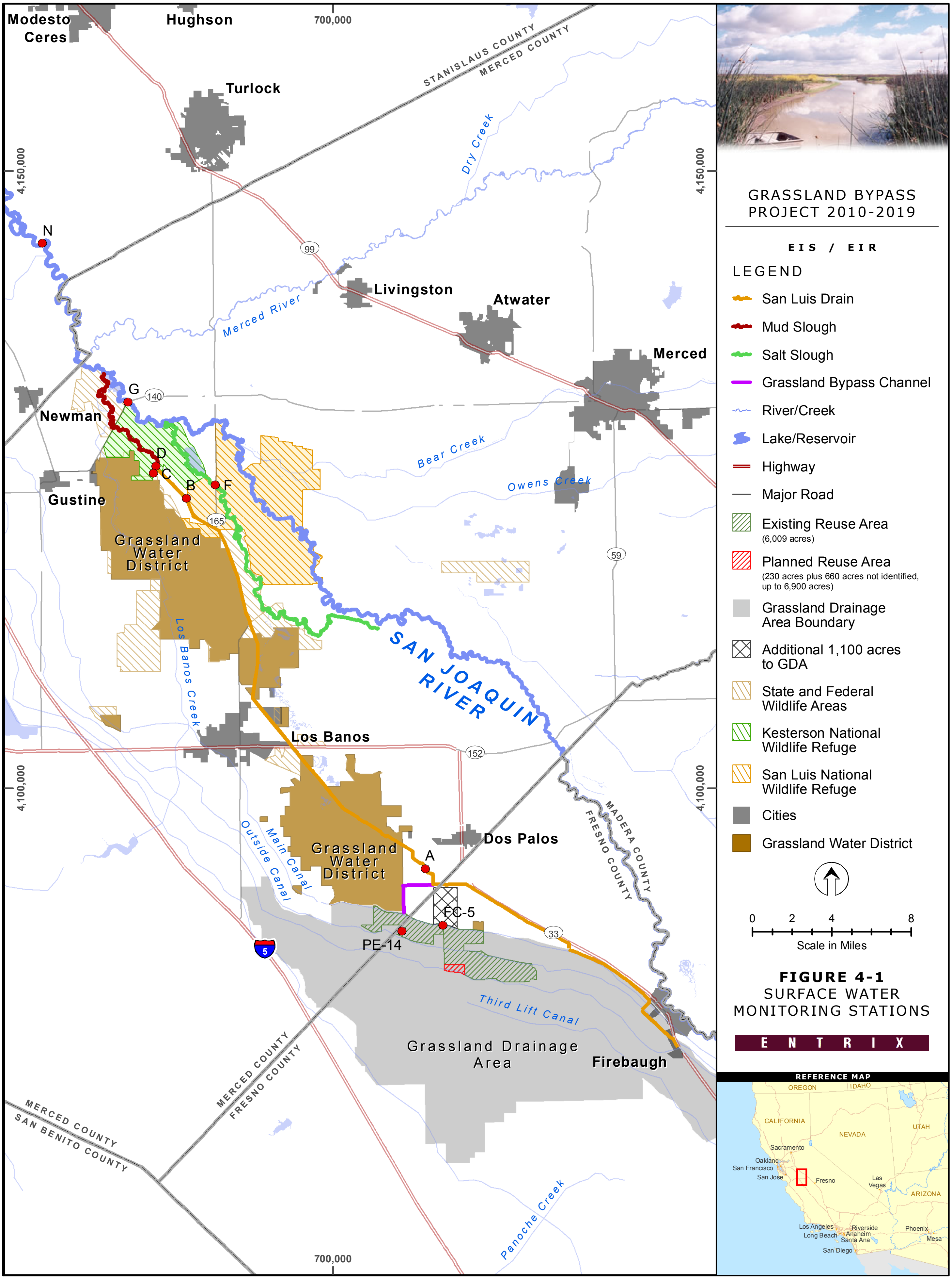
Water quality in the region downstream (north) of the GDA has changed quite extensively over the past few years. Prior to 1985, drainwater was conveyed through wetland channels and used in the Grassland Resource Conservation District, a collection of federal, state, and private wetlands, containing a diversity of bird, animal, and plant species (Reclamation 1995). Concerns over elevated concentrations of salt and trace elements, most notably Se, endangering waterfowl and their habitat resulted in ending this practice. Drainwater deliveries to the wetlands ended in 1985 when wetlands were prohibited from receiving any water with Se concentrations greater than 2 micrograms per liter (µg/L). Drainwater was then conveyed in alternating wetland channels (i.e., “flip-flop” system) and discharged primarily via Salt Slough and secondarily via Mud Slough to the San Joaquin River, resulting in poorer water quality in Salt Slough.

Additionally, when canals and drains were to be used for clean water, they had to be flushed for at least 24 hours before the clean water going to the wetlands could be transported in those canals. This meant that, at some times during the year, wetlands were prevented from receiving otherwise available water (State Board 1987, SJVDP 1990, Reclamation 1995).

4.1.1.4 Grassland Bypass Project (Water Years 1997–Present)

To address the situation described above, the original Grassland Bypass Project was implemented in 1996 to improve water quality in Salt Slough and water supply channels used to deliver water to the Grassland Water District (GWD) and wetlands. The Project involved use of 28 miles of the lower portion of the San Luis Drain (the Drain) with discharge to the San Joaquin River through 6 miles of Mud Slough. The result of the Project is that drainage was removed from 93 miles of wetland water supply canals, including Salt Slough and most of Mud Slough, allowing full use of Central Valley Project Improvement Act (CVPIA) water for wetlands management.

With the construction of the Grassland Bypass Channel and use of the Drain, drainwater is now conveyed directly to the northern part of Mud Slough. Drainwater is conveyed for 6 miles in Mud Slough (North), and is discharged directly into the San Joaquin River, upstream of the confluence of the Merced River. See Section 1.1 for history of Project through approval of the 2001 Use Agreement. See Section 4.1.2.2 for a discussion of the specific requirements in the 2001 Use Agreement.



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4.1.2 Regulatory Setting

This section describes key federal and state surface water regulations and summarizes the regulatory background for the Project Area. See also Section 17.2 on state compliance requirements.

4.1.2.1 Federal and State Water Regulations

4.1.2.1.1 Clean Water Act

The CWA is a 1977 amendment to the Federal Water Pollution Control Act of 1972 (United States Code, Title 33), which established the basic structure for regulating pollutant discharges to navigable waters of the United States. The CWA provides two general types of pollution control standards:

- Effluent standards that are technology-derived standards and limit the quantity of pollutants discharged from a point source such as a pipe, ditch, tunnel, etc., into a navigable waterbody (nonpoint source pollution is subject to state control)
- Ambient water quality standards that are based on beneficial uses and limit the concentration of pollutants in navigable waters

The primary focus of the 1977 CWA amendment was toxic substances. In 1987, the CWA was reauthorized and again focused on toxic substances, in addition to authorizing citizen suit provisions and funding sewage treatment plants under the Construction Grants Program. The National Pollutant Discharge Elimination System (NPDES) Permitting System was established under the CWA Section 402 to regulate discharges from point sources into navigable waters (Water Pollution Control Federation 1987). Agricultural discharges are classified as nonpoint source discharges and are exempt from Section 402.

Management of nonpoint source discharges is regulated under Section 319 of the CWA. Section 319 requires the states to submit an assessment report that identifies navigable waters that are not expected to achieve applicable water quality standards or goals, identify categories of nonpoint sources or specific sources that add significant pollution to contribute nonattainment of water quality standards or goals, and describe the process to develop best management practices and measures to control each category of nonpoint source or specific sources. The States are then required to develop a management program that proposes to implement the nonpoint source control program.

Section 305(b) of the CWA requires the States to perform a biannual assessment of the water quality of navigable water within the state. The assessment is required to analyze the extent to which beneficial uses are supported and provide an analysis of the extent to which elimination of pollution and protection of beneficial uses has been achieved. The assessment is also required to describe the nature and extent of nonpoint sources of pollution and provide recommendations for control programs including costs.

Section 303(d) of the CWA requires the States to identify waters that are not expected to meet water quality standards after application of effluent limitation for point sources, develop a priority ranking and determine the Total Maximum Daily Load (TMDL) of specific pollutants that may be discharged into the water and still meet the water quality standards.

4.1.2.1.2 Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act of 1969, which became Division 7 of the California Water Code, authorized the State Board to provide comprehensive protection for California's waters through water allocation and water quality protection. The State Board implements the requirement of CWA Section 303 that water quality standards be set for certain waters by adopting water quality control plans under the Porter-Cologne Act. In addition, the Porter-Cologne Act established the responsibilities and authorities of the nine Regional Water Quality Control Boards (previously the Water Pollution Control Boards), which include preparing water quality plans for areas within the region (Basin Plans), identifying water quality objectives (WQOs), and issuing NPDES permits pursuant to the CWA.[1] WQOs are defined as limits or levels of water quality constituents and characteristics established for reasonable protection of beneficial uses or prevention of nuisance. Under the Porter-Cologne Act, discharges of subsurface agricultural drainage, tailwater, and stormwater from agricultural lands to surface water do not require NPDES permits.

In addition to implementing the NPDES permitting program, the Porter-Cologne Act authorizes the Regional Water Quality Control Boards to issue Waste Discharge Requirements (WDRs). Generally, WDRs are issued for discharges that are exempt from the CWA NPDES permitting program, discharges that may affect groundwater quality, and/or wastes that may be discharged in a diffused manner. WDRs are established and implemented to achieve the WQOs for receiving waters as established in the Basin Plans.

4.1.2.2 Regional and Project-Specific Regulatory Background

Beneficial uses, WQOs, and the implementation program for achieving the WQOs for the Project Area are stipulated in the *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins* (1998 Basin Plan) (Regional Board 1998a).

In May 1996, the Central Valley Regional Water Quality Control Board (Regional Board) adopted a Basin Plan amendment to address Se concentrations in agricultural drainage discharges from the Project Area (Regional Board Resolution No. 96-078). The amendment adopted recommendations in the 1995 Consensus Letter sent to the Regional Board’s chairman by the Authority, U.S. Bureau of Reclamation, Mid-Pacific Region (Reclamation), U.S. Environmental Protection Agency (USEPA), and the U.S. Fish and Wildlife Service (Service). The amendment included identification of beneficial uses for Mud Slough (North), Salt Slough, and the wetland water supply channels; and Se WQOs for the lower San Joaquin River, Mud Slough (North), Salt Slough, and the wetland water supply channels of the Project Area. The amendment prohibits the discharge of agricultural subsurface drainage to the wetland supply channels and to Salt Slough unless WQOs are met, and prohibits discharges in excess of 8,000 pounds of Se per year, from agricultural subsurface drainage for all water year types, beginning January 10, 1997. Pursuant to the Section 303(d) listing of the San Joaquin River for Se, the Regional Board prepared the

[1] http://www4.law.cornell.edu/uscode/33/1251.html

TMDL report for Se in the lower San Joaquin River in August 2001 (Regional Board 2001a) and the TMDL for Se in Grassland Marshes in April 2000 (Regional Board 2000a).

In September 2004, the Regional Board adopted the Basin Plan amendment for salinity and boron for the lower San Joaquin River (Regional Board Resolution No. R5-2004-0108) due to the impact of these constituents on beneficial uses in the lower San Joaquin River and Southern Delta (Regional Board 2004a). Load allocations were established for irrigated lands, and waste load allocations were established for point sources. Time schedules for implementation and compliance were established by subregion. The lower San Joaquin River has been designated an impaired waterbody for salinity and boron under CWA Section 303(d). Pursuant to the Section 303(d) listing, the Regional Board prepared the TMDL for the control of salt and boron discharges into the lower San Joaquin River in July 2004 (Regional Board 2004b).

WQOs and performance goals from the 1998 Basin Plan for the Project Area for Se, boron, molybdenum, and electrical conductivity (EC) are summarized in Table 4-1.

Table 4-1 Water Quality Objectives, Performance Goals, and Compliance Dates for the Lower San Joaquin River

Waterbody	Selenium	Boron	Molybdenum	Electrical Conductivity
Salt Slough and Wetland Water Supply Channels	▪ 2 ppb, monthly mean, October 1, 1996 ▪ 20 ppb, maximum		▪ 0.050 ppm, maximum ▪ 0.019 ppm, monthly mean	
Mud Slough (North) and the San Joaquin River from Sack Dam to the Merced River	▪ 5 ppb, 4-day average, October 1, 2010 ▪ 20 ppb, maximum		▪ 0.050 ppm, maximum ▪ 0.019 ppm, monthly mean	
San Joaquin River, from mouth of Merced River to Vernalis	*Normal/Wet Year:* ▪ 5 ppb, 4-day average, October 1, 2005 ▪ 12 ppb, maximum *Critical/Dry/Below Normal Year:* ▪ 5 ppb, monthly mean (performance goal), October 1, 2005 ▪ 5 ppb, 4-day average, October 1, 2010 ▪ 12 ppb, maximum	*Wet Season:* ▪ 2.6 ppm, maximum, September 16 through March 14 ▪ 1.0 ppm, monthly mean, September 16 through March 14 *Dry Season:* ▪ 2.0 ppm, maximum, March 15 through September 15 ▪ 0.8 ppm, monthly mean, March 15 through September 15 *Critical Year:* ▪ 1.3 ppm, monthly mean	▪ 0.015 ppm, maximum ▪ 0.010 ppm, monthly mean	
San Joaquin River at Airport Way Bridge, Vernalis				*All water years:* ▪ 0.7 millimhos per centimeter (mmhos/cm), April-August, maximum 30-day running average of mean daily ▪ 1.0 mmhos/cm, September-March, maximum 30-day running average of mean daily

Source: Regional Board, 1998 Basin Plan.

The Agreement for Use of the San Luis Drain (1995 Use Agreement, Agreement No. 6-07-20-W1319) between Reclamation and the Authority contained a number of terms and conditions that address longevity and water quality for the Project Area. The 1995 Use Agreement included the provision that the Project would terminate after 2 years if WDRs were not adopted. In addition, monthly limits were placed on Se loads that could be discharged and a comprehensive, multiagency monitoring program was established. Details of this monitoring program are summarized in the *Compliance Monitoring Program for Use and Operation of the Grassland Bypass Project* (Reclamation et al. 1996). The purpose of the monitoring program is to evaluate impacts of the Project and to ensure that all the environmental commitments identified in the Project's Finding of No Significant Impact are met.

On March 22, 1996, the Regional Board issued a NPDES Permit (Order No. 96-092, NPDES NO. CA0093917) to the Authority for the discharge of groundwater accumulated in the Drain to Mud Slough (North). The groundwater accumulation was due to inflow through a series of pressure relief valves located along the Drain at the invert. This discharge was completed before the onset of the Project in 1996 when discharge of agricultural irrigation return flow from the Project Area began.

In 1997, the GAF submitted a Report of Waste Discharge at the request of the Regional Board. The Report of Waste Discharge was used by the Regional Board to develop WDRs for agricultural subsurface drainage, tailwater, and stormwater discharges from the Project Area.

On July 24, 1998, the Regional Board adopted WDR Order No. 98-171 (1998 WDR) for the Grassland Bypass Project, which rescinded Order No. 96-092 (Regional Board 1998b). The 1998 WDR included the following provisions:

- Meeting receiving WQOs in the Basin Plan.
- Complying with specific monthly and annual Se load limits, and meeting a compliance schedule. The load limits provide for a 15 percent reduction in annual Se loads over 5 years in the last 3 years of the project.
- Developing short- and long-term drainage management plans that summarize how Se load reductions will be achieved (Basin Plan requirement). The short-term plan addresses activities that will be implemented through September 30, 2001, and the long-term plan addresses activities related to management of the drainwater after that date.
- Providing toxicity screening evaluations to determine whether the Basin Plan narrative objective is violated in the receiving water as a result of the discharge.
- Continuing the Compliance Monitoring Program. This program includes monitoring of water quality, flow, biota, toxicity, and sediment in the Drain, Mud Slough, San Joaquin River, and the channels in the GWD.

In February 2001, the Authority submitted a Report of Waste Discharge for Phase II of the Grassland Bypass Project. On September 7, 2001, the Regional Board adopted WDR Order No. 5-01-234 (2001 WDR) for the Grassland Bypass Project Phase II (Regional Board 2001b). The purposes of Phase II were to continue the separation of GDA drainage discharge from wetland water supply conveyance channels for the period of September 2001 to December 2009, to facilitate drainage management in the GDA, and to promote improvement in water quality in the San Joaquin River.

The 2001 WDR includes the following provisions:

- Implementing the biological, water quality, and stormwater monitoring program (Monitoring and Reporting Program No. 5-01-234).
- Maintaining a maximum flow rate of 150 cubic feet per second (cfs) for the Drain terminus and maximum velocity of 1 foot per second in the Drain.
- Meeting maximum monthly and annual Se load limits for the GDA and the Drain.

The Regional Board revised the monitoring and reporting program in May 2005 under Order No. 5-01-234-Rev 2 (Regional Board 2005) to require daily 24-hour composite samples for Se, EC, and boron in the San Joaquin River at Crows Landing.

The *Agreement for Use of the San Luis Drain, Agreement No. 01-WC-20-2075* (2001 Use Agreement) was issued on September 28, 2001 (Reclamation 2001) and supersedes the 1995 Use Agreement. The 2001 Use Agreement specifies operational conditions for Phase II of the Grassland Bypass Project for the period of October 1, 2001 through December 31, 2009, and includes the following provisions:

- Developing a salinity management plan; a long-term management plan, for compliance with Se and salinity WQOs; a Mud Slough compliance plan, to identify how WQOs will be met in Mud Slough by the compliance date; and a revised sediment management plan.
- Maintaining a maximum flow rate of 150 cfs in the Drain.
- Meeting maximum monthly and annual Se load limits.
- Meeting maximum monthly and annual salinity load limits.
- Continuing the monitoring program established in the 1995 Use Agreement.

The monitoring program is described in detail in the Monitoring Program for the Operations of the Grassland Bypass Project, Phase II (Grassland Bypass Project Oversight Committee 2002).

4.1.2.3 Selenium Total Maximum Monthly Load for Discharges from the San Luis Drain

4.1.2.3.1 Development of the Total Maximum Monthly Load (TMML)

The lower San Joaquin River, between Mud Slough and the Merced River, is designated by the State Board as an impaired waterbody for Se under CWA Section 303(d) (State Board 2006a). Previous listings designated the San Joaquin River as impaired for Se from Mendota Pool to Vernalis (State Board 1999a). Pursuant to the 303(d) listing, the State Board was required to develop a TMDL, which would help meet WQOs in the San Joaquin River downstream of the confluence of the Merced River, as stipulated by the USEPA. The USEPA (1986) specifies that the 4-day average Se concentration in water should not exceed 5 parts per billion (ppb) more than once every 3 years on average.

The TMML for the San Joaquin River model (Karkoski model) was developed to determine the allowable load of Se that could be discharged into the San Joaquin River given the lowest flows observed in the San Joaquin River for the water year type and monthly grouping. A monthly load limit was developed rather than a daily limit because monthly control measures were deemed more feasible than daily control due to the diffuse nature of the Se. Annual limits were also set in addition to the monthly limits. Table 4-2 represents the TMML (pounds/month) within each flow regime that produces a desired frequency of violation of once every 3 years for a 5 μg/L monthly and 4-day average objective at Crows Landing according to the Karkoski model.

Table 4-2 Total Maximum Monthly Load of Selenium in the Karkoski model

Year Type	Monthly Grouping	Load (pounds Se/month) for compliance with Monthly Mean WQO of 5 μg/L Se	Load (pounds Se/month) for compliance with 4-Day Average WQO of 5 μg/L Se
C	Sep-Nov	157	114
D/BN	Sep-Nov	321	274
AN/W	Sep-Nov	157	114
C	Dec-Jan	243	190
D/BN	Dec-Jan	442	351
AN/W	Dec-Jan	243	190
C	Feb-May	197	123
D/BN	Feb-May	292	252
AN/W	Feb-May	542	419
C	Jun-Aug	83	67
D/BN	Jun-Aug	217	179
AN/W	Jun-Aug	312	256

Source: Karkoski 1994

C = Critical
D/BN = Dry/Below Normal
AN/W = Above Normal/Wet

The TMMLs needed to meet WQOs at Crows Landing in the Karkoski model were used to develop Waste Load Allocations for the GDA by subtracting the background load from upstream locations and decreasing the load by 10 percent to account for uncertainty in the model.

The load allocations in the August 2001 Regional Board staff report titled *Total Maximum Daily Load for Selenium in the Lower San Joaquin River* (Regional Board 2001a) are based in part upon the TMMLs developed in the Karkoski model. Table 4-3 lists the load allocations for the GDA as specified by the 2001 TMDL report.

Table 4-3 Selenium TMMLs for the Grassland Drainage Area by Year Type (pounds) from the 2001 TMDL for Selenium

Month	Critical	Dry/Below Normal	Above Normal	Wet
January	151	319	398	211
February	93	185	472	488
March	92	184	472	488
April	101	193	490	506
May	105	197	497	512
June	69	130	212	354
July	70	131	214	356
August	75	137	225	366
September	57	235	264	332
October	55	233	260	328
November	55	233	260	328
December	152	319	398	211

Source: Regional Board 2001a

Se loads were allocated to the GDA and to background sources. Design flows by year type and monthly grouping were used to calculate maximum loads for the San Joaquin River at Crows Landing. These loads were designed for compliance with the 4-day average WQO of 5 µg/L Se. Calculated loads from background sources and a 10 percent margin of safety were then subtracted from the Crows Landing loads to produce a load allocation for GDA. The TMMLs served as part of the technical bases for developing load limits.

4.1.2.3.2 Total Maximum Monthly Load Implementation

A compliance time schedule for meeting the 4-day average and monthly mean WQOs Se for the San Joaquin River was developed in the 1998 Basin Plan and can be found in Table 4-4.

Table 4-4 Compliance Time Schedule for Selenium Water Quality Objectives and Performance Goal in the San Joaquin River

Waterbody/Water Year Type	January 10, 1997	October 1, 2002	October 1, 2005	October 1, 2010
Salt Slough and Wetland Water Supply Channels listed in Appendix 40 of Basin Plan	2 µg/L monthly mean [a]			
San Joaquin River below the Merced River. Above Normal and Wet Water Year types		5 µg/L monthly mean [b]	5 µg/L 4-day average [a]	
San Joaquin River below the Merced River; Critical, Dry, and Below Normal Water Year types		8 µg/L monthly mean [b]	5 µg/L monthly mean [b]	5 µg/L 4-day average [a]
Mud Slough (North) and the San Joaquin River from Sack Dam to the Merced River				5 µg/L 4-day average [a]

Source: Regional Board 1998a

[a] Selenium Water Quality Objectives
[b] Performance Goals

The implementation schedule for compliance with these load limits is based on compliance with the interim performance objectives of 5 µg/L as a monthly mean for Dry/Critical years, as listed above. The compliance time schedule was developed to allow time for control programs to be developed.

The Regional Board uses a WDR to control Se effluent from the Project Area. The 2001 WDR specifies maximum monthly and annual Se load limits for the GDA and the Drain. Table 4-5 and Table 4-6 specify the 2001 WDR load limits. The 2001 Use Agreement also specifies maximum monthly and annual Se load limits for the Drain. Table 4-7 lists the load limits specified in the 2001 Use Agreement. The 2001 WDR and the 2001 Use Agreement incorporate annual reductions designed to meet interim performance goals and water WQOs in accordance with the compliance time schedule.

Table 4-5 Waste Discharge Requirement Selenium Load Limits (pounds) for the Grassland Drainage Area and the San Luis Drain from 2001 to 2006

	2001	2002	2003	2004	2005				2006			
Month	All Year Types	All Year Types	All Year Types	All Year Types	Critical	Dry/ Below Normal	Above Normal	Wet	Critical	Dry/ Below Normal	Above Normal	Wet
January	-	385	359	333	398	398	398	211	373	390	398	211
February	-	619	571	523	472	472	472	488	434	443	472	488
March	-	753	685	618	472	472	472	488	434	443	472	488
April	-	577	538	499	490	490	490	506	451	460	490	506
May	-	488	464	439	497	497	497	512	458	467	497	512
June	-	429	397	365	212	212	212	354	198	204	212	354
July	-	429	397	365	214	214	214	356	200	206	214	356
August	-	387	363	339	225	225	225	366	210	216	225	366
September	350	310	303	297	264	264	264	332	243	261	264	332
October	315	308	301	294	260	260	260	328	240	257	260	328
November	315	308	301	294	260	260	260	328	240	257	260	328
December	353	334	316	298	398	398	398	211	373	390	398	211
Annual	-	5,328	4,995	4,662	4,162	4,162	4,162	4,480	3,853	3,995	4,162	4,480

Source: Regional Board 2001b

Table 4-6 2001 Waste Discharge Requirement Selenium Load Limits (pounds) for the Grassland Drainage Area and the San Luis Drain from 2007 to 2009

	2007				2008				2009			
Month	Critical	Dry/ Below Normal	Above Normal	Wet	Critical	Dry /Below Normal	Above Normal	Wet	Critical	Dry/ Below Normal	Above Normal	Wet
January	349	382	398	211	324	374	398	211	270	357	398	211
February	396	415	472	488	358	386	472	488	275	323	472	488
March	396	414	472	488	358	386	472	488	274	322	472	488
April	412	431	490	506	373	401	490	506	288	336	490	506
May	419	437	497	512	379	407	497	512	293	341	497	512
June	183	196	212	354	169	187	212	354	138	169	212	354
July	185	197	214	356	171	189	214	356	139	171	214	356
August	195	207	225	366	180	199	225	366	147	179	225	366
September	223	258	264	332	202	255	264	332	156	249	264	332
October	219	255	260	328	199	252	260	328	153	246	260	328
November	219	255	260	328	199	252	260	328	153	246	260	328
December	349	382	398	211	324	374	398	211	270	357	398	211
Annual	3,545	3,829	4,162	4,480	3,236	3,662	4,162	4,480	2,557	3,296	4,162	4,480

Source: Regional Board 2001b

Table 4-7 2001 Use Agreement Selenium Load Limits (pounds) for the San Luis Drain

	2001	2002	2003	2004	2005	2006	2007	2008		2009	
Month	All Year Types	All Year Types	All Year Types	All Year Types	All Year Types	All Year Types	All Year Types	Critical, Dry, & Below Normal	Above Normal & Wet	Critical, Dry, & Below Normal	Above Normal& Wet
January	-	385	359	333	289	211	211	198	211	185	211
February	-	619	571	523	440	297	297	265	297	234	297
March	-	753	685	618	496	297	297	265	297	233	297
April	-	577	538	499	433	315	315	282	315	249	315
May	-	488	464	439	400	322	322	288	322	255	322
June	-	429	397	365	308	212	212	188	212	165	212
July	-	429	397	365	310	214	214	188	214	166	214
August	-	387	363	339	299	225	225	190	225	175	225
September	-	310	303	297	291	264	264	200	264	193	264
October	315	308	301	294	260	260	260	229	260	190	260
November	315	308	301	294	260	260	260	225	260	190	260
December	353	334	316	298	211	211	211	198	211	185	211
Annual	-	5,328	4,995	4,662	3,996	3,088	3,088	2,754	3,088	2,421	3,088

Source: Reclamation 2001b

The 2001 Use Agreement allowed the GAF to opt for the TMML loads described by the 2001 WDR (Table 4-5 and Table 4-6), which was done in August 2005 and applied forward.

4.1.3 Grassland Drainage Area

4.1.3.1 Location and Characteristics

The GDA is located on the western side of the San Joaquin River roughly between Los Banos to the north and Mendota to the south, as shown on Figure 4-1. The GDA consists of Charleston Drainage District, Pacheco Water District, Panoche Drainage District, a portion of the Central California Irrigation District (CCID) known as Camp 13 drainage area, Firebaugh Canal Water District, Broadview Water District (acquired by Westlands Water District following retirement from irrigation), and Widren Water District. The In-Valley drainage reuse area, called the San Joaquin River Water Quality Improvement Project (SJRIP), is owned and operated by Panoche Drainage District.

The approximate areas of the districts are given in Table 4-8. Broadview Water District and Widren Water District do not discharge to the Grassland Bypass Project and, therefore, are not directly affected by the Project. A subsurface drainage system (tile drains) was put in place to manage the shallow groundwater.

Table 4-8 Area of Drainage Districts and Tiled Area within the Grassland Drainage Area

District	Total Area (Acres)	Total Tiled Area (Acres)	Tiled Area Discharging to Grassland Bypass Project (Acres)
Broadview Water District	9,515	6,500	0
Camp 13 drainage area	5,490	804	804
Charleston Drainage District	4,314	1,100	1,100
Firebaugh Canal Water District	22,300	16,000	6,000
Pacheco Water District	5,175	2,900	2,900
Panoche Drainage District (including SJRIP)	44,940	20,000	20,000
Widren Water District	840	300	0
Other Areas	4,830	650	650
Total	97,404	48,254	31,454

Source: McGahan, J.G., March 20, 2000, fax with flow and discharge data; Linneman, C., written comm., February, 22, 2008.

4.1.3.2 Irrigation Water Deliveries

Water Years 2002–2007 (from October 2001 to September 2007) are chosen as representative of the Existing Conditions baseline. These water years span a variety of water year types. Water Years 2005 and 2006 were Wet years in terms of rainfall; Water Years 2002 and 2004 were Dry years; Water Year 2003 was a Below Normal year; and Water Year 2007 was a Critically Dry year (DWR 2007). Irrigation deliveries to the GDA averaged approximately 160,000 acre-feet per year during this time period (not including Charleston Drainage District). Dry years have increased irrigation water deliveries. Wet years and Critical years tend to have less irrigation water deliveries than Dry years, possibly due to reduced demand or available irrigation supply water (i.e., shortages). Deliveries to individual districts for Water Years 2002–2007 are shown in Table 4-9.

Table 4-9 Irrigation Deliveries for Water Years 2002–2007 by District in GDA

District	Deliveries in Water Year 2002 (acre-feet)	Deliveries in Water Year 2003 (acre-feet)	Deliveries in Water Year 2004 (acre-feet)	Deliveries in Water Year 2005 (acre-feet)	Deliveries in Water Year 2006 (acre-feet)	Deliveries in Water Year 2007 (acre-feet)
Broadview Water District	12,014	0	0	0	0	0
Camp 13 drainage area	22,273	20,502	24,481	19,930	18,842	19,540
Charleston Drainage District[a]	NA	NA	NA	NA	NA	NA
Firebaugh Canal Water District	70,544	62,523	69,080	58,680	61,207	72,614
Pacheco Water District	12,373	12,450	14,096	10,147	10,288	14,402
Panoche Drainage District[1]	60,844	63,953	66,356	58,605	63,540	56,116
Total	178,048	159,428	174,013	147,362	153,877	162,672

Source: Linneman, C., February 4, 2008; GBP 00_07 Data.xls

NA = Applied water data is not available; modeled values are assumed

[1]Includes deliveries to Panoche Water District and Eagle Field Water District.

Irrigation deliveries to the districts within the GDA are supplied from the Delta-Mendota Canal, the San Luis Canal, or both. Some water may also be supplied by groundwater pumping, particularly during Dry years; however, exact amounts have not been reported.

Table 4-10 presents water quality data for the water deliveries. Water quality delivered to Broadview (prior to 2003), Camp 13, and Firebaugh is best represented by the measurements at Mendota Pool at Check 21 of the Delta-Mendota Canal.

Table 4-10 Water Quality of Irrigation Delivered Water

Month[1]	Selenium (µg/L)			Total Dissolved Solids (mg/L)			Boron (mg/L)		
	Check 21 Mendota Pool Delta-Mendota Canal Milepost 116.50[2]	Check 13 O'Neill Forebay Delta-Mendota Canal Milepost 70.01[3]	San Luis Canal at O'Neill Forebay[4]	Check 21 Mendota Pool Delta-Mendota Canal Milepost 116.50[5,6]	Check 13 O'Neill Forebay Delta-Mendota Canal Milepost 70.01[5,7]	San Luis Canal at O'Neill Forebay[8]	Check 21 Mendota Pool Delta-Mendota Canal Milepost 116.50[9]	Washoe Avenue Delta-Mendota Canal Milepost 110.12[10]	San Luis Canal at O'Neill Forebay[8]
October	0.3	0.2	1	278	268	270	0.1	0.1	0.1
November	0.7	0.3	1	290	289	289	0.2	0.2	0.2
December	0.9	0.3	2	338	337	340	0.3	0.3	0.2
January	1.1	0.3	0.8	323	285	261	0.3	0.3	0.2
February	1.2	0.6	1	314	297	245	0.3	0.2	0.2
March	1.7	0.6	1.3	318	279	247	0.4	0.3	0.2
April	2.8	0.4	0.8	296	231	238	0.3	0.3	0.2
May	3.4	0.3	1	311	211	272	0.2	0.4	0.2
June	1.9	0.2	0.9	245	187	222	0.1	0.4	0.1
July	0.7	0.3	0.5	190	183	194	0.1	0.1	0.09
August	0.5	0.2	0.9	226	214	215	0.1	0.1	0.08
September	0.5	0.2	0.8	271	258	257	0.1	0.2	0.07

Sources: Eacock 2008a, Reclamation 2008, DWR 2008.

For purposes of data evaluation, nondetect data were assumed to equal one half of the reporting limit.

1 Averaged across Water Years 2002–2007 for each respective month, unless otherwise specified.
2 Data were not available from October 2001 through June 2002, December 2003, December 2004, and January 2006.
3 Data were not available from October 2001 through June 2002, and September 2007.
4 Data were not available from October 2001 through February 2002, April 2002 through March 2004, and November 2004.
5 Data were not available from October 2001 through June 2002.
6 Monthly Total Dissolved Solids (TDS, units of mg/L) concentrations provided by Eacock (2008a) were calculated based on EC (microSiemens per centimeter [µS/cm]). At Check 21, TDS = EC * 0.5252 + 24.87.
7 Monthly Total Dissolved Solids (TDS, units of mg/L) concentrations provided by Eacock (2008a) were calculated based on EC (µS/cm). At Check 13, TDS = EC * 0.5317 + 21.
8 Data were not available from January, March, and November 2004.
9 Includes only July 2002 through October 2003.
10 Data were not available from October 2001 through June 2002, November 2002, September 2003, December 2003, January 2004, November 2005, and February 2007.

Charleston, Pacheco, and lands within Panoche receive water from both the San Luis Canal and the Delta-Mendota Canal. The measurements at O'Neill Forebay, located at Milepost 70.01 of the Delta-Mendota Canal, and at O'Neill Forebay in the San Luis Canal are representative of the deliveries to these districts. Approximately half of Charleston's deliveries, 60 percent of Pacheco's deliveries, and about 70 percent of Panoche's deliveries come from the San Luis Canal.

4.1.3.3 Sump Flows

The groundwater collected by the tiled areas mentioned in Table 4-8 is discharged from various sumps. Even though “Other Areas” account for almost 9 percent of the total area discharging to the Grassland Bypass Project, this flow is not measured directly. The average annual measured sump discharge from each district spanning Water Years 2002–2007 is summarized in Table 4-11.

Table 4-11 Average Annual Sump Flows and Recycling for Grassland Drainage Area[1]

District	Average Annual Reported Sump Flow (acre-feet)	Average Annual Reported Recycled Drainage[2] (acre-feet)	Average Annual Percentage of Drainage Recycled (percent)
Camp 13 drainage area	1,410	10	1
Charleston Drainage District	1,991	404[a]	20
Firebaugh Canal Water District	3,647	2,192	60
Pacheco Water District	3,314	644	19
Panoche Drainage District	9,789	2,250	23
Total[b]	20,151	5,500	27

Source: Linneman, C., February 4, 2008; GBP 00_07 Data.xls, SJRIP LOADS_by dist 07.xls

1. Averaged across Water Years 2002–2007 unless otherwise specified.
2. Recycled drainage is the sum of both recirculation drainage and SJRIP diversions where appropriate. Camp 13 does not recirculate. Charleston and Pacheco did not divert to SJRIP between 2002 and 2007. SJRIP diversion data for wet season months (generally November through February) were not available.
a. Recirculated drainage for Charleston Drainage District is estimated.
b. Excludes Broadview Water District.

The Se, total dissolved solids (TDS), and boron concentrations in subsurface drainage are typically elevated compared to surface waters. Data for individual sumps were available for Firebaugh and Camp 13. Within these districts, average Se, TDS, and boron concentrations varied by as much as 1 order of magnitude between individual sumps.

Table 4-12 presents Se, TDS, and boron concentrations that are representative of average annual concentrations spanning Water Years 2002–2007.

Table 4-12 Selenium, Boron, and Electrical Conductivity of Drainage Sump Flows

District	Average Annual [Se] of Sump Flows[1] (µg/L)	Average Annual EC of Sump Flows (µS/cm)	Average Annual EC of Sump Flows Converted to [TDS][2] (mg/L)	Average Annual [B] of Sump Flows (mg/L)
Camp 13 drainage area	54	5,922	4,145	12.3
Charleston Drainage District	135	5,506[a]	3,854	5.1
Firebaugh Canal Water District	185	7,441	5,209	26.7
Pacheco Water District	92	5,037	3,526	0.0
Panoche Drainage District	188	4,940	3,458	8.6
Average[b]	131	5,769	4,038	10.5

Source: Linneman, C., February 4, 2008; GBP 00_07 Data.xls

NA = Not available.

1. Based on average annual load and volume of tile sump production data provided by Linneman 2008b.
2. Calculated as 0.7 * EC.
a. Excludes October 2001 through January 2002, October 2002 through February 2003, September 2003 through February 2004, and June 2007 through September 2007.
b. Excludes Broadview Water District

4.1.3.4 Recycled Drainage

All of the districts within the GDA, except Camp 13, currently recycle a percentage of the drainage collected in sumps. From Water Years 2002–2007, Panoche Drainage District recirculated about 17 percent of its drainage and diverted approximately 6 percent of its drainage for reuse in the SJRIP. The drainage diverted to the SJRIP is usually mixed with freshwater before being applied to salt-tolerant crops.

Panoche Drainage District measures the amount of drainwater recycled at their recycling pumping plants. Firebaugh Canal and Pacheco Water Districts recycle specific sumps, which are monitored individually. Charleston Drainage District estimates the amount of recirculation by the difference between the district sump production and drainage leaving the district. The estimated amounts of recycled drainage are listed for each district in Table 4-11. It should be noted that during some months the quantity of drainage measured at the sumps of a district is less than that leaving the district, indicating that water may be entering the system beyond the sumps.

In all of the districts within the GDA, the Se concentration of the drainwater within the sumps varies widely. For example, for Panoche, it was reported that 75 percent of the Se load came from 25 percent of the sumps (Grassland Bypass Project Oversight Committee 1999). As listed in Table 4-12, the average Se concentration of the sump flow from Panoche was estimated to be 188 µg/L, and the average Se concentration of the recirculated drainage was estimated to be 230 µg/L from Water Years 2002–2007. The Se concentration of the total recycled drainage, which contains both recirculation flows and SJRIP diversions, is likely to be higher. The Se concentrations of the recycled drainwater for other districts were assumed to be as listed in Table 4-12. It should be noted, though, that because the discharge limits are based on Se load, and not concentration, each district, where possible, recycles drainage collected in the sumps that discharge the highest load of Se (not necessarily the sumps with the highest Se concentrations).

4.1.4 San Joaquin River Hydrology

4.1.4.1 Precipitation

Water quality in the San Joaquin River system is influenced by seasonal and annual variations. Mean precipitation increases heading northward. Average annual precipitation at the Los Banos Detention Reservoir Precipitation Gauge is approximately 9.4 inches per water year but varies from 3.5 to 24 inches (Figure 4-2). Almost all of the rainfall occurs from November through April.

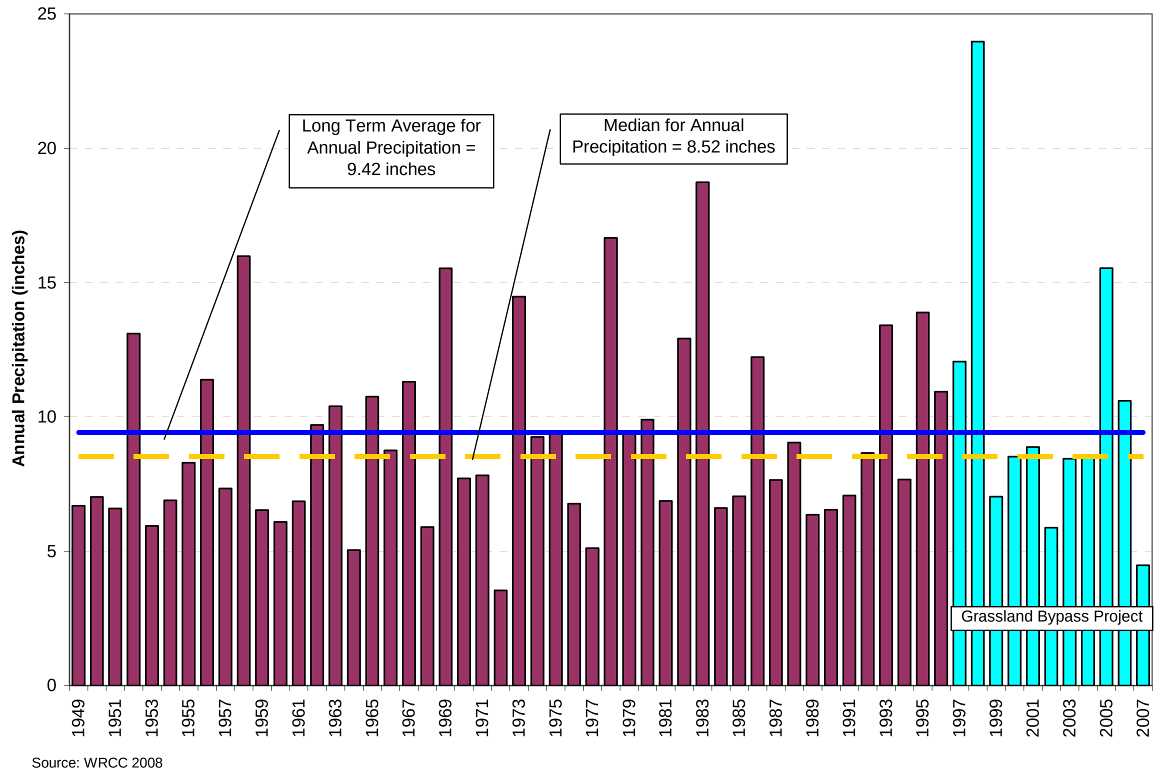


Figure 4-2 Precipitation at Los Banos Detention Reservoir Gauge

For the purposes of classifying and reporting flows, water year types have been established by the California Department of Water Resources (DWR). A water year extends from October 1 of one year to September 30 of the next year, and is classified according to total annual unimpaired runoff, i.e., runoff uninfluenced by man's activities, in the four major rivers in the San Joaquin River Basin, which are the San Joaquin, Merced, Tuolumne, and Stanislaus rivers (Table 4-13). The Grassland Bypass Project conducted monitoring from Water Year 19972007. Water Years 1997, 1998, 2005, and 2006 were classified as Wet; Water Years 1999 and 2000 were Above Normal; Water Year 2003 was Below Normal; Water Years 2001, 2002, and 2004 were Dry; and Water Year 2007 was Critical (DWR 2007).

Table 4-13 San Joaquin Valley Water Year Hydrologic Classification

Year Type	Unimpaired Runoff (millions of acre-feet)
Wet	> 3.8
Above Normal	> 3.1 to < 3.8
Below Normal	> 2.5 ≤ 3.1
Dry	> 2.1 ≤ 2.5
Critical	≤ 2.1

Source: State Board 1995

4.1.4.2 San Joaquin River Flow

Flows in and to the San Joaquin River play a major role in dictating water quality found in the river. From a regional perspective, flows in the San Joaquin River are controlled mostly by dams on east-side tributaries and on the main stem upstream from Fresno. Water stored in Millerton Reservoir, located on the San Joaquin River upstream of Fresno, is diverted through the Friant-Kern and Madera canals. Releases from the reservoir infiltrate into the river bottom and the San Joaquin River is often dry much of the year in a stretch below Gravelly Ford. The channel is usually wet in the area of San Mateo Avenue. Water supply developments on the major east-side tributaries have reduced the flow of the San Joaquin River (SJVDP 1990).

Major contributors of flow to the San Joaquin River in the Project Area include the upstream flows in the San Joaquin River above the Salt Slough confluence, Salt and Mud Sloughs (the major west-side tributaries of the San Joaquin River), and the Merced River. By far the largest of these sources is the Merced River, which accounted for approximately 35 to 65 percent of the flow in the San Joaquin River measured near Crows Landing from Water Years 2002–2007. Note that releases from Friant Dam located on Millerton Lake upstream from the drainage area are not generally a major source of flow at Crows Landing except during flood releases. Releases from Friant Dam are for riparian water users and flood control. The Vernalis Adaptive Management Plan (VAMP) on the San Joaquin River has resulted in regulated spring releases (April-May) from the dams and reservoirs located on the eastern side of San Joaquin Valley.

The largest flows in the San Joaquin River in the Project Area occur during the late winter and spring from January through May. The lowest flows occur during the late summer in August and September. Flow records dating back to January 1993 are available for the San Joaquin River near Newman (at the confluence with the Merced River prior to Crows Landing). A review of these flow records indicates that during winter months the high flows at the San Joaquin River near Newman are highly influenced by large storm events. Figure 4-3 shows the average and median monthly flow near Newman based on the historical record. During the winter to early summer (January-July) the statistics of the flow record are highly skewed. The average is influenced by a few large events and is not very representative of the typical flow rate in the river. This is indicated by the large difference between the average and the median flow (the median flow is the flow that is exceeded 50 percent of the time, i.e., half the flows are greater and half the flows are less than the median). In this situation the median provides a better representation of the typical condition. In fact, for many months about 70 percent of the monthly flows are less than the average monthly flows.

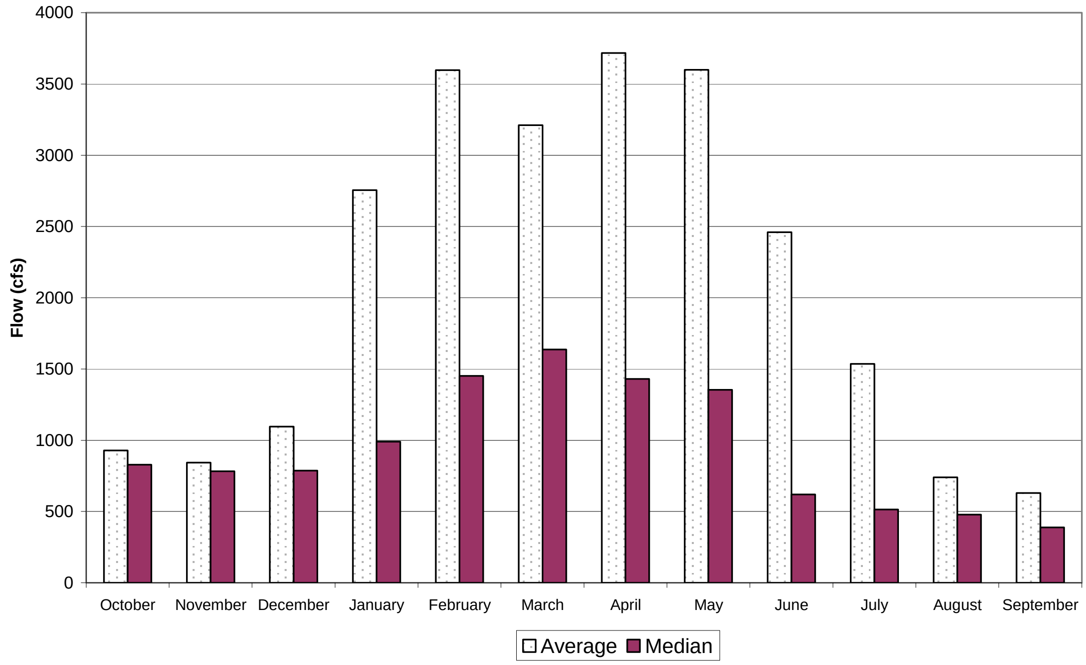


Figure 4-3 Average and Median Monthly Flows in the San Joaquin River near Newman

4.1.5 Water Quality of San Joaquin River Reaches and Tributaries

Existing water quality in specific river reaches is described below. Selected monitoring stations are shown on Figure 4-1. The specific reaches were chosen based on the segments of the river that may be affected by the Proposed Action and No Action Alternatives. Water quality data are based on the Grassland Bypass Monitoring Program results for Water Years 2002–2007, when available. Water quality data were obtained from the Regional Board through the San Joaquin River Watershed Surface Water Ambient Monitoring Program or from the San Francisco Estuary Institute (SFEI) GBP information management program (Regional Board 2008, SFEI 2008). Pre-project data were provided by the Regional Board (Westman 2008). For purpose of data evaluation, nondetect data were assumed to equal half of the reporting limit. Summary statistics reflect Regional Board data, unless otherwise noted.

Reaches discussed include:

- San Luis Drain and GDA Channels
- Mud Slough North
- Salt Slough
- Wetland Channels
- San Joaquin River upstream of Salt Slough
- San Joaquin River between Salt Slough and Mud Slough
- San Joaquin River between Mud Slough and the Merced River
- San Joaquin River between Merced and Crows Landing
- San Joaquin River at Vernalis

4.1.5.1 San Luis Drain and Grassland Drainage Area Channels

4.1.5.1.1 Drainage Area

Since 1996, 28 miles of the San Luis Drain conveyed drainwater from the GDA. The Grassland Bypass Channel is a 4-mile-long earthen ditch constructed to convey drainwater from the Panoche and Main drains to the San Luis Drain at Russell Avenue. Drainwater from Charleston Drainage District and Pacheco Water District connect along with Panoche Drainage District to the Panoche Drain and then to the bypass. Drainwater from Firebaugh Canal Water District and the Camp 13 drainage area are conveyed to the existing Main Drain, and then to the bypass. The commingled drainwater from the respective districts enters in the San Luis Drain and then discharges directly into Mud Slough (North).

4.1.5.1.2 Monitoring Stations

Three monitoring stations are located in the San Luis Drain:

- Station A at Drain Check 17 near Dos Palos, California; represents flow from the GDA into the Drain
- Station B approximately two miles from the terminus near Gustine, California; represents water discharged from the Drain into Mud Slough and is the compliance point for the load monitoring
- Station B2 at the Drain outlet; represents flow from the Drain into Mud Slough.

The Authority conducts continuous water monitoring at Stations A and B2[2]. The Regional Board conducts weekly grab and composite water quality monitoring at Station A and daily grab and composite water quality monitoring at Station B. The U.S. Geological Survey (USGS) conducts flow monitoring at Station B.

4.1.5.1.3 Flow

Flow into the Drain is limited to 150 cfs and velocity is limited to 1 foot per second. Excessive storm flows are diverted prior to entering in the Grassland Bypass to Agatha Canal and Camp 13 Ditch, if required. Excess flows from the Drain that are routed through wetland supply channels are not discharged to the wetlands.

For Water Years 2002–2007, flow from the Drain into Mud Slough (North) rarely exceeded 100 cfs. Peak flow in the Drain during this period was 132 cfs, which occurred during February 2005 following heavy rains. Flow from the Drain varies seasonally with peak discharges generally occurring during the early spring (February through March) and the lowest flow occurring in October and November (Table 4-14, Table 4-15, and Figure 4-4).

[2] Station B2 discharge is measured as stage over a sharp-crested weir, identical to Station A. This is considered a simpler and possibly more accurate method that will not be altered by sediment accumulation.

Table 4-14 Summary of Average Daily Flow –San Luis Drain Check 17, Station A

Water Year	San Joaquin Valley Index Water Year Type	Average (cfs)	Median (cfs)	Minimum (cfs)	Maximum (cfs)
2002	Dry	36	38	6	70
2003	Below Normal	35	36	8	82
2004	Dry	35	37	9	113
2005	Wet	38	38	8	132
2006	Wet	32	34	9	118
2007	Critical	23	21	0	47

Source: Eacock 2008b, GBP all selenium data.xls (LBL, USGS and Summers Engineering data).

Table 4-15 Summary of Average Daily Flow – Discharge from the San Luis Drain, Station B and B2

Water Year	San Joaquin Valley Index Water Year Type	Average (cfs)	Median (cfs)	Minimum (cfs)	Maximum (cfs)
2002	Dry	39	40	10	69
2003	Below Normal	38	39	11	82
2004	Dry	38	39	15	111
2005	Wet	42	42	17	123
2006	Wet	36	36	16	114
2007	Critical	26	24	2	50

Source: Eacock 2008b, GBP all selenium data.xls (USGS and LBL, USGS and Summers Engineering data).

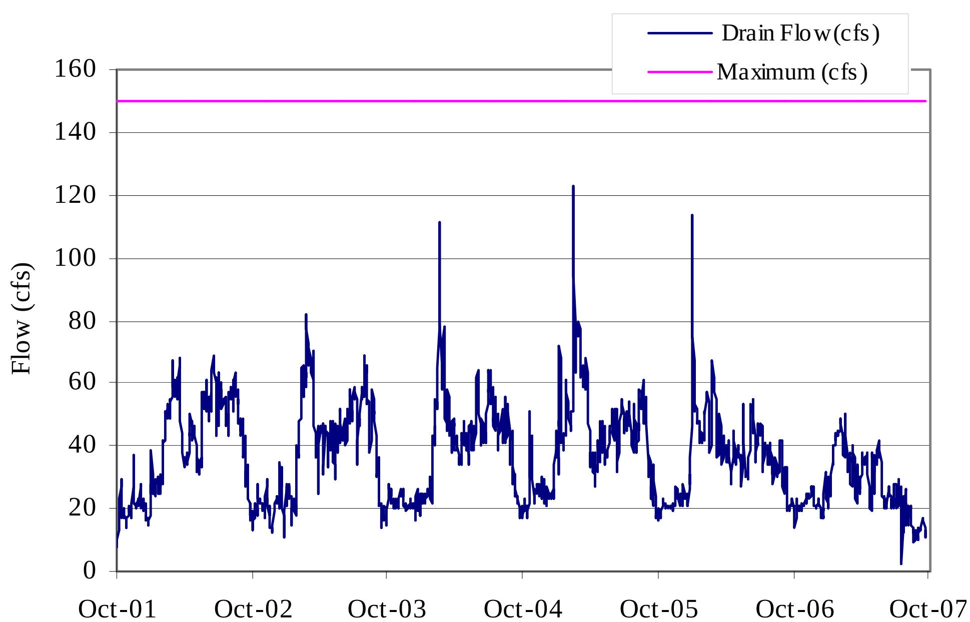


Figure 4-4 Discharge from the San Luis Drain (Station B) for Water Years 2002–2007

Flows through the Drain are highly managed and tend to have the highest concentrations of salt, Se, and boron during the pre-irrigation season, with concentrations decreasing throughout the year to a minimum during the nonirrigation season (Regional Board 2008).

4.1.5.1.4 Water Quality

For Water Years 2002–2007, weekly composite samples for Se at Station A had concentrations that ranged from 19.8 µg/L to 120 µg/L with an average concentration of 59 µg/L (Figure 4-5). The mean boron concentration was 7.8 milligrams per liter (mg/L). The average total suspended solids concentration from weekly grab samples was 110 mg/L, while the average EC value was 4,650 micromhos per centimeter (µmhos/cm). Average TDS concentration in the Drain was approximately 3,400 mg/L when the EC-TDS ratio of 0.74 was used to convert between EC and TDS. Site specific EC-TDS ratios were provided by Reclamation (Eacock 2008b, gbp summary data in rb layout_2.xls).

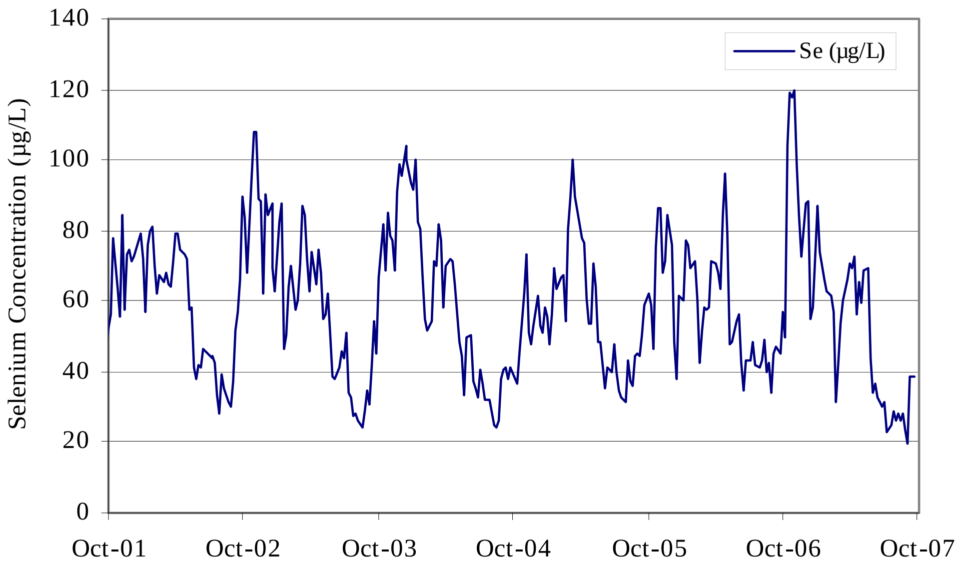


Figure 4-5 Selenium Concentration in the San Luis Drain at the inflow (Station A) for Water Years 2002–2007

Water quality at Station A is similar to that at Station B. Station B is sampled more frequently than Station A and is representative of the drainwater quality discharged to Mud Slough. The mean Se concentration measured at Station B for Water Years 2002–2007, based upon daily data, was 51 ppb (Figure 4-6), while mean boron concentrations averaged about 7.3 parts per million (ppm). Measured EC values ranged from 2140 to 6340 µmhos/cm, with an average of 4,420 µmhos/cm. Average TDS concentration in the Drain was approximately 3,300 mg/L when the EC-TDS ratio of 0.74 was used to convert between EC and TDS.

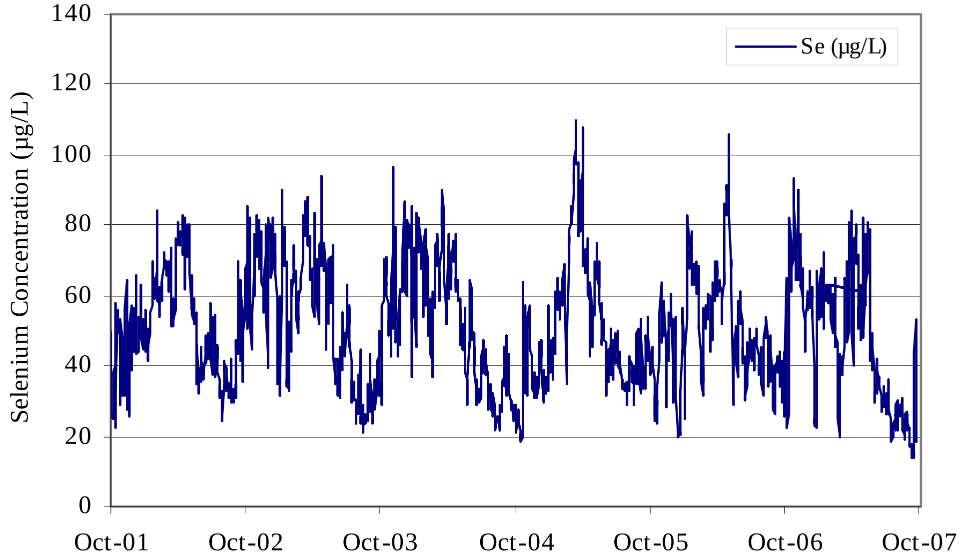


Figure 4-6 Selenium Concentration in the San Luis Drain at the terminus (Station B) for Water Years 2002–2007

4.1.5.2 Mud Slough North (Confluence with San Joaquin River at River Mile 121.1)

4.1.5.2.1 Drainage Area

Mud Slough (North), one of the two major west-side tributaries of the San Joaquin River, is currently the major carrier of agricultural drainage from the GDA to the San Joaquin River. Drainage originates from the GDA, travels via the San Luis Drain, and is discharged directly into Mud Slough. Flow in Mud Slough (North) upstream of the discharge point consists of wetland releases from the northern and southern GWD and additionally from Volta Wildlife Management Area, as well as operational spills from the Delta-Mendota Canal and CCID's Main Canal and floodflows from Los Banos Creek (Grassland Bypass Project Oversight Committee 1999). Mud Slough (North) downstream of the discharge point is often dominated by water originating from GDA via the Drain, but also carries a blend of subsurface tile drainage water and discharges from surrounding duck clubs.

4.1.5.2.2 Monitoring Stations

Three water quality monitoring stations are located in Mud Slough:

- Station C in Mud Slough (North), approximately 0.5 mile upstream of the Drain discharge; derives primarily from managed wetlands in the northern and southern GWD and represents a baseline condition prior to receiving the Drain discharge
- Station D in Mud Slough (North) near Gustine, California, approximately 0.6 mile downstream from the Drain terminus; represents water quality of Mud Slough (North) after being impacted by the Drain discharge
- Station I2 in Mud Slough (North) backwater; represents water quality of Mud Slough (North) flooding in Kesterson Refuge

The Regional Board conducts the routine weekly water quality monitoring at both Stations C and D. The USGS conducts continuous water quality and flow monitoring at Station D. Reclamation conducts water quality monitoring at Station I2.

4.1.5.2.3 Flow

Flow in Mud Slough (North) upstream of the Drain discharge is highly variable throughout the year, ranging from high flow during the wet season and during periods of wetland releases to very low flow during the summer and early fall (Regional Board 2008). In Water Years 2002–2007, Mud Slough (North) contributed approximately 11 percent of the flow measured at the San Joaquin River at Crows Landing Bridge. On an annual basis little more than two-thirds of this flow originates from Mud Slough (North) upstream, while the remainder is due to discharge from the GDA via the Drain. Flow from the Drain was found to account for as little as 23 percent and as much as 38 percent of the annual flow found in Mud Slough (North).

Flow in Mud Slough (North) upstream of the Drain discharge is determined by the difference between measured flow in Mud Slough (North) downstream of the Drain and measured flow in the Drain. The flow in Mud Slough (North) upstream of the Drain is estimated to average 90 cfs in Water Years 2002–2007 and rarely exceeded 200 cfs, except in the winter months of February and March, during which peak flows are estimated to have reached 538 cfs during the flood that occurred in February of Water Year 2005 (Table 4-16).

Table 4-16 Daily Flow Summary – Mud Slough (North) Upstream of Drain Discharge Station C

Water Year	San Joaquin Valley Index Water Year Type	Average (cfs)	Median (cfs)	Minimum (cfs)	Maximum (cfs)
2002	Dry	65	54	0	215
2003	Below Normal	85	53	0	491
2004	Dry	82	54	0	446
2005	Wet	111	74	5	538
2006	Wet	124	101	4	524
2007	Critical	74	46	0	226

Source: Eacock 2008b, GBP all selenium data.xls (derived flow).

A summary of flows in Mud Slough (North) downstream of the Drain discharge for Water Years 2002–2007 is shown in Table 4-17. The highest flows occurred in Water Year 2005, and reached over 615 cfs.

Table 4-17 Daily Flow Summary – Mud Slough (North) Downstream of Drain Discharge Station D

Water Year	San Joaquin Valley Index Water Year Type	Average (cfs)	Median (cfs)	Minimum (cfs)	Maximum (cfs)
2002	Dry	104	98	33	243
2003	Below Normal	122	88	29	511
2004	Dry	120	99	36	519
2005	Wet	153	109	40	617
2006	Wet	160	144	44	610
2007	Critical	100	71	9	247

Source: Eacock 2008b, GBP all selenium data.xls (USGS data).

4.1.5.2.4 Water Quality

Figure 4-7 shows the Se monitoring data for Mud Slough (North) upstream of the Drain (Station C) during the 6-year monitoring period that represents existing conditions. The average Se concentration was 0.6 µg/L for this monitoring period. The average boron concentration was 1.4 mg/L for the same period. The Basin Plan WQO for Mud Slough (North) is a 5 µg/L 4-day average concentration. Although monitored weekly, it is clear the WQO was met during Water Years 2002–2007. Water in Mud Slough (North) upstream of the Drain discharge is usually elevated with respect to salinity (Regional Board 2008). Measured EC averaged 1,590 µmhos /cm, with a maximum EC of 3,820 µmhos/cm. This is equivalent to an average TDS concentration of 108 mg/L, when the EC-TDS ratio of 0.68 was used to convert between EC and TDS.

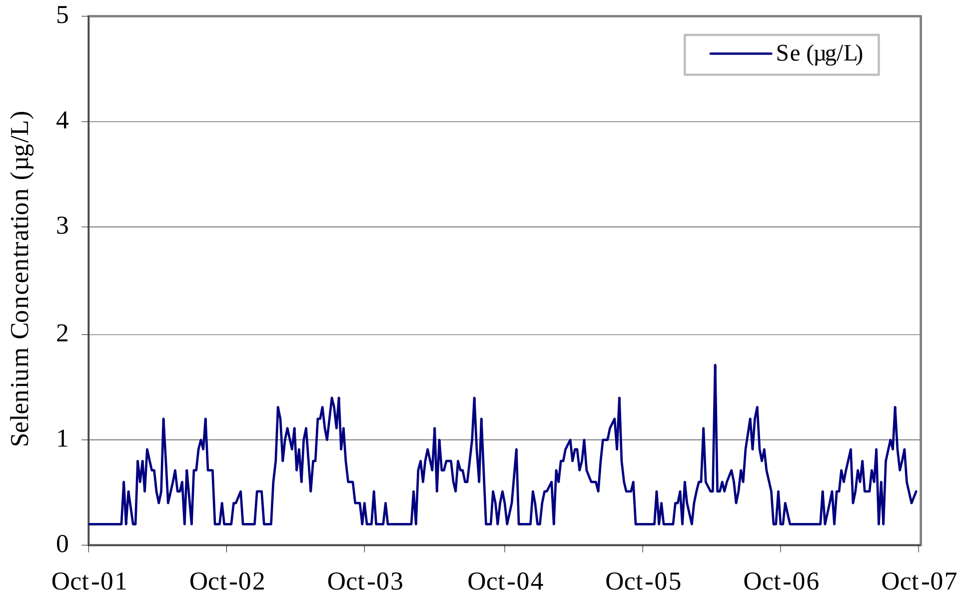


Figure 4-7 Selenium Concentration in Mud Slough (North) upstream of the Drain discharge (Station C) for Water Years 2002–2007

Water quality in Mud Slough (North) downstream of the Drain discharge (Station D) is governed by the discharge drainwater quality and is elevated with respect to salinity, Se, and boron (Regional Board 2008). Downstream Se concentrations ranged between 2.4 µg/L and 54.9 µg/L with a mean of 18 µg/L (Figure 4-8). Although direct comparison to the 5 µg/L 4-day average WQO is not feasible with the weekly data, measured concentrations were rarely less than 5 µg/L during this period. Boron concentrations averaged 3.7 mg/L during Water Years 2002–2007. The average EC was 2,710 µmhos/cm (approximately 1,870 mg/L TDS, when the EC-TDS ratio of 0.69 was used). Highest concentrations are generally found during the spring and summer.

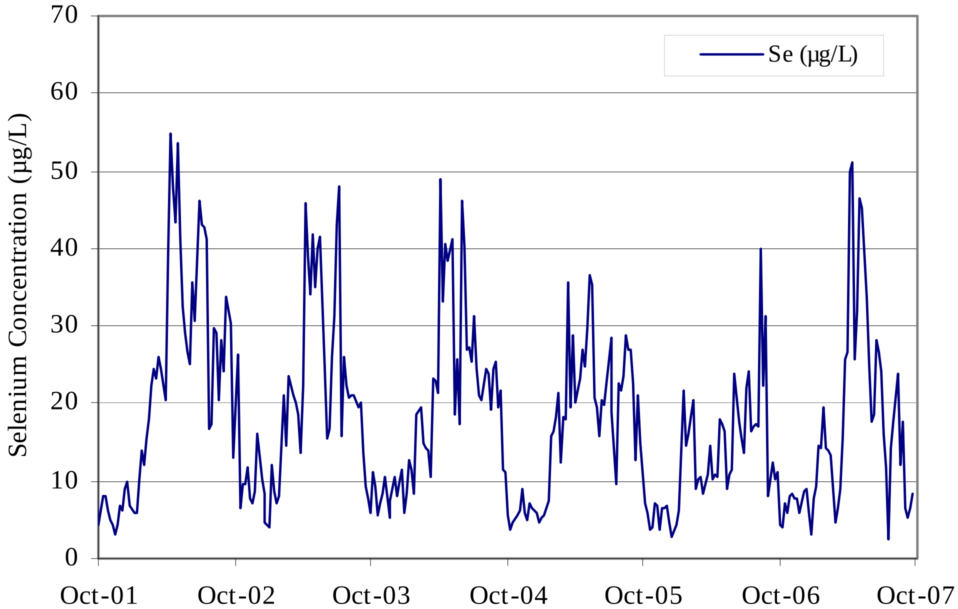


Figure 4-8 Selenium Concentration in Mud Slough (North) downstream of drainage discharge (Station D) for Water Years 2002–2007

Figure 4-9 shows pre-Project and post-Project Se concentrations in Mud Slough (North) downstream of the Drain (Station D). Mean annual Se concentrations have decreased after the start of the Project in October 1996, from a concentration of 30.3 µg/L during Water Year 1997 to a concentration of 13.1 µg/L in Water Year 2006. The mean annual Se concentration increased in Water Year 2007, which was a Critical year, to 16.3 µg/L.

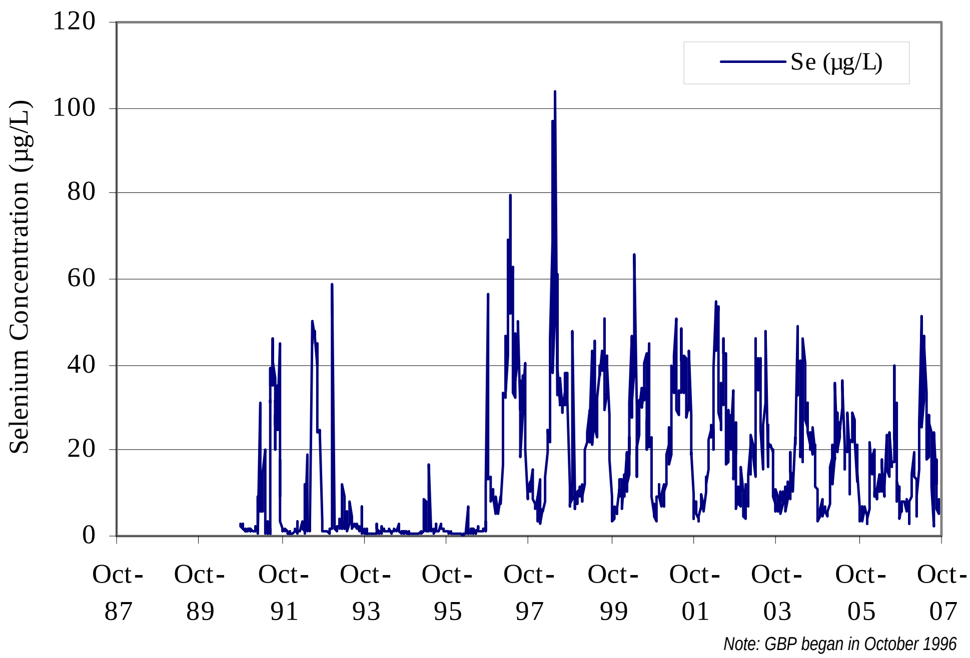


Figure 4-9 Pre-Project and Post-Project selenium concentration in Mud Slough (North) downstream of the Drain discharge (Station D)

Water quality data for Station I2 are not available.

4.1.5.3 Salt Slough (Confluence with San Joaquin River at River Mile 129.7)

4.1.5.3.1 Drainage Area

Salt Slough, the other major west-side tributary of the San Joaquin River, is located on the easterly side of the Kesterson National Wildlife Refuge. Since 1996, water in this channel comes only from wetland discharges, runoff from non-GDA farmland, and occasional floodflows and is a blend of surface tailwater, operational spills, and wetland drainage from the surrounding area.

4.1.5.3.2 Monitoring Station

One water quality monitoring station is located in Salt Slough:

- Station F in Salt Slough at Lander Avenue (Highway 165) near Stevinson, California; used to track improvements in the former drainage conveyance channel

The USGS conducts flow and water quality monitoring and the Regional Board conducts weekly water quality monitoring at Station F.

4.1.5.3.3 Flow

The water quality and quantity at this site varies, but the range of variation is dampened by the large area that drains into the San Joaquin River (Regional Board 2008). During Water Years 2002–2007, total flow in Salt Slough contributes approximately 16 percent of total flow measured at the San Joaquin River at Crows Landing. Flows in Salt Slough ranged from a minimum of approximately 40 cfs in September 2007 to a maximum of approximately 640 cfs in February 2005 for Water Years 2004–2007. The flows during this period are summarized in Table 4-18.

Table 4-18 Daily Flow Summary – Salt Slough Station F

Water Year	San Joaquin Valley Index Water Year Type	Average (cfs)	Median (cfs)	Minimum (cfs)	Maximum (cfs)
2002	Dry	145	137	47	347
2003	Below Normal	177	145	49	487
2004	Dry	170	150	62	553
2005	Wet	214	190	58	644
2006	Wet	233	207	51	592
2007	Critical	154	148	39	299

Source: Eacock 2008b, GBP all selenium data.xls (USGS data)

4.1.5.3.4 Water Quality

Prior to the Grassland Bypass Project (1996 and 2001), Salt Slough exceeded the current 2 ppb monthly mean Se WQO. Water quality in Salt Slough improved immediately following implementation of the 1996 Grassland Bypass Project. In the first year of the Project, Water Year 1997, Se objectives became effective for Salt Slough and were achieved, which was a major goal of the Project (Figure 4-10). Water Year 1998 had exceedances of Se WQOs only during

February 1998, when uncontrollable floodflows were discharged. During Water Years 2002–2007, the average Se was 0.6 µg/L. Water quality at Salt Slough continued to meet the 2 µg/L monthly average Se WQO during this time period (Figure 4-11).

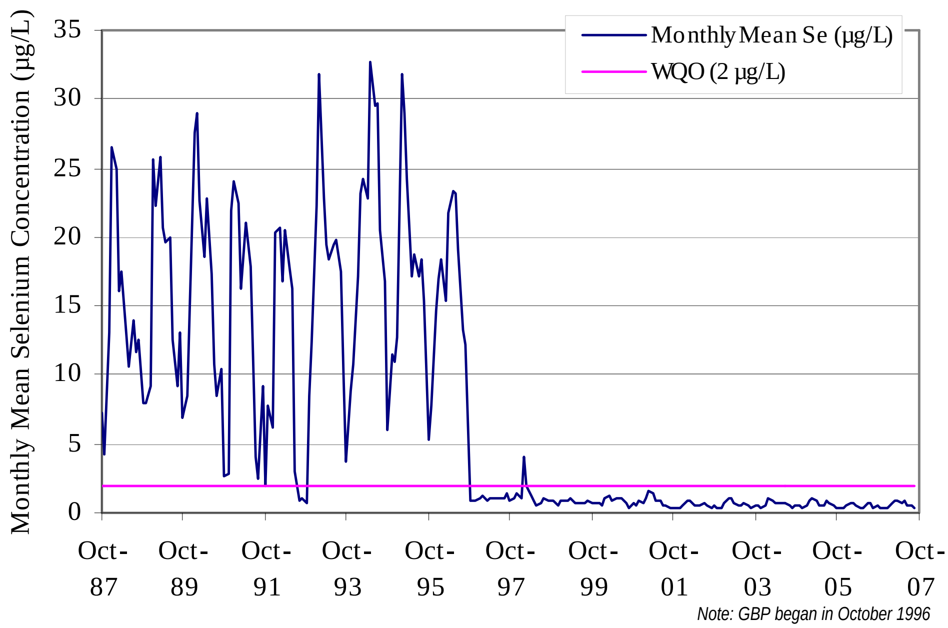


Figure 4-10 Pre-Project and Post-Project selenium concentration in Salt Slough at Lander Avenue (Station F)

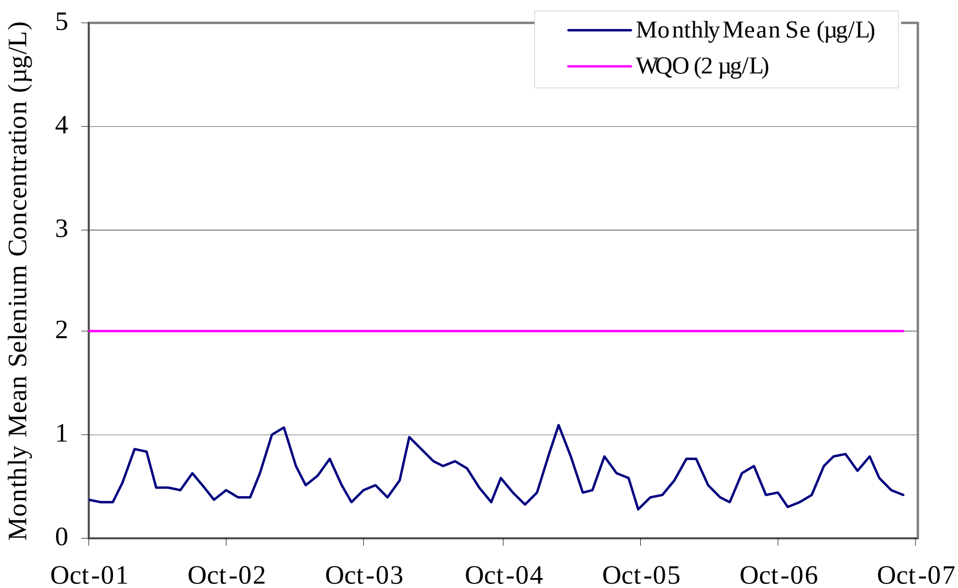


Figure 4-11 Selenium Concentration in Salt Slough at Lander Avenue (Station F) during Water Years 2002–2007

The mean boron concentration for Water Years 2002–2007 was 0.8 mg/L. Measured EC averaged 1,350 µmhos/cm for this same time period (approximately 920 mg/L TDS when the EC-TDS ratio of 0.68 was used to convert between EC and TDS).

4.1.5.4 San Joaquin River Upstream of Salt Slough (River Mile >129.7)

4.1.5.4.1 Drainage Area

Upstream of Salt Slough the San Joaquin River receives drainage from east-side tributaries including Fresno River, Bear Creek, as well as return flows from other non-GDA agricultural districts including San Luis Canal Company, and CCID. Also included are occasional releases of floodwater from Friant. Tile drainage does not enter the San Joaquin River upstream of Salt Slough.

4.1.5.4.2 Monitoring Station

One monitoring station is located within the Project Area on this stretch of the San Joaquin River:

- San Joaquin River at Lander Avenue, Highway 165; located approximately 16.5 miles north of Los Banos near Stevinson, California

No Grassland Bypass Project monitoring stations are located on this reach of the San Joaquin River; however, the Regional Board conducts sampling at Lander Avenue Bridge (Regional Board Station MER522) as a part of its monitoring program. The DWR operates a flow monitoring station at the Lander Avenue Bridge, near Stevinson (California Data Exchange Center [CDEC] Station SJS) that records stage, flow, EC, and temperature.

4.1.5.4.3 Flow

A summary of flows in the San Joaquin River upstream of Salt Slough for Water Years 2002–2007 is shown in Table 4-19. Flows in the San Joaquin River near Stevinson are relatively low, averaging less than 50 cfs during the drier years (Water Years 2002–2005, and 2007). In Water Year 2006, CDEC reported extremely high flows reaching up to approximately 20,000 cfs.

Table 4-19 Daily Flow Summary – San Joaquin River near Stevinson (CDEC Station SJS)

Water Year	San Joaquin Valley Index Water Year Type	Average (cfs)	Median (cfs)	Minimum (cfs)	Maximum (cfs)
2002	Dry	29	21	1	421
2003	Below Normal	28	10	0	466
2004	Dry	30	15	0	458
2005	Wet	684	113	0	5,923
2006	Wet	2,574	329	5	20,061
2007	Critical	46	31	3	567

Source: CDEC 2008.

4.1.5.4.4 Water Quality

Water quality at this site is expected to show natural background levels or good quality surface runoff from irrigated agriculture (Regional Board 2008).

No monitoring was performed in this river reach as a part of the Grassland Bypass Project. Water quality was characterized based on monitoring conducted in Water Years 2002–2007 by the Regional Board. During Water Years 2002–2007, measured Se concentrations were below 5 µg/L and the average Se concentration was less than 0.3 µg/L (Figure 4-12). The average concentration of boron was 0.2 mg/L for this 6-year monitoring period. Average EC was 1,130 µmhos/cm.

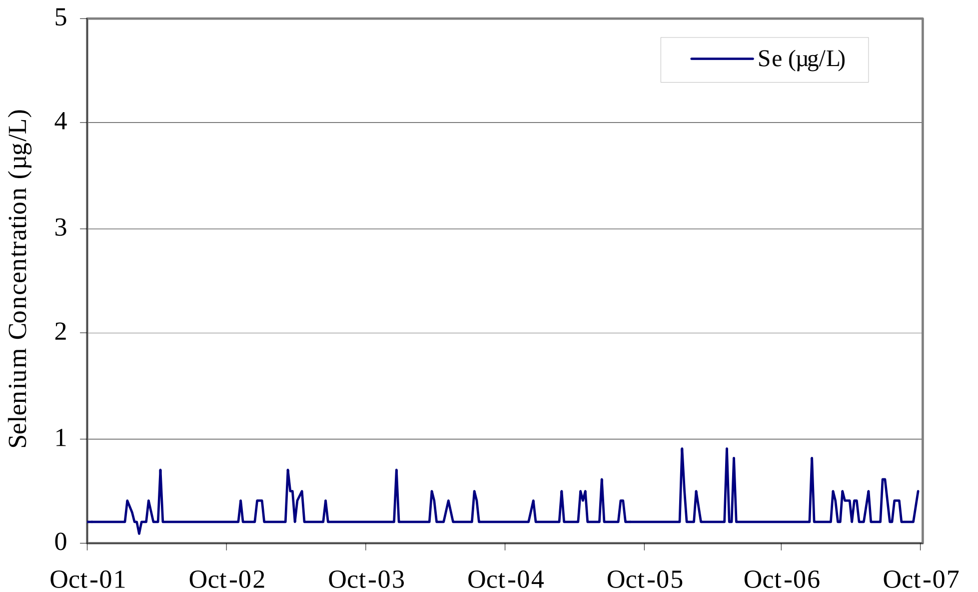


Figure 4-12 Selenium Concentration in the San Joaquin River at Lander Avenue during Water Years 2002–2007

4.1.5.5 Wetland Channels

4.1.5.5.1 Drainage Area

Wetland channels located in the Grassland Subarea consist of approximately 70 miles of water supply channels to privately, state-, and federally owned wetlands and national wildlife refuges (Reclamation 1995) and 23 miles of Salt Slough (see Figure 2-1). (See also Section 7.1.3 and Figure 7-1 for the location of the wildlife refuges and management areas.)

4.1.5.5.2 Monitoring Stations

Five monitoring stations are located within the Project Area wetland channels:

- Station J in Camp 13 Ditch, located approximately 5.7 miles south of the Almond Bridge; represents the water quality of the wetland water supply channel; consists of a mixture of water from the Firebaugh Drain, the Hamburg Drain, and operational spill water from the CCID Main Canal

- Station K in Agatha Canal, located approximately 4.3 miles east of Camp 13 Ditch; represents the water quality of the wetland water supply channel; consists of a mixture of water from Helm Canal, the Panoche Drain, and the Mercy Springs Drain, all of which can carry a portion of tile drainage water, and from the CCID Main Canal
- Station L2 in San Luis Canal at the splits; represents the water quality of the wetland water supply channel and is a diversion off of the CCID Main Canal
- Station M2 in Santa Fe Canal at the weir; represents the water quality of the wetland water supply channel and has the Delta-Mendota Canal as source water
- CCID Main Canal at Russell Avenue (Regional Board Station MER510) south of Dos Palos, California; represents wetland water supply

Current wetland channels include monitoring stations that collect data with the goal of assessing and verifying removal of agricultural drainwater and suitability of the channels for year-round wetland water supply delivery. The Regional Board conducts weekly water quality monitoring at Stations J, K, L2, M2, and CCID Main Canal. Flow data are collected from GWD records for Stations J, K, L2, and M2, but are not subjected to GBP monitoring program criteria.

4.1.5.5.3 Flow

Flow to wetlands through the supply canals is regularly measured but not reported as a part of the Grassland Bypass Project. These flow data are unavailable. Water supply deliveries to the wetlands have been measured infrequently by GWD staff. However, the CVPIA water delivery schedules for Level 4 water supply to all San Joaquin Valley Action Plan habitat areas in the Project Area are approximately 270,000 acre-feet per year with peak deliveries occurring in May, June, September, and October.

4.1.5.5.4 Water Quality

Water quality in the Camp 13 Ditch (Station J) and Agatha Canal (Station K) represent a composite of different sources; therefore, differences in water quality reflect the quality and quantity of input from each of its sources (Regional Board 2008). During Water Years 2002–2007, Se concentrations ranged from less than 0.4 to 3.6 µg/L with an average concentration of 1.1 µg/L for Station J (Camp 13 Ditch); Se concentrations ranged from less than 0.4 to 44 µg/L, with an average of 1.1 µg/L for Station K (Agatha Canal); Se concentrations ranged from less than 0.4 to 5.3 µg/L, with an average of 1.4 µg/L for Station L2 (San Luis Canal at the splits); and Se concentrations ranged from less than 0.4 to 4.7 µg/L, with an average of 1.1 µg/L for Station M2 (Santa Fe Canal at the weir). The Se concentration for the CCID Main Canal ranged from less than 0.4 to 4.6 µg/L with an average of 1.0 µg/L. Boron concentrations averaged 0.5 mg/L at Station J, 0.5 mg/L at Station K, 0.9 mg/L at Station L2, and 1.3 mg/L at Station M2 for Water Years 2002–2007. Mean EC measured at Station J, K, L2, and M2 were 630 µmhos/cm, 640 µmhos/cm, 930 µmhos/cm, and 1,200 µmhos/cm respectively.

The CCID Main Canal contains irrigation supply water from the Delta-Mendota Canal and Mendota Pool, and supplies water to Camp 13 Ditch, Agatha Canal, and the San Luis Canal (Figure 4-13).

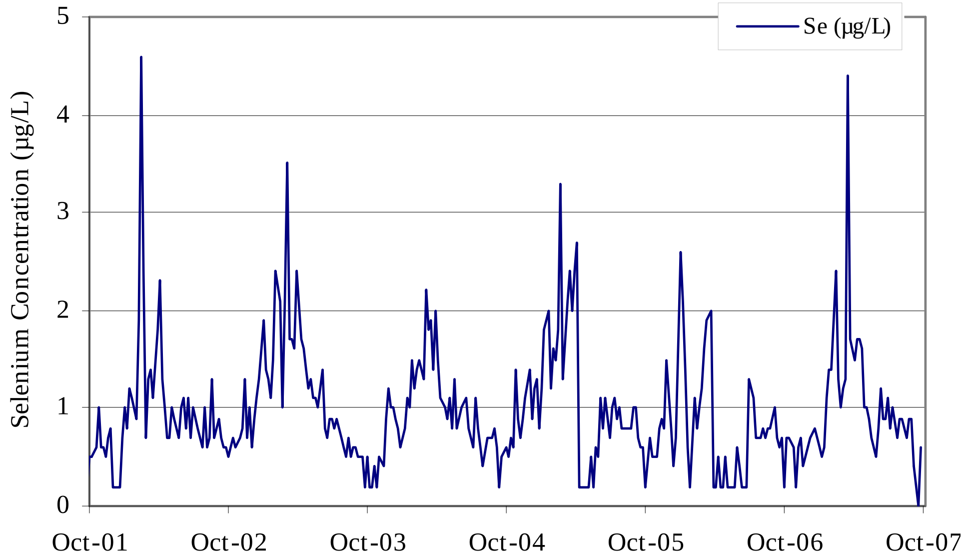
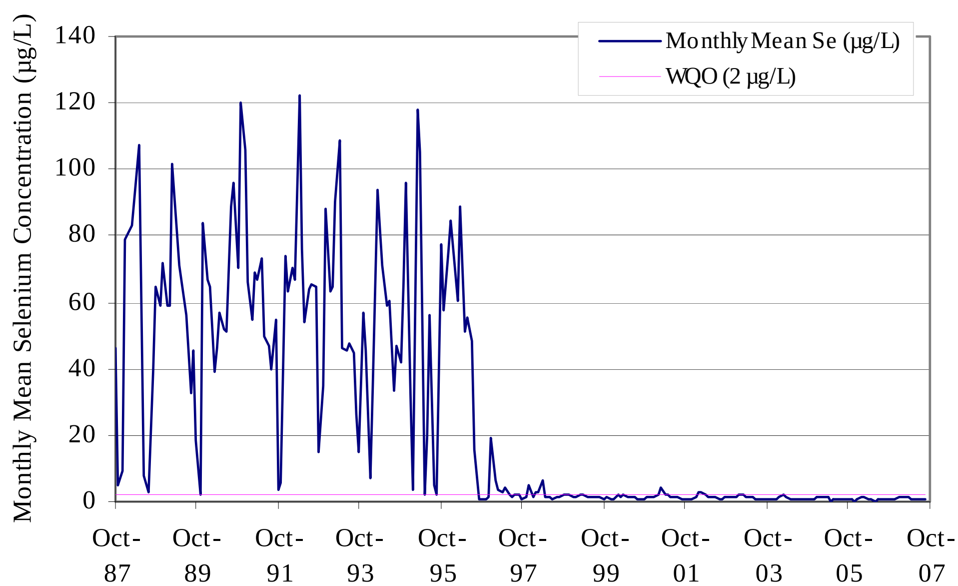


Figure 4-13 Selenium Concentration in CCID Main Canal at Russell Avenue (MER510) for Water Years 2002–2007

One of the Grassland Bypass Project's goals was to remove Se from wetland channels and allow implementation of a WQO of 2 ppb (monthly mean). The first year of operation (beginning October 1996) showed that Se concentrations had been reduced significantly in the wetland channels but still had some months with concentrations above the WQO (Figure 4-14 and Figure 4-15). Prior to the Grassland Bypass Project (Water Years 1988–1996), the mean Se concentration was 53 µg/L at Camp 13 Ditch and 35 µg/L at Agatha Canal.



Note: GBP began in October 1996

Figure 4-14 Pre-Project and Post-Project selenium concentration in Camp 13 Ditch (Station J)

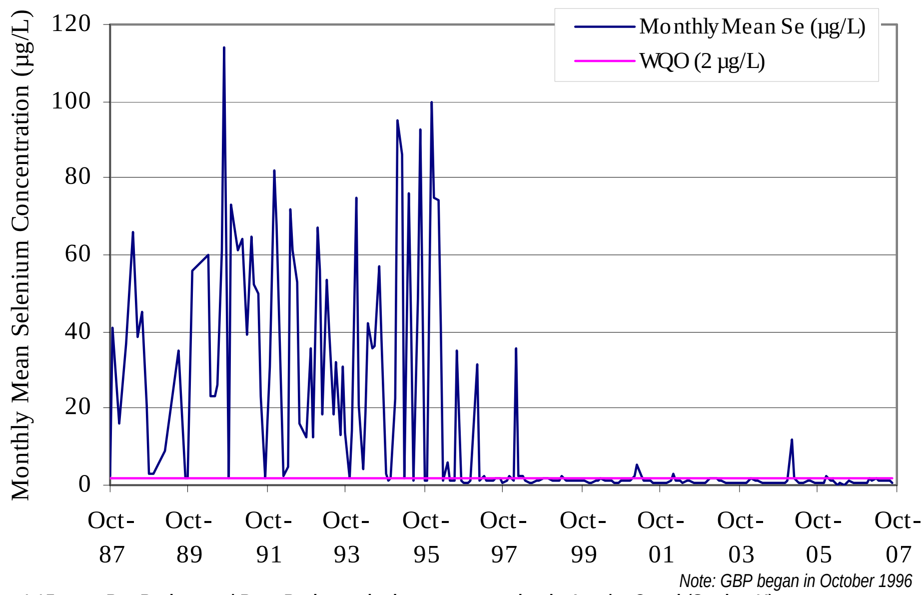


Figure 4-15 Pre-Project and Post-Project selenium concentration in Agatha Canal (Station K)

For Water Years 2002–2007, the mean monthly Se concentrations in Camp 13 Ditch (Station J) were between 0.3 µg/L and 2.9 µg/L, with 5 of 72 months above the 2 ppb monthly mean WQO (Figure 4-16); in Agatha Canal (Station K), mean monthly Se was between 0.2 µg/L and 12.1 µg/L, with 3 of 72 months above the WQO (Figure 4-17); in San Luis Canal at the splits (Station L2), mean monthly Se was between 0.4 µg/L and 3.3 µg/L, with 8 of 72 months above the WQO (Figure 4-18); and in Santa Fe Canal at the weir (Station M2), mean monthly Se was between 0.4 µg/L and 3.8 µg/L, with 2 of 72 months above the WQO (Figure 4-19). Agatha Canal has Se concentration spikes during winter storm events when excess flows from the Drain generated by commingled stormwater and drainage discharge are diverted and routed through Agatha Canal. These diversion flows are not discharged to wetlands.

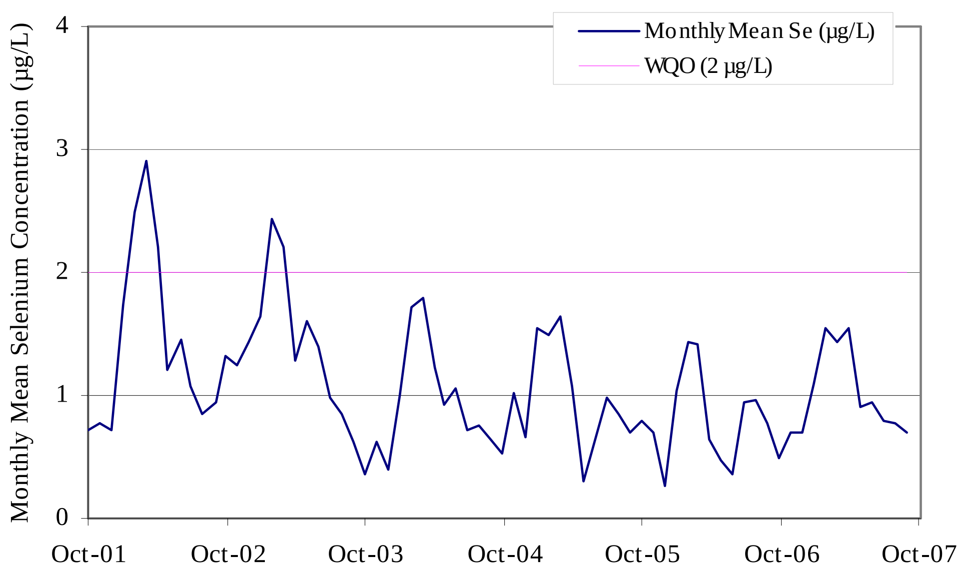


Figure 4-16 Selenium Concentration in Camp 13 Ditch (Station J) during Water Years 2002–2007

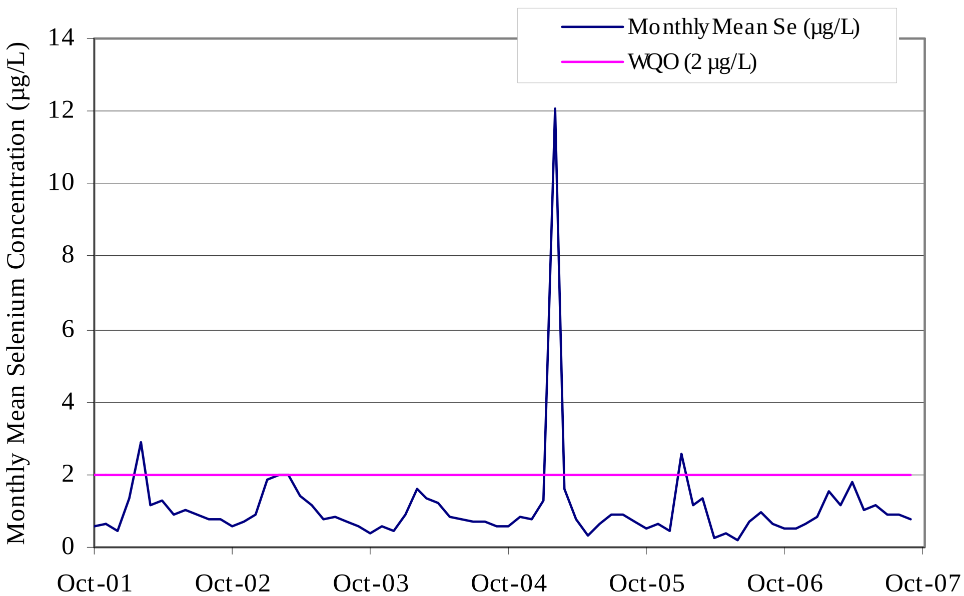


Figure 4-17 Selenium Concentration in Agatha Canal (Station K) for Water Years 2002–2007

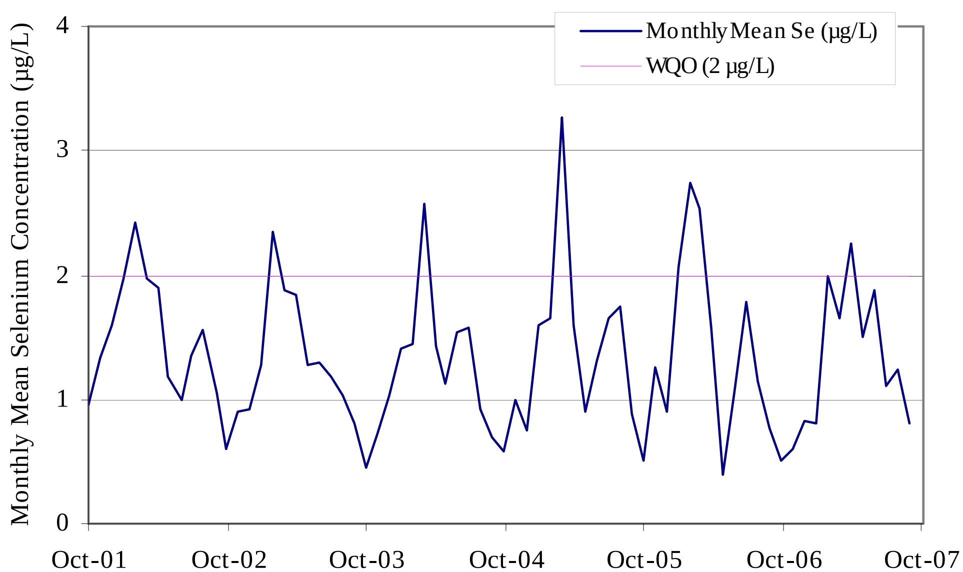


Figure 4-18 Selenium Concentration in San Luis Canal at the splits (Station L2) for Water Years 2002–2007

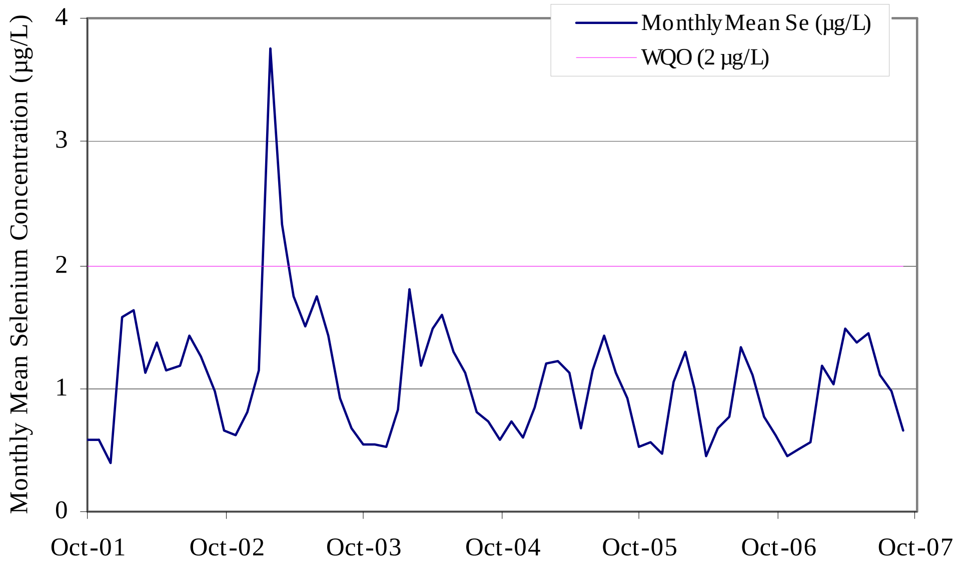


Figure 4-19 Selenium Concentration in Santa Fe Canal at the weir (Station M2) for Water Years 2002–2007

4.1.5.6 San Joaquin River - Salt Slough to Mud Slough (River Miles 129.7 to 121.1)

4.1.5.6.1 Drainage Area

This portion of the San Joaquin River is located between the confluence of Mud Slough and Salt Slough with the San Joaquin River. Drainage discharges to this section of the San Joaquin River originate from Salt Slough, i.e., drainage from non-GDA farmland and wetlands.

4.1.5.6.2 Monitoring Station

One monitoring station is located on this reach of the San Joaquin River:

- Station G in the San Joaquin River at Fremont Ford, located at the Highway 140 bridge, approximately 5.4 miles northeast of Gustine; used to track improvements in Salt Slough, which was a former drainage conveyance channel

The Regional Board conducts weekly water quality monitoring at Station G. The USGS operates a real time, continuous flow and water quality monitoring station in the San Joaquin River at Fremont Ford Bridge (CDEC Station FFB).

4.1.5.6.3 Flow

No flow data collected as a part of the Grassland Bypass Project are available for this reach of the San Joaquin River. Overall flow contribution from this portion of the San Joaquin River to the flow measured at Crows Landing accounts for about 35 percent (Water Years 2002–2007).

A summary of flows in the San Joaquin River at Fremont Ford for Water Years 2004–2007 is shown in Table 4-20. Flows at this site during this period ranged from a minimum of 52 cfs in September 2007 to a maximum 23,200 cfs in April 2006.

Table 4-20 Daily Flow Summary – San Joaquin River at Fremont Ford Bridge Station G

Water Year	San Joaquin Valley Index Water Year Type	Average (cfs)	Median (cfs)	Minimum (cfs)	Maximum (cfs)
2002	Dry	221	175	69	2,090
2003	Below Normal	216	171	57	841
2004	Dry	223	166	72	2,190
2005	Wet	887	430	73	4,130
2006	Wet	2,667	322	132	23,200
2007	Critical	216	217	52	768

Source: Eacock 2008b, GBP all selenium data.xls (USGS data).

Notes: Data shown for 2002 do not represent the full water year. The data starts with November 29, 2001.

4.1.5.6.4 Water Quality

Since this site is located upstream of the GDA discharge point into the San Joaquin River, it has lower measured Se concentrations than downstream monitoring sites located on the San Joaquin River. Water quality has improved at Fremont Ford as a result of the Grassland Bypass Project. This improvement is evident in a comparison of the pre-Project and post-Project concentrations of Se, boron, and EC based on long-term monitoring data collected by the Regional Board and the Grassland Bypass Monitoring Program. During the pre-Project period (Water Years 1988–1996) the mean Se concentration was 12 µg/L (Figure 4-20). During Water Years 2002–2007 measured Se concentrations were below 5 µg/L and the mean Se concentration decreased to 0.5 µg/L (Figure 4-21). Similarly, during the pre-Project monitoring period the mean boron concentration was 1.7 mg/L. During Water Years 2002–2007 the mean boron concentration was 0.6 mg/L. In contrast, EC increased somewhat between the two monitoring periods from a mean of 1,030 µmhos/cm during the pre-Project period to a mean of 1,390 µmhos/cm during Water Years 2002–2007.

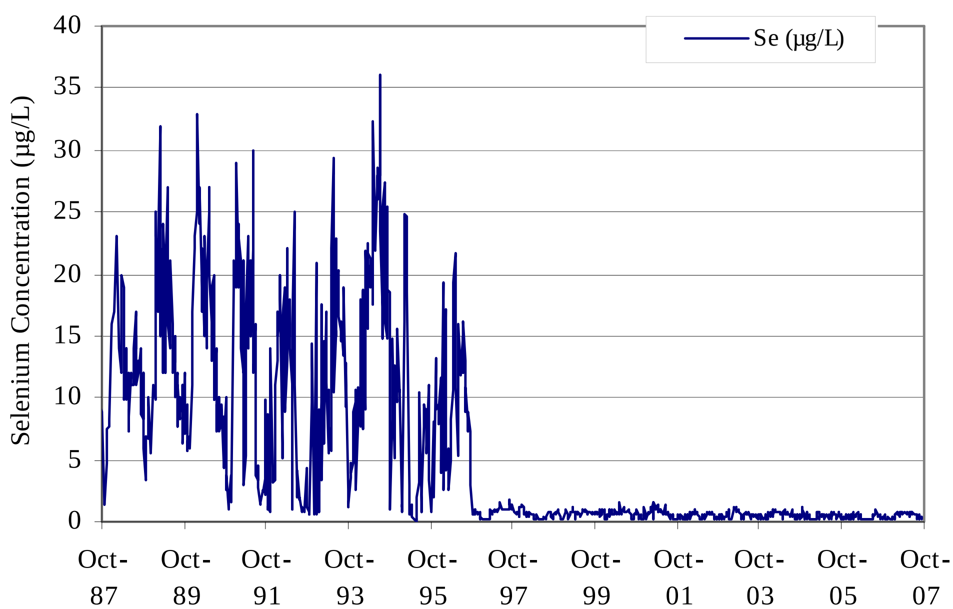


Figure 4-20 Pre-Project and Post-Project selenium concentration in San Joaquin River at Fremont Ford (Station G)

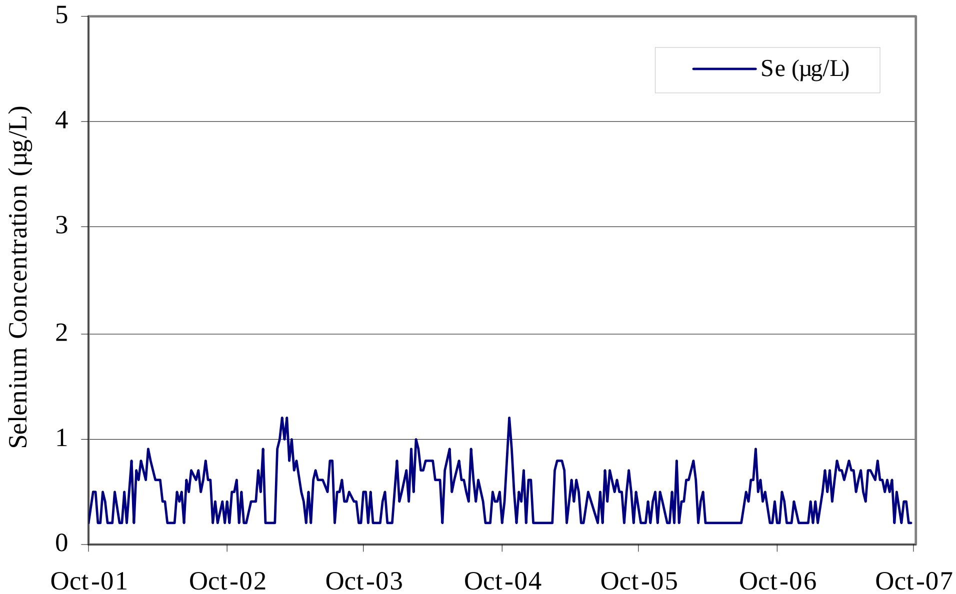


Figure 4-21 Selenium Concentration in San Joaquin River at Fremont Ford (Station G) for Water Years 2002–2007

4.1.5.7 San Joaquin River - Mud Slough to Merced River (River Miles 119.6 to ~118)

4.1.5.7.1 Drainage Area

The agricultural drainage that discharges into the San Joaquin River at the confluence of Mud Slough travels about 3 miles before it is diluted by the incoming Merced River. Water in this reach is a mixture of drainage from wetlands and GDA and non-GDA farmland, as well wet season inflows from Merced River flood channels.

4.1.5.7.2 Monitoring Station

One water quality monitoring station is located in this reach of the San Joaquin River:

- Station H in the San Joaquin River at Hills Ferry upstream of the Merced River; intended to represent the water quality of the San Joaquin River most impacted by drainage discharge

The Regional Board conducts weekly water quality monitoring at Station H as part of the GBP monitoring program. No flow monitoring is conducted for this portion of the San Joaquin River.

Note: this monitoring station was discontinued by the Grassland Bypass Project Monitoring Oversight Committee due to the influence of other flows not related to the Grassland Bypass Project. The data collected at this station are intended for use with the biological monitoring data.

4.1.5.7.3 Flows

Flows in this portion of the San Joaquin River originate from GDA, wetlands, and other non-GDA discharges. As flows were not measured at this monitoring station, they can be estimated by summing up flows from Mud Slough (North) and the San Joaquin River upstream of the Mud

Slough confluence. Total flows accounted for approximately 45 percent of the flow measured at the Crows Landing site (Water Years 2002–2007). The quality of these flows greatly influence water quality in the river.

4.1.5.7.4 Water Quality

Water at this site can be elevated with respect to salt, Se, and boron. Total Se averaged 4.0 µg/L in this reach of the San Joaquin River during Water Years 2002–2007. Measured Se concentrations ranged from less than 0.4 to 13.2 µg/L, with an average of 4.0 µg/L (Regional Board and SFEI data; Figure 4-22). The average boron concentration was 1.3 mg/L. Measured EC averaged 1,670 µmhos/cm for this same time period (approximately 1,140 mg/L TDS, when the TDS/EC ratio of 0.68 was used to convert between EC and TDS).

Direct comparison of measured Se concentration to the 5 µg/L 4-day average WQO is not possible from weekly data; however, Se concentrations during Water Years 2000–2007 are generally lower than pre-Project conditions (Figure 4-23). Water Years 1988–1996 had an average annual Se concentration of 9.7 µg/L. Water Years 2002–2007 had an average annual Se concentration of 3.9µg/L.

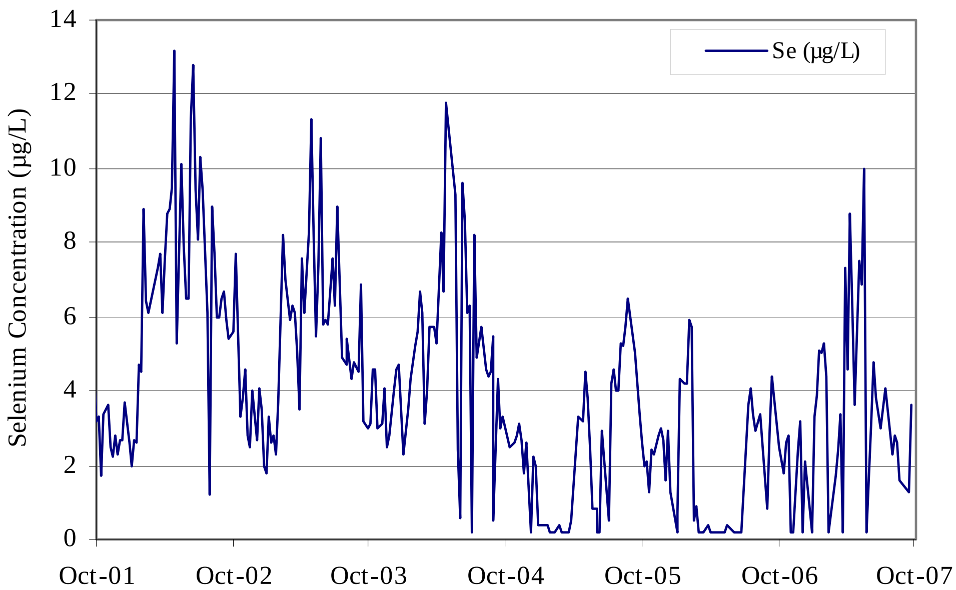


Figure 4-22 Selenium Concentration in San Joaquin River at Hills Ferry (Station H) for Water Years 2002–2007

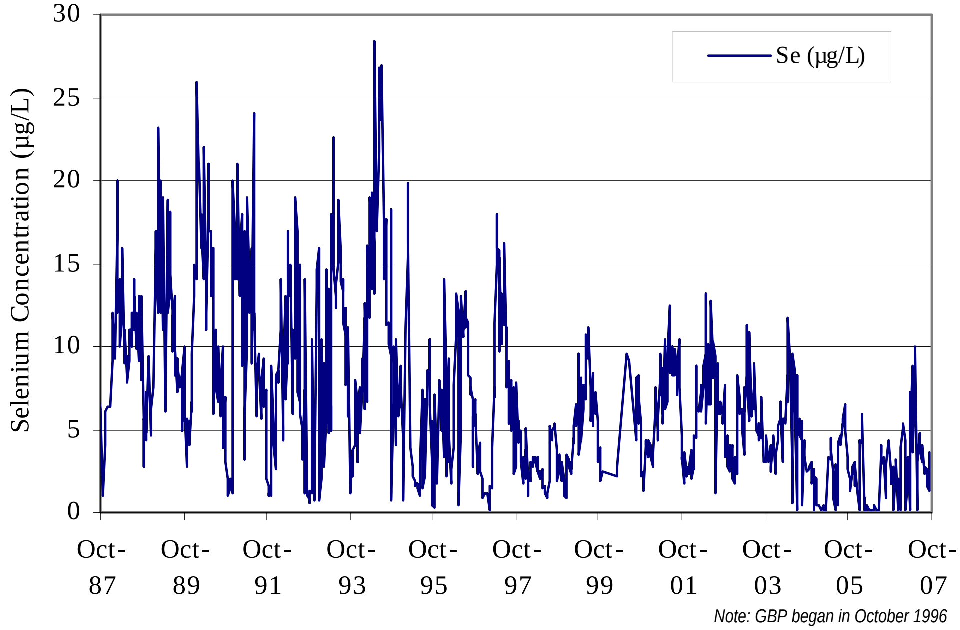


Figure 4-23 Pre-Project and Post-Project selenium concentration in San Joaquin River at Hills Ferry (Station H)

4.1.5.8 San Joaquin River - Merced River to Crows Landing (River Miles ~ 118.5 to 100.0)

Downstream of the Merced River confluence, the San Joaquin River at Crows Landing (site of Station N) is a Regional Board compliance point. This site represents the San Joaquin River as influenced by the Project Area and vicinity discharges and diluted by the Merced River flow.

4.1.5.8.1 Drainage Area

The GDA, other agricultural lands, Los Banos Creek, Merced River, Orestimba Creek, all other sites previously discussed, and regional groundwater all contribute to flows found in this portion of the San Joaquin River.

4.1.5.8.2 Monitoring Station

Two monitoring stations are located in this reach of the river:

- Station N in the San Joaquin River at Crows Landing; used to characterize water quality in the San Joaquin River downstream of the Merced River
- San Joaquin River near Newman (CDEC Station NEW), immediately downstream of the Merced River confluence and prior to Crows Landing

The Regional Board conducts weekly and daily composite water quality monitoring; and the USGS operates a real time, continuous flow and water quality monitoring station at Station N. Flow monitoring at the Merced confluence (CDEC Station NEW) is operated by the USGS and the DWR.

4.1.5.8.3 Flow

Flows at this point in the San Joaquin River are an aggregate of all the flows that have been described earlier in this section: the sum total of Mud Slough, Salt Slough, the San Joaquin River upstream of Salt Slough, and the Merced River. Other water sources contribute to the San Joaquin River in this reach including Orestimba Creek and various other surface and subsurface flows. Section 4.1.4.2 described the seasonal flow record along this river reach.

A summary of daily flows in the San Joaquin River at Crows Landing for Water Years 2002–2007 is shown in Table 4-21. Flows at this site are relatively large and ranged from a minimum of 250 cfs in September 2003 to a maximum of over 23,900 cfs in April 2006 during Water Years 2002–2007.

Table 4-21 Daily Flow Summary – San Joaquin River at Crows Landing, Station N

Water Year	San Joaquin Valley Index Water Year Type	Average (cfs)	Median (cfs)	Minimum (cfs)	Maximum (cfs)
2002	Dry	738	732	288	2,290
2003	Below Normal	754	747	250	1,740
2004	Dry	764	680	293	2,650
2005	Wet	2,377	1,570	320	10,200
2006	Wet	4,748	1,840	686	23,900
2007	Critical	839	852	311	1,890

Source: Eacock 2008b, GBP all selenium data.xls (USGS data).

A summary of daily flows in the San Joaquin River near Newman for Water Years 2002–2007 is shown in Table 4-22. Flows average approximately 700 cfs during the drier years (Water Years 2002–2005 and 2007). In Water Year 2006, a Wet Year, the flows at this site reached up to 33,000 cfs.

Table 4-22 Daily Flow Summary – San Joaquin River near Newman (CDEC Station NEW)

Water Year	San Joaquin Valley Index Water Year Type	Average (cfs)	Median (cfs)	Minimum (cfs)	Maximum (cfs)
2002	Dry	672	687	273	2,261
2003	Below Normal	709	709	242	1,629
2004	Dry	714	671	230	2,665
2005	Wet	2,301	1,535	272	10,500
2006	Wet	4,412	1,896	633	32,725
2007	Critical	720	747	225	1,483

Source: CDEC 2008.

4.1.5.8.4 Water Quality

Water quality at this site is improved compared to upstream stations on the San Joaquin River due to the influence of the Merced River. Figure 4-24 presents the 4-day average Se concentration in the San Joaquin River at Crows Landing for Water Years 2002–2007. Measured Se concentrations from grab samples ranged from less than 0.4 to 6.0 µg/L with an average concentration of 2.2 µg/L for this monitoring period. Autosampler data for Se ranged from less than 0.4 to 6.8 µg/L, with an average of 2.3 µg/L; 4-day average Se concentrations were calculated from daily autosampler data.

For Water Years 2002–2007, the 4-day average Se concentration at Crows Landing was above the 5 µg/L WQO during 3 percent of the recorded days (or 56 out of 1913 measured days, with 278 days not recorded). Concentrations were above the WQO during 2002–2004; however, concentrations were below the WQO after July 2004, indicating that the compliance time schedule for the 5 µg/L 4-day average WQO was met.

The compliance time schedule to meet the Se WQO at Crows Landing is described in Section 4.1.2.3.2. The performance goal for Water Year 2002 was not established. For Water Years 2003 and 2004 (Below Normal and Dry years), the performance goal was 8 µg/L monthly mean. For Water Year 2005 (a Wet year), the performance goal was 5 µg/L monthly mean. For Water Year 2006 (a Wet Year), the 5 µg/L 4-day average WQO applied directly. For Water Year 2007 (a Critical year), the performance goal was a 5 µg/L monthly mean.

Se concentrations at Crows Landing were below performance goals during Water Years 2002–2007 as seen by Figure 4-24. The 4-day average Se concentration at Crows Landing was below 8 µg/L (and thus the monthly mean was also below 8 µg/L) during Water Years 2002–2004, and the 4-day average concentration was below 5 µg/L during Water Years 2005–2007.

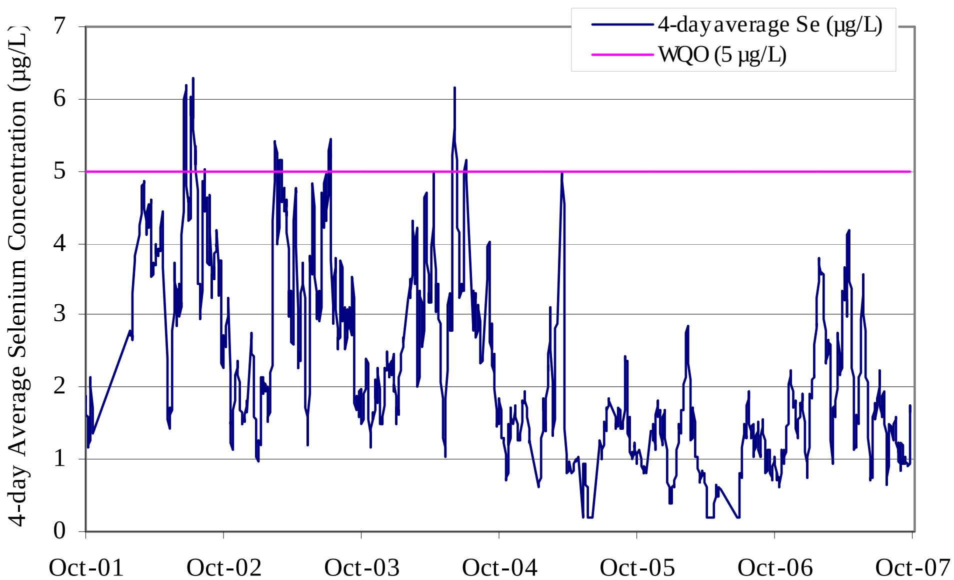


Figure 4-24 Selenium Concentration in San Joaquin River at Crows Landing (Station N) for Water Years 2002–2007

Measured Se water quality has improved in comparison to pre-Project conditions (Figure 4-25). Based on the comparison of the mass of Se discharged from the Drain and Se mass monitored at Crows Landing, the bulk of the Se found in the San Joaquin River at Crows Landing originates from the agricultural drainage discharged to Mud Slough (North).

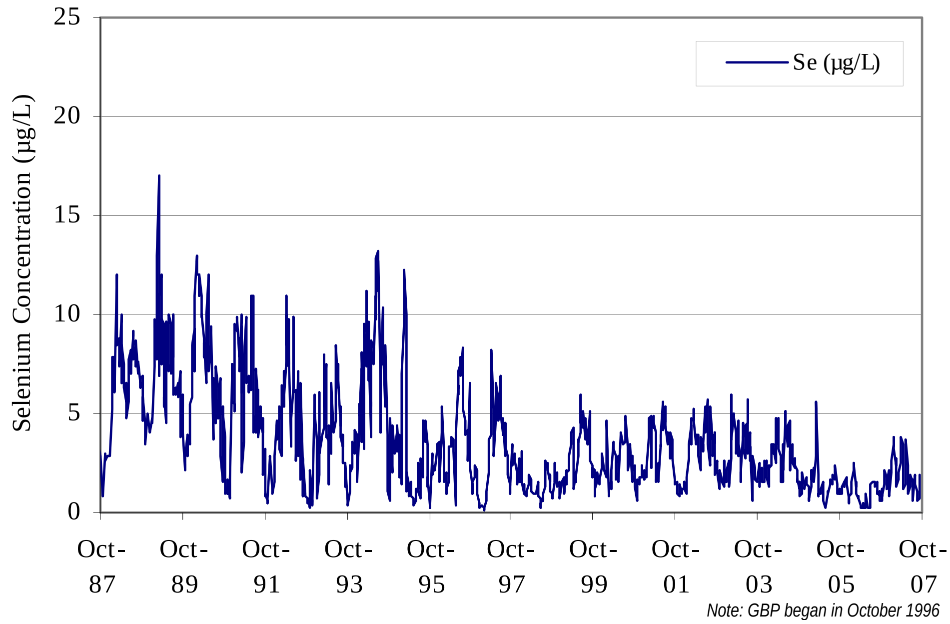


Figure 4-25 Pre-Project and Post-Project selenium concentration in San Joaquin River at Crows Landing (Station N)

Boron concentrations from grab samples ranged from less than 0.05 to 1.7 mg/L, with an average of 0.7 mg/L for Water Years 2002–2007. Autosampler data for boron ranged from 0.06 to 1.6 mg/L, with an average of 0.8 mg/L. Concentrations were below the instantaneous maximum WQOs. Monthly mean concentrations were calculated for October through February and April through August. Semimonthly concentrations were calculated for March and September, which correspond to the WQO averaging periods. Monthly mean concentrations for grab samples ranged from 0.08 to 1.45 mg/L (Figure 4-26). Thirty percent of the mean monthly or semimonthly concentrations were above the WQO (25 out of 82 periods). Concentrations were above the monthly mean WQO during 2002 to 2004; however, monthly mean concentrations were below the WQO after August 2004. Please note that Water Year 2007 was a Critical Year and, therefore, the WQO was 1.3 mg/L.

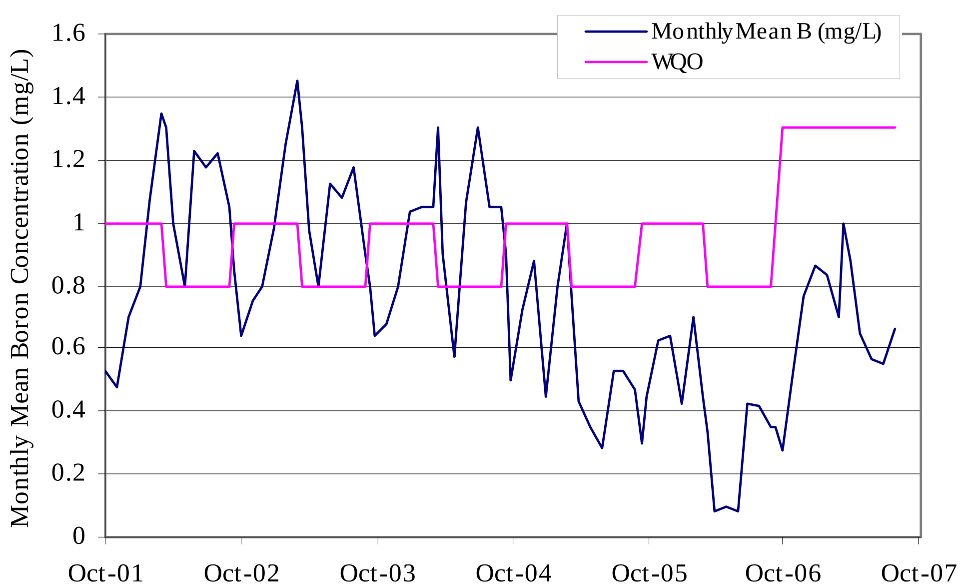


Figure 4-26 Boron Concentration in San Joaquin River at Crows Landing (Station N) for Water Years 2002–2007

EC ranged from 100 to 1,900 µmhos/cm (62 to 1,180 mg/L TDS), with an average of 1,060 µmhos/cm (660 mg/L TDS) for measurements taken in the field during Water Years 2002–2007 (Figure 4-27). EC ranged from 120 to 1970 µmhos/cm (77 to 1,220 mg/L TDS), with an average of 1,100 µmhos/cm (690 mg/L TDS) for autosampler data. The TDS/EC ratio of 0.62 was used to convert between EC and TDS at Station N.

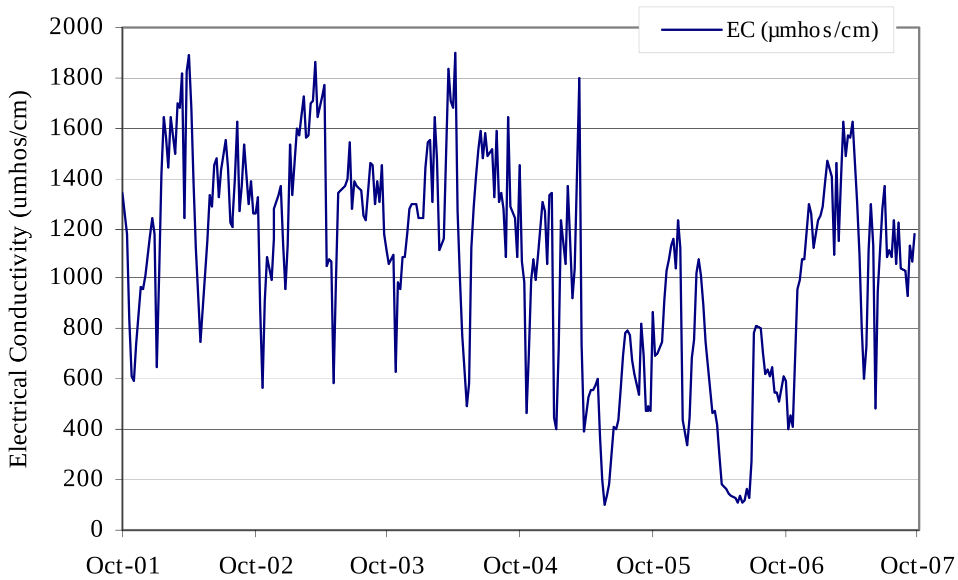


Figure 4-27 Electrical Conductivity in San Joaquin River at Crows Landing (Station N) for Water Years 2002–2007

4.1.5.9 San Joaquin River at Vernalis (River Mile <77)

Discharges from the GDA, together with all other inputs in the watershed, contribute to water quality at Vernalis. Water quality at Vernalis is of concern because this is the current compliance point for EC objectives. The State Board under CWA Section 303(d) has listed this site as an impaired waterbody for salt and dissolved oxygen.

4.1.5.9.1 Drainage Area

The major tributaries, including the Merced, Tuolumne, and Stanislaus rivers as well as west-side inputs, contribute to flows in this portion of the San Joaquin River.

4.1.5.9.2 Monitoring Station

One monitoring station is located at this section of the river:

- San Joaquin River at Airport Way, Vernalis (Regional Board Station SJC501, CDEC Station VER, CDEC Station VNS)

The Regional Board conducts weekly water quality monitoring at Vernalis. Reclamation operates the continuous water quality monitoring station at CDEC Station VER. The USGS and the DWR operate the flow monitoring CDEC Station VNS.

4.1.5.9.3 Flow

Flow in the San Joaquin River at Vernalis ranged from 60,209 to 1,675,000 acre-feet per month during Water Year 2002–2007 (Eacock 2008b, gbp summary data in rb layout_2.xls). Peak discharges generally occur in February to May with low flows occurring in the late summer. A summary of mean daily flows in the San Joaquin River near Vernalis for Water Years 2002–2007 is shown in Table 4-23. Flows at this site are large and range from approximately 1,000 cfs during the dry season to nearly 35,000 cfs during a peak event in April 2006.

Table 4-23 Daily Flow Summary – San Joaquin River near Vernalis (CDEC Station VNS)

Water Year	Average (cfs)	Median (cfs)	Minimum (cfs)	Maximum (cfs)
2002	1,934	1,875	1,002	5,984
2003	1,920	1,888	1,137	3,499
2004	1,880	1,609	9,50	4,375
2005	5,279	3,847	6,18	16,100
2006	10,323	6,666	1,860	34,767
2007	2,193	2,343	7,68	4,569

Source: CDEC 2008.

4.1.5.9.4 Water Quality

The CDEC Station VNS site is located just downstream of the inflow from the Stanislaus River;, thus, water quality is typical of surface flow and is likely to be the best of any of the river sites (Regional Board 2008). Constituents of concern in the San Joaquin River at Vernalis include salt (characterized as EC) and dissolved oxygen. Se and boron concentrations are typically below WQOs.

Elevated salinity concentrations have resulted in exceedances of WQOs for the San Joaquin River in previous years. The 700 µmhos/cm 30-day running average EC WQO for the San Joaquin River near Vernalis for the April to August period has been exceeded 54 percent of the time from 1986 through 1997. The l,000-µmhos/cm WQO for the September to March period has been exceeded 13 percent of the time (CALFED 2000).

For Water Years 2002–2007, EC ranged from 197 to 1,200 µmhos/cm, with an average of 610 µmhos/cm. This is equivalent to approximately 60 to 740 mg/L TDS, with an average of 380 mg/L TDS, when the EC-TDS ratio of 0.62 was used. EC was above the 30-day running average WQO during 11 percent of the datapoints, or 35 out of the 314 of the Regional Board weekly field measurements (Figure 4-28). 30-day average concentrations were above the WQO during 2002 to 2004 and during 2007.

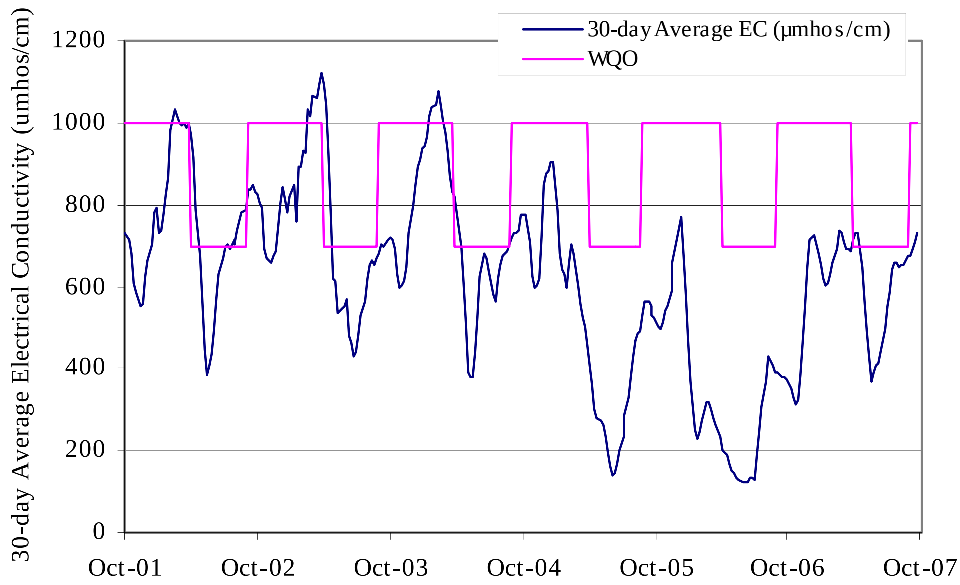


Figure 4-28 Electrical Conductivity in San Joaquin River at Vernalis for Water Years 2002–2007

Since Water Year 1995, Se concentrations have been less than 5 µg/L, and therefore, have not exceeded the 5 µg/L 4-day average WQO since then. In Water Years 2002–2007, Se concentrations have ranged from less than 0.4 to 2.8 µg/L, with an average of 0.9 µg/L (Figure 4-29).

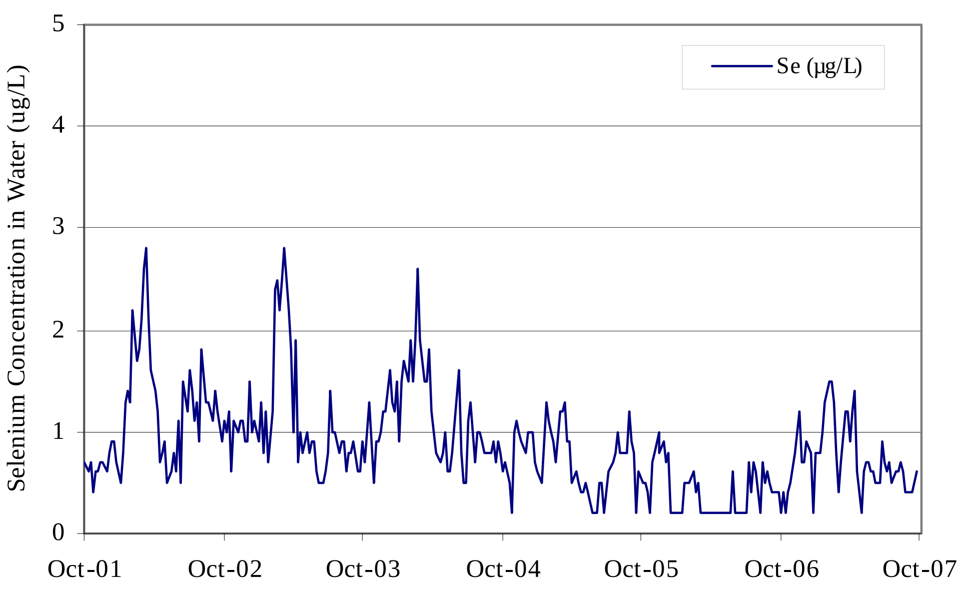


Figure 4-29 Selenium Concentrations in San Joaquin River at Vernalis for Water Years 2002–2007

Since Water Year 1995, boron concentrations have been lower than the 0.8 mg/L and 1.0 mg/L monthly mean WQOs. During Water Years 2002–2007, boron concentrations ranged from less than 0.05 to 0.9 µg/L, with an average concentration of 0.3 µg/L. Monthly mean concentrations were not above WQOs during this time period (Figure 4-30). Please note that Water Year 2007 was a Critical Year and, therefore, the WQO was 1.3 mg/L.

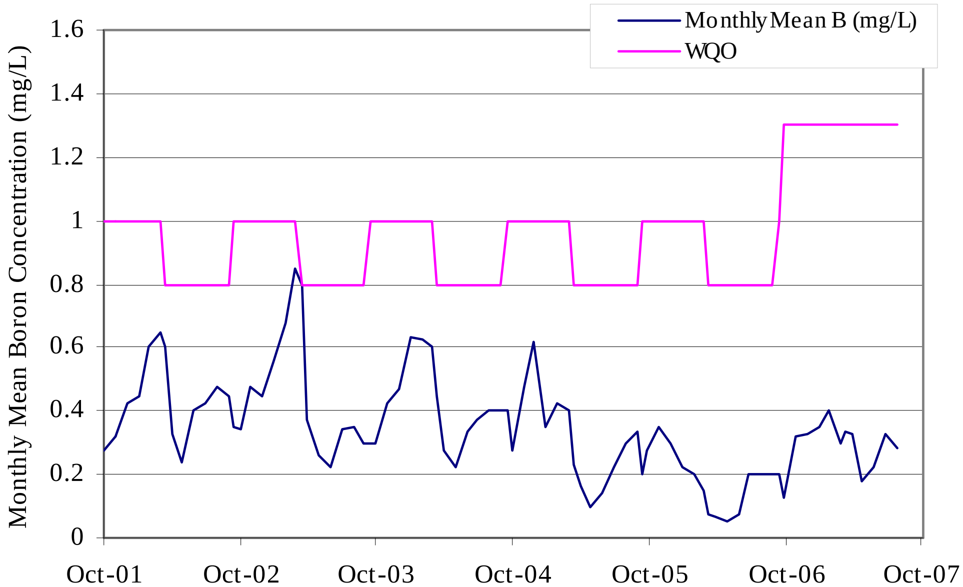


Figure 4-30 Boron Concentrations in San Joaquin River at Vernalis for Water Years 2002–2007

Low dissolved oxygen conditions have been measured in the San Joaquin River around the Stockton area. Dissolved oxygen concentrations as low as 0.34 mg/L have been quantified in Smith Canal, Mosher Slough, 5-Mile Slough, and the Calaveras River. They tend to occur during late summer and fall due to a combination of high water temperature, nutrients, algal blooms, and discharge (CALFED 1999). Low dissolved oxygen concentrations are of concern due to the potential hazard to fisheries. During Water Years 2002–2007, dissolved oxygen in the San Joaquin River at Vernalis ranged from 1.3 to 19.3 mg/L, with and average concentration of 11 mg/L.

In addition, high levels of organic carbon in the Delta are of concern to drinking water suppliers because they can act as precursors to disinfection byproducts, a potential public health hazard associated with drinking water.

4.1.6 Sediment Accumulation in the San Luis Drain

The 2001 Use Agreement between the Authority and Reclamation for use of the San Luis Drain stipulates that the Authority is responsible for sediments that accumulate in the Drain due to its use of the Drain, an this provision will continue under the proposed 2010 Use Agreement. Since the sediments contain high concentrations of Se, the long-term accumulation of sediment in the Drain may pose a disposal problem. Also, because of the high Se concentrations in the sediment, velocity in the Drain is limited to 1 foot per second, corresponding to a flow of 150 cfs, to prevent the mobilization of the deposited sediment and discharge to Mud Slough.

The Compliance Monitoring Program (Reclamation et al. 1996) for the Grassland Bypass Project specifies annual monitoring of the accumulation of sediment in the Drain. Between March 1987 and June 1997 very little sediment appeared to accumulate in the Drain. Measurements of sediment volume in the Drain showed an increase in sediment from 58,094 to 60,594 cubic yards, an increase of about 5 percent and well within the measurement error of sediment volume.

The sediment volume measurements taken in July 1998 showed a significant increase in sediment accumulated in the Drain. The estimated volume of sediment in the Drain increased by 21,812 yards, from 60,594 to 82,406 cubic yards, an increase of about 35 percent. This increase was primarily due to the large storm events that occurred during Spring 1998. Since 1998, an estimated 222,000 cubic yards of sediment has accumulated in the Drain, the majority of it located in the upstream portion near Site B. Most recently, between October 2006 and 2007, the volume of sediment in the Drain increased by 3,017 cubic yards (McGahan 2008b). The data indicate that high flows into the Drain during storm events (generally corresponding to high runoff periods) contain high concentrations of suspended solids. Sediment accumulation and flow are discussed in Appendix B, Draft Sediment Management Plan for the San Luis Drain.

Sediment depth survey data for July 1999 showed an increase of 6,200 cubic yards from July 1998. Less overall accumulation as compared to the previous water year may be attributed to the relatively normal rainfall amounts in 1999, which unlike Water Year 1998 had no stormwater conveyed through the Drain. More recent sediment depth survey data conducted in 2006 indicate that the average depth of sediments in the Drain is approximately 3 feet with a maximum sediment depth of 7.96 feet.

Total suspended solids are measured at both the inflow to the Drain at Site A and near the exit from the Drain at Site B on a weekly basis. Except for a few isolated samples, the concentrations at Site B are much less than the concentrations at Site A, indicating that sediments are depositing in the Drain.

4.2 ENVIRONMENTAL CONSEQUENCES

4.2.1 Key Impact and Evaluation Criteria

The impacts to surface water resources are focused on water quality and are primarily based on changes in the Se, salt, and boron concentrations in the San Joaquin River, Mud and Salt Sloughs, and the wetland channels. The degree of water quality impact is based on the concentration in the receiving water relative to the WQOs and Implementation Program contained in the Basin Plan for the San Joaquin River Basin (Regional Board 1998). An impact would be considered adverse and significant if it resulted in an increase in the frequency of exceedances in the WQOs over what was measured under existing conditions (Water Years 2002–2007). An impact would be considered beneficial if it resulted in a decrease in the frequency of exceedances in the WQOs. The Action Alternatives were assumed to have no significant impact on water supply, as recycling on farm or at the SJRIP facility does not affect water supply contracts.

A consequence of reducing the Se load discharged from the GDA is the corresponding reduction in the salt load discharged from the area. Salt loads from the GDA and TDS concentrations in Mud Slough, the San Joaquin River at Crows Landing, and the San Joaquin River at Vernalis were compared to existing conditions to determine the significance of this reduction.

The SJRIP has been operating since 2001 to dispose of drainwater generated in the GDA. Existing operations have included activities associated with Phases I and II of this In-Valley Treatment/Drainage Reuse Facility. The impact evaluation criteria for these and subsequent phases of the Project are based on the likelihood of ponding or surface runoff from the land due to irrigation with drainwater. An impact would be considered significant if the application of the drainwater would cause water to either pond on the surface or run off the land into a surface drainage system.

The primary concern with sediment accumulation is that sediment will restrict the capacity of the Drain to carry the maximum allowed flow (150 cfs). The other concern is a significant increase in Se concentration of the sediment. Therefore, the impact evaluation criterion is that the capacity of the Drain should not be reduced below 150 cfs through sediment accumulation.

4.2.2 Environmental Impacts and Mitigation

4.2.2.1 Methods Used to Evaluate Impacts

Water balance models were developed for the GDA (drainage model) and receiving waters above Crows Landing (for Se and boron) and Vernalis (for TDS) (receiving water model). The drainage model was used to calculate the volume and concentration of Se, salt, and boron in drainwater from the agricultural fields. The receiving water model was used to predict the Se, salt, and boron concentrations in the San Joaquin River and Mud Slough. Details of the models are provided in Appendix C. A brief description is provided below.

The drainage model was district-based and ran on a monthly time step. Inputs to the model included a physical description of the drainage area such as size, crops, fraction of district with drains, and depth to drains. Monthly data included rainfall, reference evapotranspiration, water deliveries, depth to the water table, and amount of recycling. Depth to the water table was an important parameter in the analysis. It was estimated using a drain flow model as the average of annual groundwater depths over the period from 2000 to 2007 that resulted in modeled drain flows most closely matching observed annual drain flows in the GDA. Output from the drainage model included the volume of drainwater generated by each district for each month.

The receiving water model was used to predict the Se, salt, and boron volume and concentrations in the San Joaquin River and Mud Slough. The output from the drainage model was used as input to the receiving water model (i.e., the discharge from the San Luis Drain). The model output was verified using measured data between 1997 and 2007. Results of the receiving water model verification generally indicated good overall agreement between modeled and measured data with median differences less than 20 percent. Details of the model development and verification are provided in Appendix C.

Insufficient data were available to model molybdenum directly. Instead, a linear relationship between TDS and molybdenum was established for Mud Slough (North) downstream of the discharge (Station D) and for the San Joaquin River at Crows Landing (Station N) using monitoring results from Water Years 1998–2000. The results of the regression were used with the modeled receiving water TDS results to predict when molybdenum concentrations would exceed WQOs. Based on the regressions, TDS concentrations greater than 2,500 mg/L would result in molybdenum concentrations greater than 19 µg/L at Stations D and C. TDS concentrations greater than 1,300 mg/L are predicted to result in molybdenum concentrations greater than 10 µg/L at Station N (McGahan, pers. comm., 2000b).

The Se WQO at Crows Landing and Vernalis is expressed as a 4-day average concentration. (The performance goal for Se during January to September 2010 for Below Normal, Dry, and Critical years is a monthly average of 5 µg/L.). To relate the concentration output from the model (monthly averages) to a 4-day average concentration, daily monitoring data from Crows Landing were used to calculate monthly and 4-day average concentrations to determine what monthly average concentration resulted in exceedance of the 5 µg/L 4-day average. Figure 4-31 presents the relationship. The data indicated that exceedances of the 5 µg/L 4-day average only occurred when the monthly average concentration was greater than 4 µg/L. Therefore, for the purpose of establishing when the Se WQO is likely to be exceeded, a monthly average concentration of 4.0 µg/L Se is used as a benchmark.

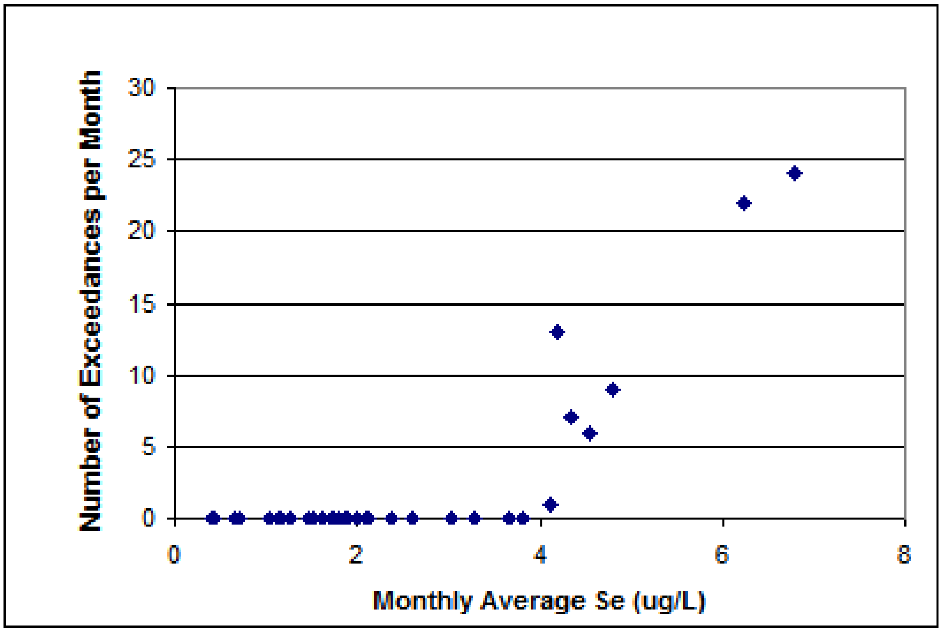


Figure 4-31 Relationship between Monthly Average Selenium at Crows Landing and Exceedance of 4-day Average Water Quality Criteria

4.2.2.2 Proposed and Alternative Waste Load Allocations

The Se waste load allocations in the 1998 WDR Order provide guidance as to limits that might apply for the Project to continue beyond September 2001. Provision 23 of the Order explains the basis for the TMMLs and states:

> *"…This TMML will serve as part of the technical basis for settling limits on discharges of selenium to the river after the Project unless an alternative approach is developed to achieve compliance with the performance goals and water quality objectives."*

The 2010 Use Agreement Se load limits (proposed values) were developed to require continuing Se load reductions and additional methods of drainage management to meet very low levels of Se load discharge. Load limits for each year of the 10-year term are described below.

- Year 1 (January to September 2010): Monthly load values equal to an average of the 2009 monthly load values and TMML monthly load values for each water year type.

- Years 2–5 (October 2010 to December 2014): Load values equal to TMML load values.
- Years 6–8 (January 2015 to December 2017): Load values on a glide path to 2018/2019 loads.
- Years 9–10 (January 2018 to December 2019): Annual loads approximately equivalent to the highest monthly load value for each water year type (Critical-150 pounds, Below Normal/Dry-300 pounds, Above Normal-450 pounds, and Wet-600 pounds). Monthly loads equal to monthly TMML loads.

The proposed values require greater reductions in later years (consistent with the phasing of the SJRIP).

In addition to the proposed values, alternative load values were developed for the 2001 Requirements Alternative (alternative values). The 2001 Requirements Alternative is similar to the Proposed Action except the Se and salt loads discharged to Mud Slough would be limited to load values in the 2001 Use Agreement. The alternative values are the same as the proposed values for Years 1 to 5 and the TMML load values are maintained for Years 6 to 10. Table 4-24 presents the annual load values for the two different scenarios. Monthly load values are presented in Attachment C-3.

Table 4-24 Annual Selenium Load Limits Considered

Load Value Source	Proposed	Alternative	Proposed	Alternative	Proposed	Alternative	Proposed	Alternative
Water Year Types	W	W	AN	AN	BN/D	BN/D	C	C
Water Year	Annual Load Values (pounds/year)							
2010	4480	4480	4162	4162	2864	2864	1658	1658
2011–2014	4480	4480	4162	4162	2496	2496	1075	1075
2015	3510	4480	3234	4162	1947	2496	844	1075
2016	2540	4480	2306	4162	1398	2496	613	1075
2017	1570	4480	1378	4162	849	2496	381	1075
2018–2019	600	4480	450	4162	300	2496	150	1075

Source: Appendix C

4.2.2.3 No Use Agreement (No Action)

Under the No Action Alternative discharge of drainwater to the San Luis Drain would be discontinued. However, because of the extensive drainage collection system already in place, drainwater would continue to be produced.

In analyzing the impacts of the No Action Alternative, the following assumptions were made:

- Drainwater from sumps would continue to be produced at the same rate as at present.
- For modeling purposes, 100 percent of drainwater from sumps would be recycled either on farm or within the district areas, including the existing lands developed for the SJRIP reuse area, and not discharged beyond the GDA. Outside the district areas this drainwater would not be recycled.
- Seepage from GDA district areas upstream of the SJRIP and discharge from the existing areas of the SJRIP containing tile drains would be captured and applied to the SJRIP reuse area.

- The drains would be closed at the edge of the GDA to prevent drainwater from exiting from the GDA through any conveyance system. Therefore, the only outflows from the GDA would be indirectly through groundwater seepage (except for large flood events).
- Seepage from both GDA and non-GDA lands into the feeder channels to the Grassland Bypass Channel would continue as at present. This seepage consists of drainwater from nondistrict lands (within the GDA), surface water runoff (both stormwater and nonstormwater), and groundwater seepage.

Seepage from both GDA and non-GDA lands into the feeder channels to the Grassland Bypass Channel is estimated to be about 5,800 acre-feet per year as shown in Table 4-25. This is the volume of water measured near the terminus of the San Luis Drain at Station B that is not accounted for by the discharge measured at the stations located farthest downstream in the GDA (at PE14 and FC5). Since the drainage channels have a positive slope towards the San Joaquin River, the seepage would continue to flow downgradient. This may cause the channels to overflow in the low-lying portions of the GDA unless removed. Seepage would not be removed from the San Luis Drain.

The Grassland Bypass Project annual reports provide a mass balance between Stations A and B (SFEI 2007). The average annual net change in flow between Stations A and B for Water Years 2002–2007 is approximately 2,360 acre-feet (Eacock 2008c), which accounts for about 40 percent of the estimated seepage between PE14 and FC5 and Station B.

Table 4-25 presents the drainage model inputs and results for the No Action Alternative.

Table 4-25 Drainage Model Inputs and Results (Annual Totals of Drainage Model Components [acre-feet])

	No Action
Drainage from GDA Sumps	26,400
Drainage Recycled by GDA Districts	13,800
Reuse of GDA Sump Drainage at the SJRIP Reuse Area	12,600
Drainage Discharge from Reuse Area Sumps	1,700
Seepage from within the GDA	4,700
Total Drainage Applied to Reuse Area	19,000
Uncontrolled Flow from outside of the GDA	5,800
Flow to Reach Station B	5,800[1]

Notes:

Flow is not recycled in Camp 13 Drainage District.

Seepage is water entering GDA drains that is not measured as discharge leaving the GDA districts but is measured at the stations located farthest downstream in the GDA (at PE14 and FC5).

Uncontrolled flow is seepage that either enters the Grassland Bypass Channel or the San Luis Drain upstream of Station B and downstream of the SJRIP Reuse Area.

[1]Flow from outside the GDA

The discussion of the impacts for the No Action Alternative is provided by area: within the GDA, other agricultural areas outside of the GDA, wetlands, Mud Slough (North), and San Joaquin River (Mud Slough to Merced River).

4.2.2.3.1 Impacts to the Grassland Drainage Area

Excess drainwater from sumps would be recycled as part of the drainage management program. This would be used to replace an equivalent amount of irrigation deliveries and, therefore, would not increase the total volume of applied water.

Areas within the GDA that do not belong to a district are drained by deep drainage canals that presently discharge to the Grassland Bypass Channel. With the Grassland Bypass Channel blocked (for example at the Main Canal), these lands would no longer have a drainage outlet. Some lands within this area may experience waterlogged soils and loss of productivity. Seepage would continue into canals and flow towards the Grassland Bypass Channel. The canals may overflow and ponding may occur. The ponding could persist for extended periods of time especially during the winter and spring when the water table is high and evaporation is low. The ponds would constitute a nuisance to the farmers and may attract wildlife. A discussion of the impacts to wildlife of these ponds is provided in Section 6.2.2.1.4. The Se concentration in these ponds would equal or exceed the concentration in groundwater (due to evapoconcentration effects). If it is assumed that the Se concentration in groundwater equals the concentration in the sump flows from the two most downgradient districts near the nondistrict lands, Charleston Drainage District and Pacheco Water District, the Se concentration in the ponds would vary from about 81 to over 150 μg/L (see Table C-13 in Appendix C for details).

Prior to the Grassland Bypass Project, stormwater from rainfall within the GDA and surrounding areas was discharged into the wetland channels. Under the No Action Alternative, stormwater runoff could pond within the lower portions of the GDA. Some of this water would infiltrate to groundwater and some water may remain ponded for an extended period of time.

4.2.2.3.2 Other Agricultural Areas Outside of the Grassland Drainage Area

Some of the seepage in the Grassland Bypass Channel comes from agricultural areas outside of the GDA. These areas are primarily located to the north of the GDA adjacent to the Grassland Bypass Channel. If the Grassland Bypass Channel is blocked, drainage from these areas would no longer be captured by the Grassland Bypass Project. This drainage may discharge into existing drains, which may ultimately end up in the GWD and wetland water supply channels. For example, drainage from the Poso Drain Area, which is located north of the GDA, could enter Poso Drain and flow to the GWD (Regional Board 2000b).

If drainage from agricultural areas outside of the GDA continued to enter the Grassland Bypass Channel, the channel may overflow at its low points. The water that overflows could pond and/or flow into existing drains or swales that flow towards the Grassland wetlands. Ponded water could also spill onto private property and become a nuisance to local farmers. The ponds could also attract wildlife; the effects on wildlife are discussed in Section 6.2.2.1.4.

4.2.2.3.3 Wetlands

If the discharges to the Grassland Bypass Channel from areas outside of the GDA are blocked, water from surface flow or seepage may enter other existing drainage channels. Some of these drains may flow towards the Grassland wetlands. When discharges mix with water in the wetlands (or wetland channels), the result may raise the Se concentration. Since the Se concentration in the wetland canals presently is often near or at the WQO of 2.0 ppb, the addition of the seepage could raise the concentration above the WQO.

Concentrations in Salt Slough would not change compared to existing conditions because Salt Slough is not directly connected to the GDA and is too far away to be immediately affected by changes in sump flows or recycling rates.

4.2.2.3.4 Mud Slough (North) Downstream of Current San Luis Drain Discharge

Under the No Action Alternative, water quality and flow in Mud Slough (North) downstream of the current discharge point would be similar to water quality and flow in Mud Slough (North) upstream of the current discharge point. Therefore, water quality is predicted to improve dramatically as compared to existing conditions for Se, TDS, molybdenum, and boron due to the removal of agricultural drainage from this section of Mud Slough. Se and boron WQOs would be achieved in this section of Mud Slough by the established compliance schedule under the No Action Alternative. This alternative would have a significant and positive impact on this reach of Mud Slough as compared to existing conditions. As discussed in Section 5.2.3.1.1, model results indicate little change in subsurface flow leaving the GDA assuming the recycled drainwater is added to the existing delivered water. Mud Slough (south of Site D) is about 29 miles from the GDA. This distance was considered too far from the GDA for Mud Slough to be impacted by changes in sump flows or recycling rates.

4.2.2.3.5 San Joaquin River (Mud Slough to Merced)

Water quality in the San Joaquin River downstream of Mud Slough is predicted to improve as compared to the existing conditions for Se, TDS, molybdenum, and boron due to the removal of agricultural drainage from this section of the San Joaquin River. Se and boron WQOs are both achieved in this section of the San Joaquin River under the No Action Alternative. This alternative would have a significant and positive impact on this reach of the San Joaquin River as compared to the existing conditions.

4.2.2.3.6 San Joaquin River Water Quality Improvement Project

The regional SJRIP reuse area is assumed to have the same cropped acreage (4,800 acres) and tiled area (1,700 acres) as model assumptions for year 2010. The total annual drainage applied to the reuse area is estimated to be 19,000 acre-feet (Table 4-25). This includes recycled drainage from the reuse area. The total applied water would have an annual average of approximately 4 acre-feet per cropped acre, which would not significantly exceed maximum crop water requirements. The maximum allowable applied drainage to the SJRIP reuse area is 4.5 acre-feet per acre (see Table C-3 of Appendix C). Although, crop water requirements and drainage from GDA sumps may not have the same monthly timing, additional drainwater could be applied to fallow areas to infiltrate to groundwater, if needed; however, this could cause ponding.

Over an extended period of time, the reuse capacity of the SJRIP reuse area may be diminished due to salt accumulation within the crop root zone to the point where the production of salt-tolerant crops declines. If the reuse capacity is diminished, fields in the lower portion of the region could become waterlogged and unfarmable and may be abandoned. Water table rise may occur at the lower elevations. If the reuse facility becomes inoperative, individual districts and farmers would have to recycle drainwater "on farm and within districts."

4.2.2.4 Grassland Bypass Project, 2010–2019 (Proposed Action)

The Proposed Action is the continuation of the Grassland Bypass Project for the period of 2010 to 2019 under the terms and conditions of the proposed 2010 Use Agreement for the San Luis Drain. The Grassland Bypass Project would continue to operate as it does now; however, the proposed Se load values described in Section 4.2.2.2 would be implemented. The GAF would meet the proposed values for Se through a combination of management methods including recycling, reuse, in-valley treatment, and other management actions.

In the model analyses it was assumed that monthly loads would be met either by recycling, reuse, and/or treatment. Key assumptions in drainwater management under this alternative included:

- **Recirculation of drainwater collected in sumps.** For each Water Year type, the percentage of drainwater recycled was adjusted each month to meet the monthly load, subject to an applied water TDS concentration limit of 600 mg/L. The recirculated water was assumed to replace the irrigation deliveries for that particular month. If recycling was insufficient to meet the monthly load, then the SJRIP reuse area would be utilized.
- **Reuse and treatment of drainwater from sumps**. The SJRIP reuse area would be used to apply excess drainwater from GDA sumps to salt-tolerant crops. Discharge from the reuse area would be blended with drainage from the rest of the GDA until a treatment facility was developed (assumed to occur in 2015). It was assumed that the treatment facility would have sufficient capacity to treat all of the discharge from the reuse area.

4.2.2.4.1 Grassland Drainage Area

Impacts to water resources in the GDA include impacts to water quality in surface water drains and to ponded water in low-lying areas. Water quality in surface drains and supply canals would be worse than existing conditions for constituents of concern (Se, boron, and salt) until treatment is available (assumed to occur in year 2015) due to the increased recycling and reuse needed to meet the lower load limits. Water quality in the GDA should be similar or better than existing conditions after treatment is available. Water quality in surface drains and supply canals would be better than under the No Action Alternative for constituents of concern (Se, boron, and salt) due to less recycling in the Proposed Action, an outlet for contaminant loads, and treatment that is assumed to be available by 2015.

4.2.2.4.2 Mud Slough Upstream of San Luis Drain Discharge, Salt Slough, Wetland Channel, and San Joaquin River Upstream of Mud Slough

These areas of the river are all upstream of the discharge point and water quality would not change due to the Project relative to existing conditions, a less-than-significant impact.

Under flood conditions, runoff from the Panoche/Silver Creek watershed could result in emergency releases of floodwaters to wetland supply channels at Camp 13 Ditch and Agatha Canal if drainage from the GDA exceeded the maximum capacity of the Grassland Bypass

Channel of 150 cfs. During periods of heavy rain, bypass of the Grassland Bypass Channel was necessary to protect the structural stability of the Bypass Channel, to prevent resuspension of sediment in the Drain, and to prevent introduction of a large sediment load into the Drain. Releases of commingled stormwater and drainwater to the wetland supply channels are predicted to occur at similar frequency under the proposed Grassland Bypass Project as compared to existing conditions. Therefore, these impacts from the Project are less than significant as compared to existing conditions.

The current Storm Event Plan for operating the Grassland Bypass Project outlines a series of required actions when such discharges are anticipated. These actions include notification of regulatory agencies, and users of the canals and ditch including wildlife area managers, GWD, and other irrigation districts. Flow and water quality discharged into the supply channels is also measured and reported. In addition to notification and monitoring, the GAF modify operation of the drainage system, including turning off sumps, as much as is possible to minimize the contribution of drainage to the storm event flows. These actions would continue under the 2010 Use Agreement.

Storm event discharges to wetlands and upstream areas under the Proposed Action are predicted to occur at lower frequency as compared to the No Action Alternative due to the ability of the Drain to convey many of the small- and medium-sized event flows around these areas.

4.2.2.4.3 San Luis Drain

Predicted water quality at Station B from 2010 to 2019 for the different water year types are shown in Tables C-33 to C-44 of Appendix C. Water quality in the Drain is predicted to remain similar to existing conditions (a less-than-significant impact). Assuming that the water quality of seepage is similar to drainage discharge, water quality in the Drain for the Proposed Action may be similar to the No Action Alternative; however, the No Action Alternative would result in a stagnant pool of water in the Drain.

4.2.2.4.4 Mud Slough (North) Downstream of San Luis Drain Discharge

Water quality in Mud Slough (North) downstream of the discharge is predicted to improve over the course of the 10-year project relative to existing conditions (a beneficial impact) due to the decreases in the load of Se, salt, molybdenum, and boron necessary to comply with the discharge limits. Water quality is poorer at this site as compared to the No Action Alternative due to the impact of poor quality drainwater discharges and the No Action assumption of no discharge to Mud Slough, although any seepage or poor quality water reaching the wetlands would ultimately be conveyed into Mud Slough.

Boron, molybdenum, and TDS concentrations are predicted to decrease slightly for most water years as a result of the Project. Molybdenum concentrations are predicted to frequently be higher than the 19 µg/L WQO from 2010 through 2014. Starting in 2015, molybdenum concentrations are only predicted to be higher than the 19 µg/L WQO for some months during Critical water years. The frequency of these excursions above the WQO is predicted to decrease as compared to existing conditions, a beneficial impact.

There are no WQOs for boron or TDS for Mud Slough.

The 4-day average Se WQO for Mud Slough is subject to a schedule that requires compliance by October 1, 2010. Predicted Se concentrations at Station D (Tables C-33 to C-36 of Appendix C for the four water year types) do not meet this compliance schedule. Se concentrations are predicted to be higher than the benchmark concentration (see Section 4.2.2.1) during the first year of Project implementation for all water year types, with concentrations decreasing after treatment becomes available. For Wet and Above Normal Years, the number of months above the benchmark value remains fairly constant (11 or 12 months per year). For Below Normal/Dry years the number of months above the benchmark value is reduced by half by 2019. For Critical Years, the number of months above the benchmark value is reduced by two-third during 2018 and 2019. Concentrations are predicted to be lowest for Critical years as compared to the other water year types.

Because the Proposed Action would continue to discharge Se to Mud Slough after 2010, mitigation incorporated into the proposed 2010 Use Agreement for this impact to Mud Slough is for the GAF to provide additional wetland habitat. The concept is to expand permanent wetlands in the vicinity of Mud Slough to provide benefits to species such as waterfowl, shorebirds, and terrestrial wildlife, including special status species such as the giant garter snake, San Joaquin Valley kit fox, and tricolored blackbirds. This habitat would be located on Service lands and California Department of Fish and Game lands.

Concentrations of Se, boron, molybdenum, and TDS would increase compared to the No Action Alternative due to the No Action assumption of no discharge.

4.2.2.4.5 San Joaquin River (Mud Slough to Merced River)

Water quality in the San Joaquin River upstream of the confluence with the Merced River is predicted to improve over the course of the 10-year Project relative to existing conditions (a beneficial impact) due to the decreases in the load of Se, salt, molybdenum, and boron necessary to comply with the discharge load limits. Water quality is predicted be poorer at this site as compared to the No Action Alternative due to the impact of poor quality drainwater discharges as opposed to the No Action assumption of no discharge.

No specific WQOs are designated for boron or TDS for this reach of the river.

The 4-day average Se WQO for San Joaquin River upstream of Merced River is subject to a schedule that requires compliance by October 1, 2010. Se concentrations may not meet this compliance schedule; however, Se concentrations are expected to decrease over the course of the Proposed Action due to decreases in the Se load allocation for the Drain.

Concentrations of Se, boron, molybdenum, and TDS would increase compared to the No Action Alternative.

4.2.2.4.6 San Joaquin River (Merced River to Crows Landing or Vernalis)

Water quality in the San Joaquin River from the confluence with the Merced River to Crows Landing is predicted to improve over the course of the 10-year Project relative to existing conditions (a beneficial impact) due to the decreases in the load of Se, salts, and boron necessary to comply with the discharge limits. Water quality is predicted to be poorer at this site as compared to the No Action Alternative due to the impact of poor quality drainwater discharges as opposed to the No Action assumption of no discharge.

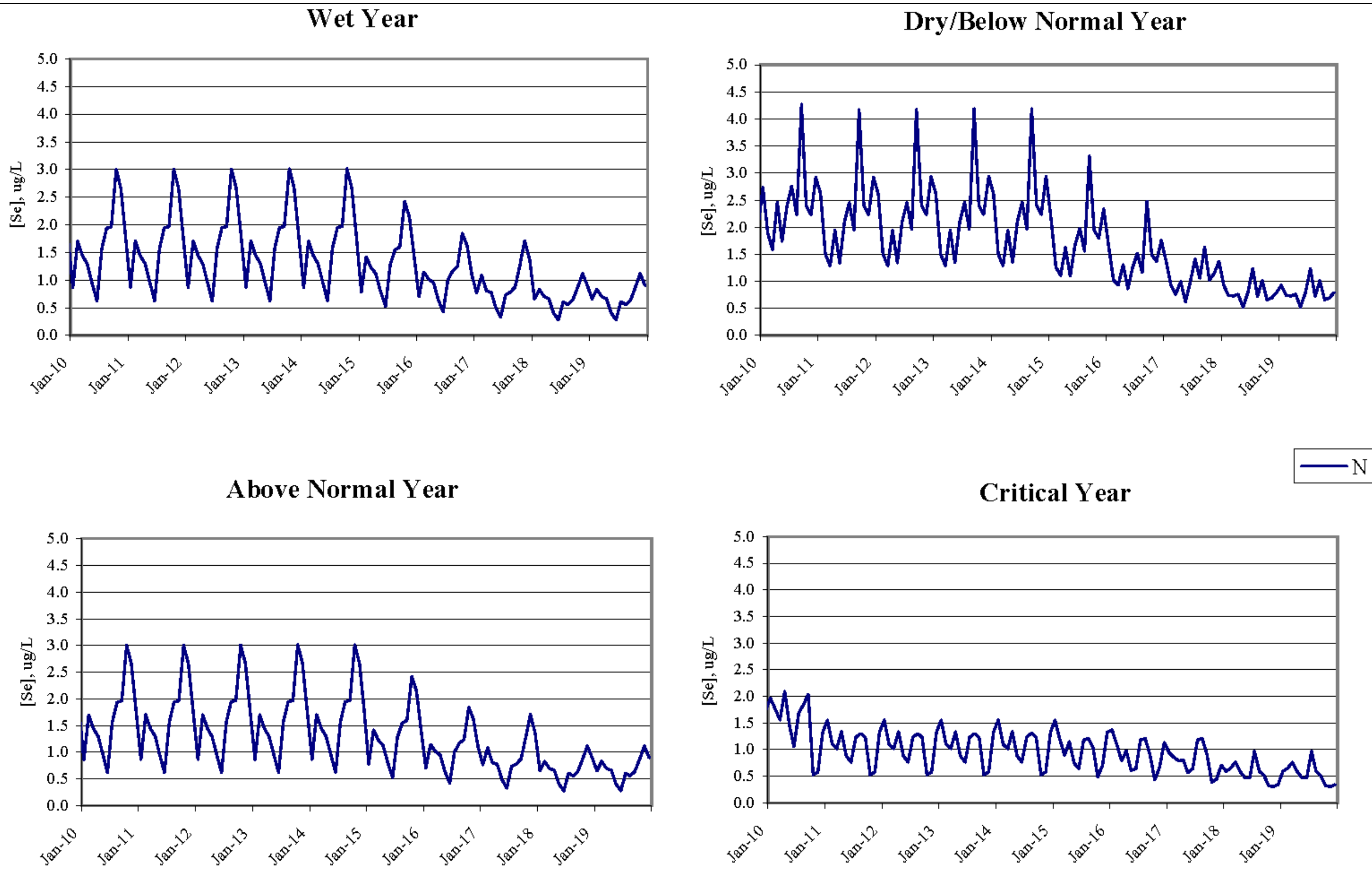
Figure 4-32, Figure 4-33, and Figure 4-34 show the predicted Se, TDS, and boron concentrations for Station N over the course of the Proposed Action for the four water year types (Wet, Above Normal, Below Normal/Dry, and Critical). Se concentrations are predicted to be higher than the 4.0 µg/L monthly mean benchmark concentration during the month of September in 2010 to 2014 for Below Normal and Dry years. Se concentrations decrease as the lower load values are implemented, and by 2015 concentrations are predicted to be below benchmark values in all months for all year types.

Trends in boron and TDS concentrations are similar to trends for Se. Boron concentrations are predicted to meet the monthly mean WQOs for all years and water year types. No specific WQOs are designated for TDS for this reach of the river. EC WQOs for the San Joaquin River at Vernalis can be converted into a TDS objective equivalent. When the beneficial effects of dilution from downstream tributaries that discharge to the San Joaquin River between Crows Landing and Vernalis are included in the analysis, predicted TDS concentrations were below this objective.

Molybdenum concentrations are predicted to decrease at Crows Landing compared to existing conditions, a beneficial impact. WQOs for molybdenum are predicted to be achieved during all water year types throughout the Project. Molybdenum concentrations are predicted to increase compared to the No Action Alternative, but concentrations would not increase above the WQO.

From 2002 to 2007, the drainage at the terminus of the San Luis Drain (Station B) accounted for between 0.8 and 5.3 percent of the total flow of the San Joaquin River at Crows Landing (Station N), and between 0.4 and 2.0 percent of the total flow at Vernalis. For modeled Project scenarios in 2019, depending on the water year type, the drainage at Station B would make up between approximately 0.6 to 1.4 percent of the total flow at Station N, and between approximately 0.3 and 0.6 percent of the total flow at Vernalis.

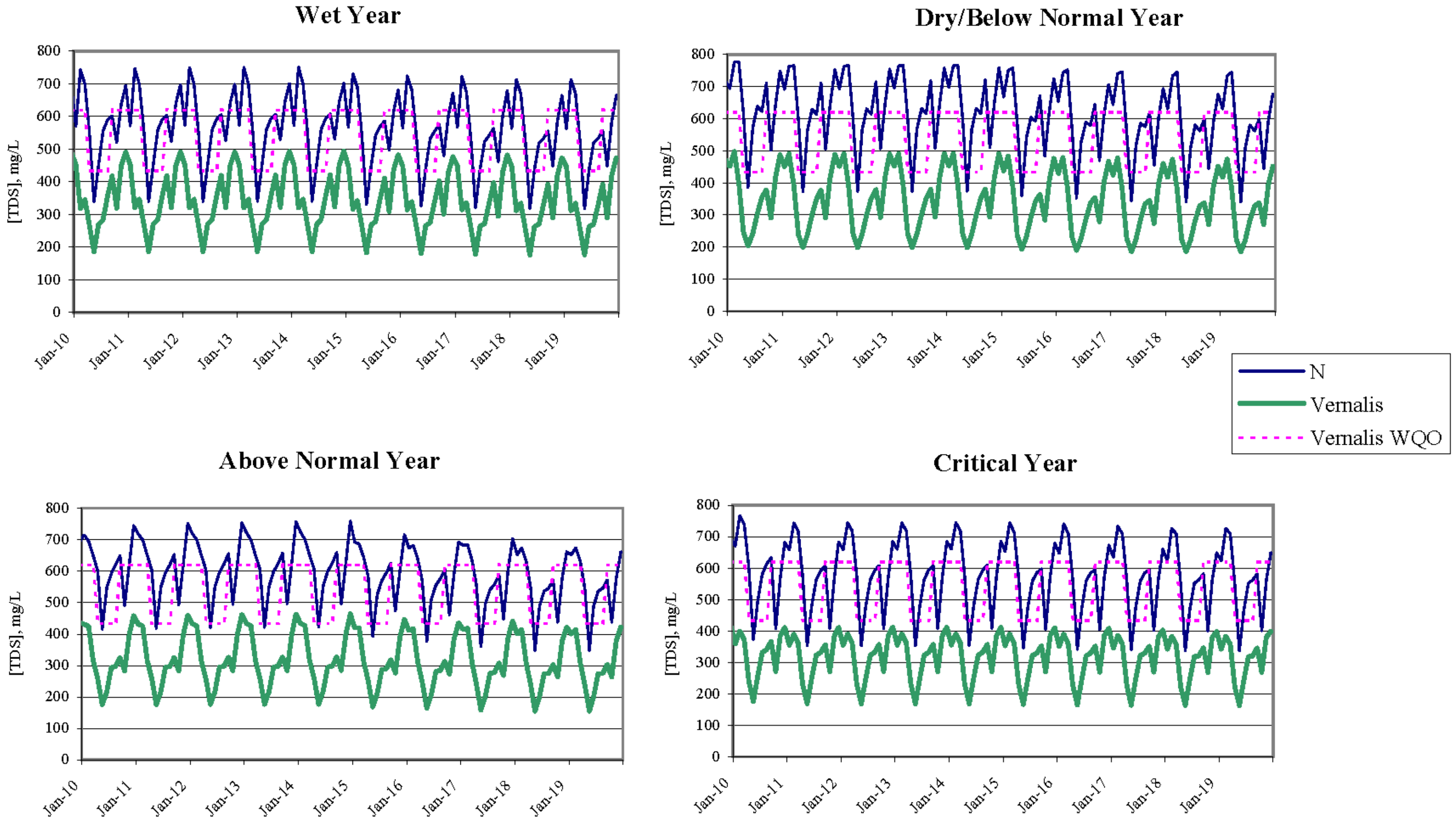
Annual modeled discharge volume for the San Luis Drain is presented in Table 4-26. Reduction in San Joaquin River flow upstream of Vernalis that would require increases in New Melones releases to meet the Vernalis flow objective would be a significant adverse impact in comparison to existing conditions.



Station N is located on the San Joaquin River at Crows Landing.

Note: The Water Quality Objective for selenium in the San Joaquin River downstream of the Merced River is a 4-day average concentration of 5 ppb (ug/L). It was estimated that if the monthly average concentration exceeded a benchmark of 4 ug/L, it was likely that the 4-day average WQO of 5 ug/L would be exceeded.

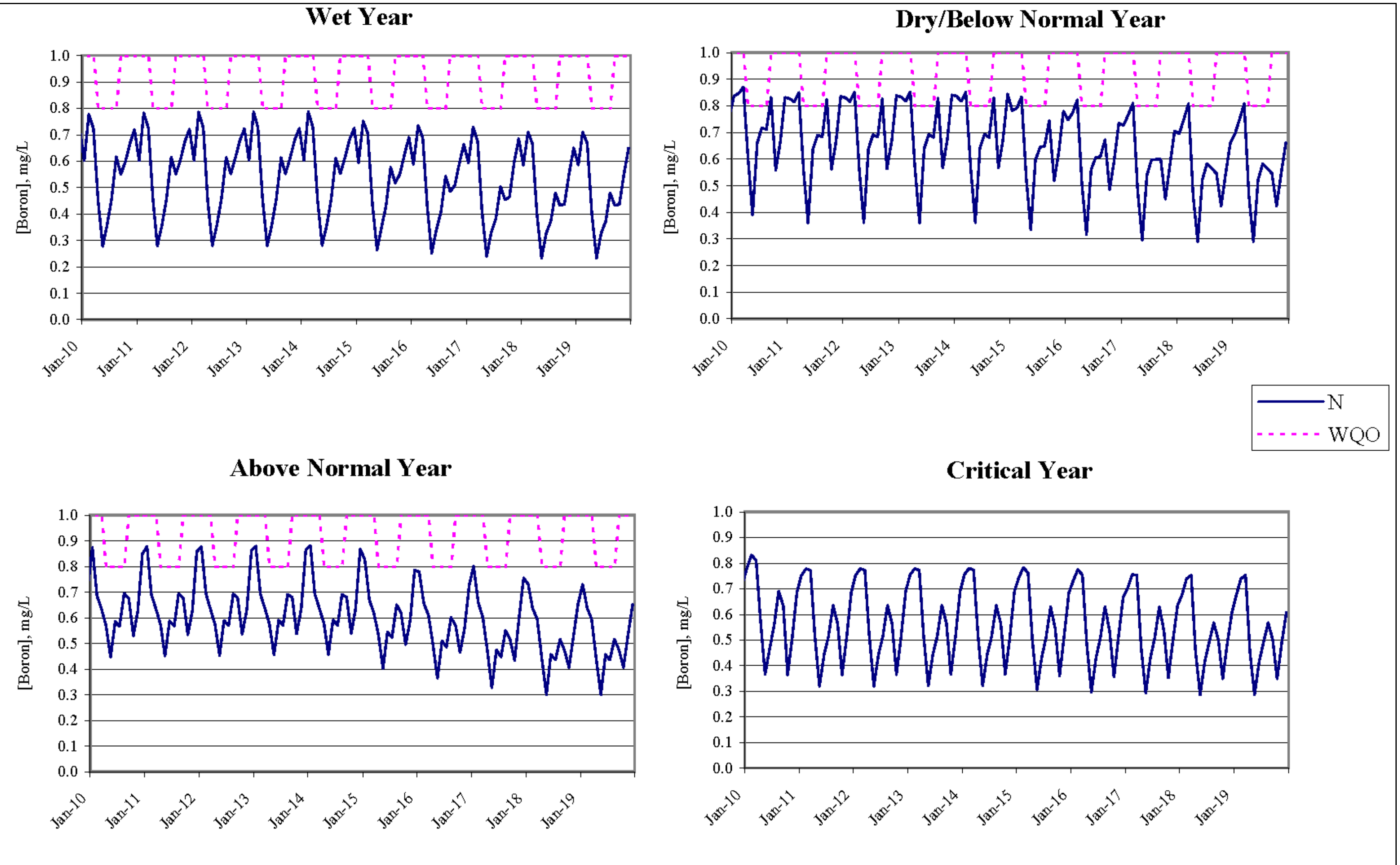
Figure 4-32 Predicted Monthly Average Selenium Concentrations at Station N for the Grassland Bypass Project 2010–2019 with Selenium Load Values for the 2010 Use Agreement



Station N is located on the San Joaquin River at Crows Landing.

Vernalis WQO is the Water Quality Objective for electrical conductivity (EC) in the San Joaquin River at Vernalis (maximum 30-day running average of mean daily EC), converted to TDS using a TDS/EC ratio of 0.62.

Figure 4-33 Predicted Monthly Average Total Dissolved Solids Concentrations at Station N and Vernalis for the Grassland Bypass Project 2010–2019 with Selenium Load Values for the 2010 Use Agreement



Station N is located on the San Joaquin River at Crows Landing.

WQO is the monthly mean Water Quality Objective for boron in the San Joaquin River downstream of the Merced River. For Critical Years, the WQO is 1.3 mg/L.

Figure 4-34 Predicted Monthly Average Boron Concentrations at Station N for the Grassland Bypass Project 2010–2019 with Selenium Load Values for the 2010 Use Agreement

Table 4-26 Annual Discharge Volume Modeled at Terminus of San Luis Drain -- Station B (acre-feet)

Year	Wet	Above Normal	Below Normal/Dry	Critical
Existing Conditions[1]	31,950	33,050	29,260	19,330
Proposed Action - Year 2010	21,410	20,280	15,592	11,238
Proposed Action - Year 2011	20,001	19,081	13,565	8,822
Proposed Action - Year 2012	18,933	18,123	13,031	8,610
Proposed Action - Year 2013	18,102	17,364	12,603	8,441
Proposed Action - Year 2014	17,430	16,748	12,251	8,302
Proposed Action - Year 2015	20,573	19,154	13,512	9,436
Proposed Action - Year 2016	16,365	15,159	11,093	8,769
Proposed Action - Year 2017	13,441	13,311	9,389	7,766
Proposed Action - Year 2018	10,324	8,943	7,632	6,334
Proposed Action - Year 2019	10,324	8,943	7,632	6,334

[1] For existing conditions, annual discharge is based upon the representative hydrologic year for each water year type (Wet years, 2005; Above Normal years, 2000; Below Normal and Dry years, 2004; and Critical years, 2007) not the average of water years 2002 to 2007.

4.2.2.4.7 Sediment Accumulation in the San Luis Drain

Since the flow rate in the Drain has been capped at about 150 cfs to prevent the scour of sediment, the Drain acts as a sediment trap. Therefore, the accumulation of sediment would continue to occur, although the rate can be reduced if large storm events are bypassed around the Drain. The rate of accumulation is estimated to be about 1 to 2 inches per year spread through the entire Drain. This rate corresponds to a total average accumulation of between 8 and 16 inches of sediment over the 8-year Project. Currently, the Drain has greater than 1 foot of freeboard during peak flows of 150 cfs. Therefore, the accumulation of sediment is a potentially significant impact. If additional sediment accumulates to the extent that it would pose a problem to the use of the Drain or to downstream resources, the sediment would be removed in accordance with the proposed Use Agreement, applicable laws and regulations, and the Sediment Management Plan provided in Appendix B.

4.2.2.4.8 San Joaquin River Water Quality Improvement Project

The regional reuse facility (SJRIP) has been partially constructed, and an expansion of the 4,000-acre facility by 2,900 acres was approved by Panoche Drainage District on August 21, 2007. At present, approximately 2,230 additional acres have been acquired, with approximately 230 acres purchased but not receiving drainwater. The SJRIP reuse area dedicates specific lands for the irrigation of salt-tolerant crops with subsurface drainwater to reduce the volume of the drainwater.

In addition to drainwater reuse, the SJRIP would treat concentrated drainwater to remove salt, Se, and boron and would dispose of the removed salts “in valley” to prevent them from discharging to the San Joaquin River. (For modeling purposes, this is assumed to occur in 2015). The treatment systems would also potentially produce a product water sufficient in quality for reuse on agricultural lands within the GDA.

The SJRIP reuse area is assumed to consist of up to 6,900 acres, with a maximum irrigated area of 6,749 acres (excluding alkali scrublands). Drainwater would be applied up to a maximum of 4.25 acre-feet per acre on the irrigated areas. Additional drainwater could also be applied to fallow areas to infiltrate to groundwater, if needed. Applied freshwater assumes equal portions of groundwater and canal water so that total applied water reaches a maximum of 4.5 acre-feet per acre. Freshwater is applied when drainwater is insufficient to meet crop water needs with a 25 percent leaching fraction. The maximum amount of drainwater that can be applied to salt-tolerant crops is 23,460 acre-feet annually (Table C-3 of Appendix C). The goal of the Proposed Action is not to provide full crop yields but to maximize consumptive use.

Table 4-27 shows the projected monthly crop water requirements for the reuse site for year 2019. The monthly consumptive use was reduced by 14 percent to account for uneven growth, bare spots, or other factors that could reduce plant yields. This value was obtained from a study of drainwater recycling in the Broadview Water District prior to 1983 when Broadview was recycling 100 percent of its drainwater (Cal Poly 1994). During June through September, consumptive use was reduced an additional 15 percent to account for the high water table.

Table 4-27 San Joaquin River Water Quality Improvement Project Crop Water Requirement

	SJRIP Crop Water Requirement (in) (includes volume for leaching)				SJRIP Crop Water Requirement (acre-feet) (includes volume for leaching)			
	W	AN	BN/D	C	W	AN	BN/D	C
Jan-19	0.0	0.0	0.2	1.3	0	0	93	528
Feb-19	0.0	0.0	0.0	1.0	0	0	0	411
Mar-19	1.9	3.7	4.1	4.0	803	1,529	1,698	1,641
Apr-19	3.9	4.3	6.3	4.7	1,612	1,800	2,621	1,972
May-19	6.6	7.4	7.7	7.4	2,755	3,072	3,181	3,080
Jun-19	6.5	6.8	7.0	6.9	2,704	2,842	2,898	2,880
Jul-19	7.2	7.0	6.9	6.6	2,975	2,889	2,868	2,747
Aug-19	6.1	6.2	6.1	6.0	2,547	2,568	2,526	2,505
Sep-19	4.1	4.2	4.5	3.8	1,704	1,732	1,878	1,575
Oct-19	0.8	3.8	3.9	2.3	327	1,595	1,640	937
Nov-19	0.5	1.7	1.3	1.3	204	719	534	550
Dec-19	0.0	1.6	0.0	0.6	0	665	0	249
Total:	38	47	48	46	15,631	19,411	19,936	19,075

Part of the crop water requirement would be provided by the shallow water table as well as drainwater. Water would only be provided at up to 25 percent above the consumptive use to allow for leaching once tile drains were installed in the fields; therefore, the lands would not be water logged and would be managed to avoid ponding in fields or surface runoff. Ponding would be prevented by operating tailwater and subsurface drainage return systems and by controlling the rate of drainwater application; therefore, no significant impacts would result.

4.2.2.5 2001 Requirements Alternative (Alternative Action)

The 2001 Requirements Alternative is similar to the Proposed Action in all aspects except the Se and salt loads discharged to Mud Slough would be limited to load values in the 2001 Use Agreement. While the Alternative Action would not meet Mud Slough Se objectives for 2010, it was predicted to meet San Joaquin River objectives below the Merced River except for Se in Below Normal or Dry years in the month of September.

4.2.2.5.1 Grassland Drainage Area

Impacts to the GDA are the same as those predicted for the Proposed Action.

4.2.2.5.2 Mud Slough Upstream of San Luis Drain Discharge, Salt Slough, Wetland Channels, San Joaquin River Upstream of Mud Slough

Impacts to these river reaches are the same as those predicted for the Proposed Action.

4.2.2.5.3 San Luis Drain and Grassland Drain Area Channels

Impacts to the Drain and GDA channels are the same as those predicted for the Proposed Action.

4.2.2.5.4 Mud Slough (North) Downstream of Current San Luis Drain Discharge

Impacts to Mud Slough (North) downstream of the Drain are similar as those predicted for the Proposed Action, with the exception that concentrations are expected to be higher and similar to existing conditions during years 2015 to 2019.

4.2.2.5.5 San Joaquin River (Mud Slough to Merced)

Impacts to the San Joaquin River from Mud Slough to the Merced River are the same as those predicted for the Proposed Action, with the exception that concentrations are expected to be higher and similar to existing conditions during years 2015 to 2019.

4.2.2.5.6 San Joaquin River (Merced River to Crows Landing)

Impacts to the San Joaquin River downstream of the Merced River are the same to those predicted for the Proposed Action, with the exception that concentrations are expected to be higher and similar to existing conditions during years 2015 to 2019.

4.2.2.5.7 Sediment Accumulation in the San Luis Drain

Impacts from sediment accumulation under the 2001 Requirements Alternative would be similar to those described under the Proposed Action.

4.2.2.5.8 San Joaquin River Water Quality Improvement Project

This facility is part of the 2001 Requirements Alternative. Impacts would be the same as described for the Proposed Action.

4.2.3 Cumulative Effects

Cumulative effects are impacts associated with the action alternatives that are not significant on their own but, when combined with the impacts of other projects and plans in the region, can have incremental effects that would result in a significant effect. The implication is that numerous insignificant effects can create a significant effect. This section discusses other plans and programs in the Central Valley and Bay-Delta regions that could have significant cumulative effects.

4.2.3.1 Central Valley Project Improvement Act

The CVPIA amends the previous authorizations of the 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. In response to these requirements the U.S. Department of the Interior has developed programs to improve environmental conditions and modify operations, management, and physical facilities of the CVP. The primary element in the preferred alternative described in the Final Programmatic EIS potentially affecting the Project Area involves acquisition and delivery of an additional 110,000 acre-feet per year of water for fish and wildlife on the San Joaquin River and tributaries. (Reclamation et al. 1999)

Refuges in the Project Area receiving approximately 270,000 acre-feet per year are hydrologically connected to San Joaquin River in the Project vicinity. Delivery of this additional water to wetlands and its subsequent release back to the San Joaquin River, primarily during April and May, could result in higher river flows that could provide additional assimilative capacity in the San Joaquin River and tributaries for Se during these months. This is a potential beneficial effect for the San Joaquin River.

Wetland water releases are elevated in TDS and organic carbon, constituents of concern to municipal drinking water supplies. Therefore, the load of organic carbon and TDS discharged to the San Joaquin River may increase as a result of the CVPIA. The Final Programmatic EIS indicated impacts to drinking water agencies that remove water from the Delta could be significant during the spring and early summer for dissolved organic carbon. Impacts for TDS were less than significant for the Delta following mitigation and less than significant (generally less than 10 percent different) for the San Joaquin River at Vernalis. Grassland Bypass Action Alternatives would result in less organic carbon, salt, boron, and Se discharged compared to existing conditions. Therefore, the Project Alternatives would not contribute to the cumulative impact of nonproject actions on the San Joaquin River and south Delta. See Section 5.2.3.2.3 for a discussion of the wetland enhancement component of the proposed 2010 Use Agreement.

4.2.3.2 CALFED Bay-Delta Program

The CALFED Bay-Delta Program was established in 1995. CALFED is a consortium of five state and ten federal agencies with management and regulatory responsibilities in the Bay-Delta Estuary. The state and federal agencies pledged to coordinate their implementation of water quality standards to protect the Bay-Delta Estuary, coordinate the operation of the State Water Project and CVP, which both involve transporting freshwater through the Delta to points south, and develop a process to establish a long-term Bay-Delta solution that will address four categories of problems: ecosystem quality, water quality, water supply reliability, and levee system vulnerability. For water quality the primary concern was focused on impacts to drinking water and agricultural supplies derived from the Bay-Delta due to elevated salts, organic carbon, and bromide.

The CALFED Final Programmatic EIR/EIS was released in 2000 (CALFED 2000). The preferred CALFED Program includes construction of an operable barrier at the head of Old River as well as construction of other operable barriers, or their equivalent, taking into account fisheries, water quality, and water storage needs in the south Delta. The impacts evaluation in the Programmatic EIR/EIS indicates salinity would be improved at the major diversions to the State Water Project and CVP (Clifton Court Forebay), resulting in lower salt loads in irrigation deliveries water. This impact would be beneficial to agriculture. The two Grassland Bypass Project Action Alternatives would result in less salt, boron, and Se discharged compared to the Existing Conditions baseline, which would result in cumulative impacts that are beneficial.

4.2.3.3 South Delta Improvements Program

The South Delta Improvements Project (SDIP) is one element of the preferred CALFED Program that was identified in the CALFED Record of Decision as part of the programmatic solution to achieve the goals of water supply reliability, water quality, ecosystem restoration, and levee system integrity. The program is described in detail in the December 2006 SDIP Final EIS/EIR. The proposed project is to be implemented in two stages, the first being the physical/structural component and the second relating to changes in Delta exports. Only Stage 1 is proposed at this time. The physical/structural component includes (1) replacing the seasonal barrier with a permanent operable fish control gate on the head of Old River; (2) replacing the three seasonal temporary agricultural control barriers with permanent operable gates on Middle River, Grant Line Canal, and Old River; and (3) dredging portions of Middle River and Old River and possibly West, Grant Line, Victoria, and North canals to improve flows in the south Delta channels. Stage 2 is being deferred and will include making a decision on the operational component of SDIP after the pelagic organism decline is remedied. Project Alternatives would not interfere with Stage 1 of the SDIP. Therefore, the Action Alternatives would not contribute to the cumulative impact of nonproject actions on the San Joaquin River

4.2.3.4 Vernalis Adaptive Management Plan

The VAMP is designed to provide augmented flows to the San Joaquin River to benefit fish migration from 1990–2010. This plan resulted in the planned releases of up to 110,000 acre-feet (or more under some hydrologic conditions) during the April to May period, and an additional 12,500 acre-feet of flow during the month of October. The influence of these flows is included in the receiving water model for the Grassland Bypass Project. Therefore, cumulative affects of these flows have already been included in the analysis. At issue is whether the plan will continue after 2010 when the current San Joaquin River Agreement expires.

4.2.3.5 San Luis Drainage Feature Re-evaluation Project

The purpose of the San Luis Drainage Feature Re-evaluation Project is to identify a plan to provide agricultural drainage service to the CVP’s San Luis Unit in accordance with the Ninth District Circuit Court decision. Drainage service has been defined as managing the regional shallow groundwater table by collecting and disposing shallow groundwater from the root zone of drainage-impaired lands and/or reducing contributions of water to the shallow groundwater table through land retirement.

The related ROD, signed in March 2007, selected the In-Valley/Water Needs Alternative for implementation. This alternative includes collection systems, reuse areas, treatment, disposal facilities, and no drainage to the San Joaquin River, as well as the retirement of 194,000 acres of farmland. Land retirement would be used to balance the internal water demand of the San Luis Unit with the expected available supply. Reclamation is finalizing an estimate of project costs, which is expected to confirm the need for authorizing legislation to increase the appropriation ceiling for funding beyond what was authorized by the San Luis Act of June 3, 1960. The two Action Alternatives would not interfere with this program, and the cumulative impacts to the San Joaquin River would be beneficial.

4.2.3.6 Westside Regional Drainage Plan

The Westside Regional Drainage Plan, an integrated plan adopted by the Authority, is designed to eliminate irrigated agricultural drainage water from, and enhance water supply reliability for, about 100,000 acres in the GDA. The program began as a successful effort to reduce Se discharges to the San Joaquin River. It is now being proposed for expansion to go beyond regulatory requirements and eliminate Se and salt discharges to the San Joaquin River while maintaining the productivity of production agriculture in the region and enhancing water supplies to lands remaining in production. To the extent this program is successful, it would reduce salinity and may also reduce total flows in the San Joaquin River (Exchange Contractors et al. 2003). This plan includes water demand reduction, groundwater pumping and management, and water transfer elements to provide for drainage source control and improve water supply reliability for the partners executing this plan (Exchange Contractors et al. 2003). The DWR and State Board have provided funding for the Westside Regional Drainage Plan under the Integrated Regional Water Management Grants Program (DWR, undated), funded by Proposition 50, Chapter 8. The two Action Alternatives would result in less Se and salt discharged compared to existing conditions, which would result in cumulative impacts that are beneficial.

4.2.3.7 San Joaquin River Restoration Settlement

A litigation Settlement among the Natural Resources Defense Council (NRDC), Friant Water Users Authority, the U.S. Department of the Interior, and the U.S. Department of Commerce in the case of NRDC v. Rodgers was approved in late 2006 by the U.S. District Court in Sacramento (Reclamation et al. 2006). The Settlement ended an 18-year legal dispute over the operation of Friant Dam and resolved longstanding legal claims brought by a coalition of conservation and fishing groups led by the NRDC.

The Settlement provides for substantial river channel improvements and sufficient water flow to sustain a salmon fishery upstream from the confluence of the Merced River tributary, while providing water supply certainty to Friant Division water contractors. At the heart of the Settlement is a commitment to provide continuous flows in the San Joaquin River to sustain naturally reproducing Chinook salmon and other fish populations in the 153-mile stretch of the San Joaquin River between Friant Dam and the Merced River. Accomplishing this goal will require funding and constructing extensive channel and structural improvements in many areas of the river, including some that have been without flows (except for occasional flood releases) for decades.

Restoring continuous flows to the approximately 60 miles of dry river will occur in phases through the San Joaquin River Restoration Program. Planning, design work, and environmental reviews will begin immediately, and interim flows for experimental purposes will start in 2009. The flows will be increased gradually over the next several years, with salmon being re-introduced by December 31, 2012. The Settlement continues in effect until 2026, with the U.S. District Court retaining jurisdiction to resolve disputes and enforce the settlement. After 2026, the court, in conjunction with the State Board, will consider any requests by the parties for changes to the restoration flows. Full implementation of the Federal actions in the Settlement requires enactment of authorizing legislation.

Alternatives would result in slightly reduced flows in the San Joaquin River, as compared to existing conditions, which would be in conflict with the San Joaquin River Restoration Settlement goals for flow; however, the two Action Alternatives will result in less Se contamination in the lower San Joaquin River.

4.2.4 Impact and Mitigation Summary

Impacts and mitigation (for action alternatives only) are presented for the different alternatives. Impacts are discussed by affected area. Significance determinations under the California Environmental Quality Act of 1970 (CEQA) are based on comparisons to the Existing Conditions baseline, which approximates 2007 as explained in Section 4.1.3.2. Table 4-28 summarizes the water quality impacts of the three Alternatives. The impact terminology in Table 4-28 is consistent with the National Environmental Policy Act of 1969 (NEPA)/CEQA determinations in Section ES.6. NEPA requires a comparison of the Action Alternatives with No Action, which is the reasonably foreseeable future condition. The NEPA comparisons use the following terms: “negative” for adverse effect, “neutral” for no effect or minimal effect, and “positive” for a beneficial effect. CEQA requires a determination of impact significance or no impact based on existing conditions. These impacts are discussed below.

4.2.4.1 No Action Alternative

4.2.4.1.1 Impacts in Sloughs and in the San Joaquin River Upstream of the Confluence with the Merced River

- Water quality in sloughs and canals within the GDA could be degraded due to increased drainwater recycling compared to existing conditions. This is a potentially significant adverse impact.
- Seepage may result in ponding of drainwater in low-lying areas of the GDA and non-GDA lands that previously drained to the Grassland Bypass Channel. The ponds may contain elevated concentrations of Se, boron, and salinity. This is a significant adverse impact.
- Se, boron, molybdenum, and salinity in Mud Slough and the San Joaquin River downstream of Mud Slough would improve under this alternative. Since WQOs for Se and molybdenum would be achieved more frequently in Mud Slough than under existing conditions, this is a significant beneficial impact for Se and molybdenum, and a less-than-significant beneficial impact for boron and salinity.

4.2.4.1.2 Impacts in Wetlands

- Uncontrolled flow from outside of the GDA (that formerly discharged to the Grassland Bypass Channel) may enter into wetland supply channels resulting in Se concentrations higher than WQOs. Concentrations of molybdenum, boron, and salinity are also predicted to increase due to uncontrolled flow. This is a potentially significant adverse impact for Se and less-than-significant adverse impact for boron, molybdenum, and salinity.
- Occasional temporary impacts to wetlands from Se, boron, and salinity are predicted during high flow storm events when drainage canals and ditches may overflow into wetland supply canals. These are temporary but, nevertheless, potentially significant adverse impacts for Se and less-than-significant impacts for boron, molybdenum, and salinity.

4.2.4.1.3 Impacts to San Joaquin River Downstream of the Merced River

- Se, boron, and salinity concentrations in the San Joaquin River downstream of the confluence with the Merced River are predicted to decrease as compared to existing conditions. Decreases in the Se, boron and salinity concentrations are predicted to result in fewer exceedances of applicable WQOs. These are significant beneficial impacts for Se, boron, and salinity.

4.2.4.1.4 Sediment Accumulation in San Luis Drain

- No additional sediment input or accumulation would occur from the GDA, and there is no impact.

4.2.4.2 Proposed Action

4.2.4.2.1 Impacts in Sloughs and in the San Joaquin River Upstream of the Confluence with the Merced River

- Concentrations of Se, boron, molybdenum, and salinity would decrease in Mud Slough and in the San Joaquin River between Mud Slough and the Merced River relative to existing conditions as a result of this alternative, a significant beneficial impact. Concentrations are predicted to decrease as the Project progresses due to the implementation of additional control measures to comply with the lower load values.
- Concentrations of Se, boron, and salinity in Salt Slough and in the San Joaquin River upstream of Mud Slough would remain the same as existing conditions, i.e., no impact.
- The 4-day average Se WQO is subject to a compliance schedule for these reaches that is in effect by 2010. Se concentrations are predicted to exceed WQOs for Mud Slough downstream of the Drain and may also exceed WQOs for the San Joaquin River from Mud Slough to the Merced River. The frequency of exceedances is predicted to decrease as the Project progresses. Because the Proposed Action would continue to discharge Se to Mud Slough after 2010, mitigation for the impact to Mud Slough is addressed in the 2010 Use Agreement with the provision of additional wetland habitat (Section 2.2.1.2.1). Because the frequency of exceedances is predicted to be less than existing conditions but greater than the

No Action Alternative, this is a significantly beneficial impact in comparison to existing conditions and a negative impact in comparison to the No Action Alternative.

- These reaches do not have WQOs for salinity or boron. Therefore, the beneficial impact is less than significant for salinity and boron. WQOs for molybdenum would be exceeded less frequently as compared to existing conditions, a beneficial impact. Concentrations of Se, boron, molybdenum, and salinity would increase compared to the No Action Alternative.

4.2.4.2.2 Impacts in Wetlands

- Occasional temporary increases in Se, boron, molybdenum, and salinity in wetland water supply channels are predicted during high flow storm events when the Grassland Bypass Channel would be bypassed to prevent accumulation and scour of sediments in the San Luis Drain. The frequency of these events is predicted to be similar to existing conditions. Therefore, no impact occurs when compared to existing conditions.
- Se, boron, molybdenum, and salinity concentrations in wetlands and wetland supply channels are predicted to decrease as compared to the No Action Alternative both during storm events and during dry weather when seepage, uncontrolled flows, and/or storm events are less than 150 cfs due to the ability to bypass flows around the wetlands through use of the Drain.

4.2.4.2.3 Impacts in the San Joaquin River Downstream of the Merced River

- Se, boron, molybdenum, and salinity concentrations in the San Joaquin River downstream of the Merced River would decrease relative to existing conditions under this alternative. The frequency with which Se concentrations would be higher than the 4-day average WQO is predicted to decrease compared to existing conditions. This is a significant beneficial impact for Se. The frequency with which boron and salinity concentrations would be higher than applicable WQOs is also predicted to decrease compared to existing conditions, a significant beneficial impact.
- Se, boron, molybdenum, and salinity concentrations in the San Joaquin River downstream of the Merced River are predicted to increase as compared to the No Action Alternative.

4.2.4.2.4 Sediment Accumulation in the Drain

- Additional sediment would accumulate in the Drain over the duration of the Proposed Action. This is a potentially significant impact compared to existing conditions. Mitigation is to monitor the accumulation and remove the sediments in accordance with a Sediment Management Plan, reducing the impact to less than significant.

4.2.4.3 Alternative Action

4.2.4.3.1 Impacts in Sloughs and in the San Joaquin River Upstream of the Confluence with the Merced River

- Concentrations of Se, boron, molybdenum, and salinity would decrease in Mud Slough and in the San Joaquin River between Mud Slough and the Merced River relative to existing conditions as a result of this alternative due to decreased load allocations for Below Normal, Dry, and Critical Years, a significant beneficial impact. Concentrations of Se, boron, and salinity in Salt Slough and in the San Joaquin River upstream of Mud Slough would remain the same as existing conditions, i.e., no impact.
- The 4-day average Se WQO is subject to a compliance schedule for these reaches that is in effect by 2010. Se concentrations are predicted to exceed WQOs for Mud Slough downstream of the Drain and may also exceed WQOs for the San Joaquin River from Mud Slough to the Merced River. WQOs would be met less frequently than the Proposed Action. Because this action would continue to discharge Se to Mud Slough after 2010, mitigation for the impact to Mud Slough provides additional wetland habitat. Because the frequency of exceedances is predicted to be similar to or less than existing conditions but greater than the No Action Alternative, this is a significantly beneficial impact in comparison to existing conditions and a negative impact in comparison to the No Action Alternative.
- These reaches do not have assigned WQOs for salinity or boron. Therefore, the beneficial impact is less than significant for salinity and boron. WQOs for molybdenum would be achieved more frequently under this alternative, a significantly beneficial impact. Concentrations of Se, boron, molybdenum, and salinity would increase compared to the No Action Alternative.

4.2.4.3.2 Impacts in Wetlands

- Occasional temporary increases in Se, boron, molybdenum, and salinity in wetland supply water channels are predicted during high flow storm events when the Grassland Bypass Channel would be bypassed to prevent accumulation and scour of sediments in the San Luis Drain. The frequency of these events is predicted to be similar to existing conditions. Therefore, no impact occurs.
- Se, boron, molybdenum, and salinity concentrations in wetlands and wetland supply channels are predicted to decrease as compared to the No Action Alternative during storm events and during dry weather when seepage and uncontrolled flows are less than 150 cfs due to the ability to bypass flows less than 150 cfs around the wetlands through use of the Drain under this alternative.

4.2.4.3.3 Impacts in the San Joaquin River Downstream of the Merced River

- Se, boron, molybdenum, and salinity concentrations in the San Joaquin River downstream of the Merced River would decrease relative to existing conditions under this alternative; however, concentrations would be higher than the Proposed Action. The frequency with which Se concentrations would be higher than the 4-day average WQO is predicted to decrease compared to existing conditions; however, the frequency would not decrease as much as the Proposed Action. This is a significant beneficial impact for Se compared to existing conditions. The frequency with which boron and salinity concentrations would be higher than applicable WQOs is also predicted to decrease compared to existing conditions, a significant beneficial impact.
- Se, boron, molybdenum, and salinity concentrations in the San Joaquin River downstream of the Merced River are predicted to increase as compared to the No Action Alternative.

4.2.4.3.4 Sediment Accumulation in the Drain

- Additional sediment would accumulate in the Drain over the duration of the Proposed Action. This is a potentially significant impact. Mitigation is to remove the sediments in accordance with a Sediment Management Plan, reducing the impact to less than significant.

Table 4-28 Summary of Water Quality Impacts

Water Quality Parameter	No Action Alternative Compared To Existing Condition	Proposed Action Compared To No Action	Proposed Action Compared To Existing Condition	Alternative Action Compared To No Action	Alternative Action Compared To Existing Condition
Selenium (Se) in Sloughs and San Joaquin River (SJR) Upstream of Merced River	*Significant Beneficial Impact* No change in Salt Slough or SJR upstream of Mud Slough; Se concentrations substantially lower in Mud Slough and San Joaquin River downstream of Mud Slough; Se water quality objectives (WQOs) are achieved for these reaches.	*Negative* No change in Salt Slough or SJR upstream of Mud Slough; WQOs will not be met in Mud Slough and the SJR between Mud Slough and the Merced River. Se in GDA subsurface drainage continues to enter SJR downstream of Mud Slough but decreases over time.	*Significant Beneficial Impact* No change in Salt Slough or SJR upstream of Mud Slough; Reduction in Se concentrations in Mud Slough and SJR downstream of Mud Slough; WQOs are achieved more frequently for these reaches.	*Negative* No change in Salt Slough or SJR upstream of Mud Slough; Se concentrations remain elevated in Mud Slough and SJR downstream of Mud Slough; WQOs are achieved less frequently for these reaches; WQO are achieved less frequently than the Proposed Action.	*Significant Beneficial Impact* No change in Salt Slough or SJR upstream of Mud Slough; Se concentrations lower in Mud Slough and SJR downstream of Mud Slough. WQOs achieved more frequently for these reaches; however, WQO are achieved less frequently than the Proposed Action.
Se in Wetlands During Storm Events	*Potentially Significant Adverse Impact* Se concentrations in wetland water supply channels increased due to uncontrolled flow of drainwater and stormwater into wetland supply channels.	*Positive* Se concentrations in wetlands decreased due to routing of storm event and uncontrolled flows that do not exceed 150 cfs around wetlands.	*No Impact* Se concentrations essentially unchanged from existing condition due to routing of similar sized storm event flows around wetlands.	*Positive* Se concentrations in wetlands decreased due to routing of storm event and uncontrolled flows that do not exceed 150 cfs around wetlands.	*No Impact* Se concentrations essentially unchanged from existing condition due to routing of similar sized storm event flows around wetlands.
Se in Wetlands During Dry Weather	*Potentially Significant Adverse Impact* Se concentrations in wetlands water supply channels increased due to uncontrolled flow without a drainage outlet.	*Positive* Se concentrations in wetlands water supply channels decreased due to routing of seepage around wetlands, wetlands no longer receive uncontrolled flows.	*No Impact* Se concentrations essentially unchanged from existing conditions due to routing of drainage water around wetlands.	*Positive* Se concentrations in wetlands water supply channels decreased due to routing of seepage around wetlands; wetlands no longer receive uncontrolled flows.	*No Impact* Se concentrations essentially unchanged from existing conditions due to routing of drainwater around wetlands.
Se in SJR Downstream of Merced River	*Significant Beneficial Impact* Se concentrations substantially lower in river; WQOs in the river are achieved.	*Negative* Se concentrations in river increased due to drainwater. Se concentrations higher than WQO for some water years and year types.	*Significant Beneficial Impact* Se concentrations in river decrease as a result of reduced discharges of drainwater. WQOs in river are achieved more frequently.	*Negative* Se concentrations in river increased due to drainwater. Se concentrations higher than WQO for some water years and year types; WQO are achieved less frequently than the Proposed Action.	*Significant Beneficial Impact* Se concentrations in river decrease as a result of reduced discharges of drainwater. WQOs in river are achieved more frequently; however, WQO are achieved less frequently than the Proposed Action.
Salinity in Sloughs/SJR Upstream of Merced River	*Less-than-Significant Beneficial Impact* Salinity concentrations in Mud Slough and SJR downstream of Mud Slough decrease; WQOs not assigned for these reaches.	*Negative* Salinity concentrations in Mud Slough and SJR downstream of Mud Slough increase; WQOs not assigned for these reaches.	*Less-than-Significant Beneficial Impact* Salinity concentrations decrease in Mud Slough and the SJR downstream of Mud Slough as a result of reduced discharges of drainwater; WQOs not assigned for these reaches.	*Negative* Salinity concentrations in Mud Slough and SJR downstream of Mud Slough increase; WQOs not assigned for these reaches.	*Less-than-Significant Beneficial Impact* Salinity concentrations in Mud Slough and SJR downstream of Mud Slough decrease as a result of reduced discharges of drainwater; WQOs not assigned for these reaches.

Table 4-28 Summary of Water Quality Impacts

Water Quality Parameter	No Action Alternative Compared To Existing Condition	Proposed Action Compared To No Action	Proposed Action Compared To Existing Condition	Alternative Action Compared To No Action	Alternative Action Compared To Existing Condition
Salinity in SJR Downstream of Merced River	*Significant Beneficial Impact* Reduction in salt load would reduce salinity concentrations; WQOs are predicted to be achieved at Vernalis.	*Neutral* Salinity concentrations at Vernalis increase; however, WQOs are predicted to be achieved at Vernalis.	*Significant Beneficial Impact* Salinity concentrations at Vernalis decrease as a result of reduced discharges of drainwater. Salinity WQOs are predicted to be achieved at Vernalis.	*Neutral* Salinity concentrations at Vernalis increase; however, WQOs are predicted to be achieved at Vernalis.	*Significant Beneficial Impact* Salinity concentrations at Vernalis decrease as a results of reduced discharges of drainwater. Salinity WQOs are predicted to be achieved at Vernalis.
Boron in Sloughs/SJR Upstream of Merced River	*Less- than-Significant Beneficial Impact* Boron concentrations in Mud Slough and SJR downstream of Mud Slough decrease; WQOs do not apply to these reaches.	*Negative* Boron concentrations in Mud Slough and SJR downstream of Mud Slough increase; however, WQOs do not apply for these reaches.	*Less-than-Significant Beneficial Impact* Boron concentrations decreased in Mud Slough and the SJR downstream of Mud Slough as a result of reduced discharges of drainwater; WQOs do not apply for these reaches.	*Negative* Boron concentrations in Mud Slough and SJR downstream of Mud Slough increase; however, WQOs do not apply for these reaches.	*Less-than-Significant Beneficial Impact* Boron concentrations in Mud Slough and SJR downstream of Mud Slough decrease as a result of reduced discharges of drainwater; WQOs do not apply for these reaches.
Boron in SJR Downstream of Merced River	*Significant Beneficial Impact* Reduction in boron load would reduce boron concentrations; WQOs are predicted to be achieved for this reach.	*Neutral* Boron concentrations in river increase; however, WQOs are predicted to be achieved for this reach.	*Significant Beneficial Impact* Boron concentrations in SJR decrease as a result of reduced discharges of drainwater; WQOs are predicted to be achieved for this reach.	*Neutral* Boron concentrations in river increase; however, WQOs are predicted to be achieved for this reach.	*Significant Beneficial Impact* Boron concentrations in SJR decrease as a result of reduced discharges of drainwater; however, concentrations are higher than Proposed Action; WQOs are predicted to be achieved for this reach.
Sediment Accumulation in San Luis Drain	*No Impact* No additional sediment input or accumulation in the Drain.	*Neutral* Additional sediment may accumulate. Accumulation to be monitored and addressed through management plan.	*Potentially Significant Adverse Impact - Less than Significant with Mitigation* Additional sediment may accumulate. Accumulation to be monitored and addressed through management plan.	*Neutral* Additional sediment may accumulate. Accumulation to be monitored and addressed through management plan.	*Potentially Significant Adverse Impact - Less than Significant with Mitigation* Additional sediment may accumulate. Accumulation to be monitored and addressed through management plan.
Molybdenum in Sloughs/SJR Upstream of Merced River	*Significant Beneficial Impact* Molybdenum concentrations in Mud Slough and SJR downstream of Mud Slough decrease; WQOs achieved more frequently.	*Negative* Molybdenum concentrations in Mud Slough and SJR downstream of Mud Slough increase; WQOs exceeded more frequently.	*Significant Beneficial Impact* Molybdenum concentrations decrease in Mud Slough and SJR downstream of Mud Slough as a result of reduced discharges of drainwater; WQOs are exceeded less frequently.	*Negative* Molybdenum concentrations in Mud Slough and SJR downstream of Mud Slough increase. WQOs exceed more frequently for these reaches; WQO are achieved less frequently than the Proposed Action.	*Significant Beneficial Impact* Molybdenum concentrations in Mud Slough and SJR downstream of Mud Slough decrease as a result of reduced discharges of drainwater; WQOs exceeded less frequently for these reaches; however, WQO are achieved less frequently than the Proposed Action.

Table 4-28 Summary of Water Quality Impacts

Water Quality Parameter	No Action Alternative Compared To Existing Condition	Proposed Action Compared To No Action	Proposed Action Compared To Existing Condition	Alternative Action Compared To No Action	Alternative Action Compared To Existing Condition
Molybdenum in SJR Downstream of Merced River	*Less-than-Significant Beneficial Impact* Molybdenum concentrations decrease. However, WQOs are already achieved under existing conditions.	*Neutral* Molybdenum concentrations at Crows Landing increase. However, WQOs are predicted to be achieved.	*Less-than-Significant Beneficial Impact* Molybdenum concentrations at Crows Landing decrease as a result of reduced discharges of drainwater. Molybdenum WQOs are already achieved.	*Neutral* Molybdenum concentrations at Crows Landing increase. However, WQOs are predicted to be achieved.	*Less-than-Significant Beneficial Impact* Molybdenum concentrations at Crows Landing decrease as a result of reduced discharges of drainwater. Molybdenum WQOs at Crows Landing are already achieved.

Note:

The Se WQOs are defined in Table III-1 of the 1998 Basin Plan (current revision Oct 2007). The time schedule for compliance and the Se performance goals are defined in Table IV-4 of the 1998 Basin Plan. Performance goals are used to measure progress towards achieving WQOs. (Performance goals and the compliance time schedule are defined on pg IV-31 of the Basin Plan.) For the surface water resources section and Table 4-28, when the WQO is referred to directly, it is not referring to the compliance time schedule or the performance goals.

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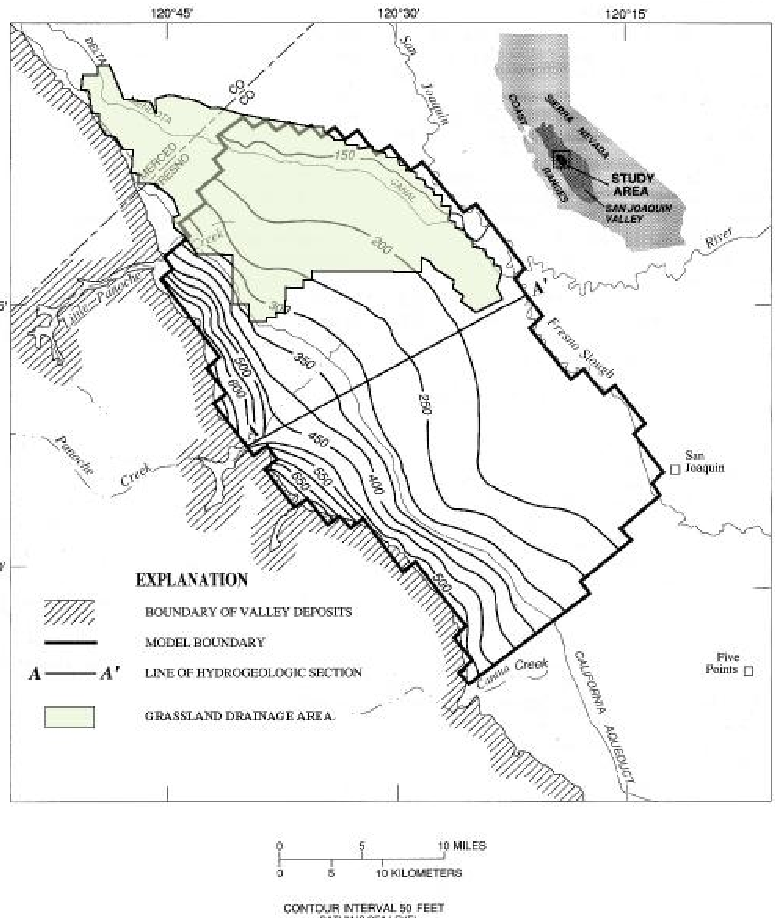
SECTION 5
Groundwater and Soil Resources

INTRODUCTION

The Grassland Drainage Area (GDA) includes 97,400 acres of farmland approximately located between the California Aqueduct on the west and San Joaquin River on the east (Figure 5-1). About 32 percent (30,800 acres) of the area is underlain by tile drainage systems, which currently discharge drainwater to the Grassland Bypass. The tile drainage systems manage the shallow water table, which otherwise causes water logging and salt accumulation in the root zone. Drainwater volumes and salt loads discharged to the Grassland Bypass are managed using a drainage reuse facility called the San Joaquin River Water Quality Improvement Project (SJRIP). The facility currently consists of about 4,000 acres of land and is expected to expand to 6,900 acres. Drainwater from the GDA is delivered to the SJRIP where it is applied to and reused on salt-tolerant crops.



(Note: The Grassland Drainage Area boundaries are approximate. See Section 2 for specific boundary location.)

Figure 5-1 Western San Joaquin Valley and Boundaries of Groundwater Flow Model (modified after Belitz et al. 1993)

5.1 AFFECTED ENVIRONMENT

5.1.1 Groundwater Resources

In the western San Joaquin Valley, sediments eroded from the Coast Range form gently sloping alluvial fans. The alluvium is more than 800 feet thick along the Coast Range and thins to 0 foot near the valley axis (Miller et al. 1971). The alluvium is a mixture of gravel, sand, silt, and clay.

The groundwater system is divided into a lower confined zone and upper semiconfined zone, separated by the Corcoran Clay (Figure 5-2). In the upper fan areas, the water table is typically located several hundred feet below land surface. In contrast, most downslope areas are underlain by a shallow water table within 7 feet of land surface (Belitz and Heimes 1990). The shallow water table is located within the semiconfined zone, and tile drainage systems are employed to manage water table depth.

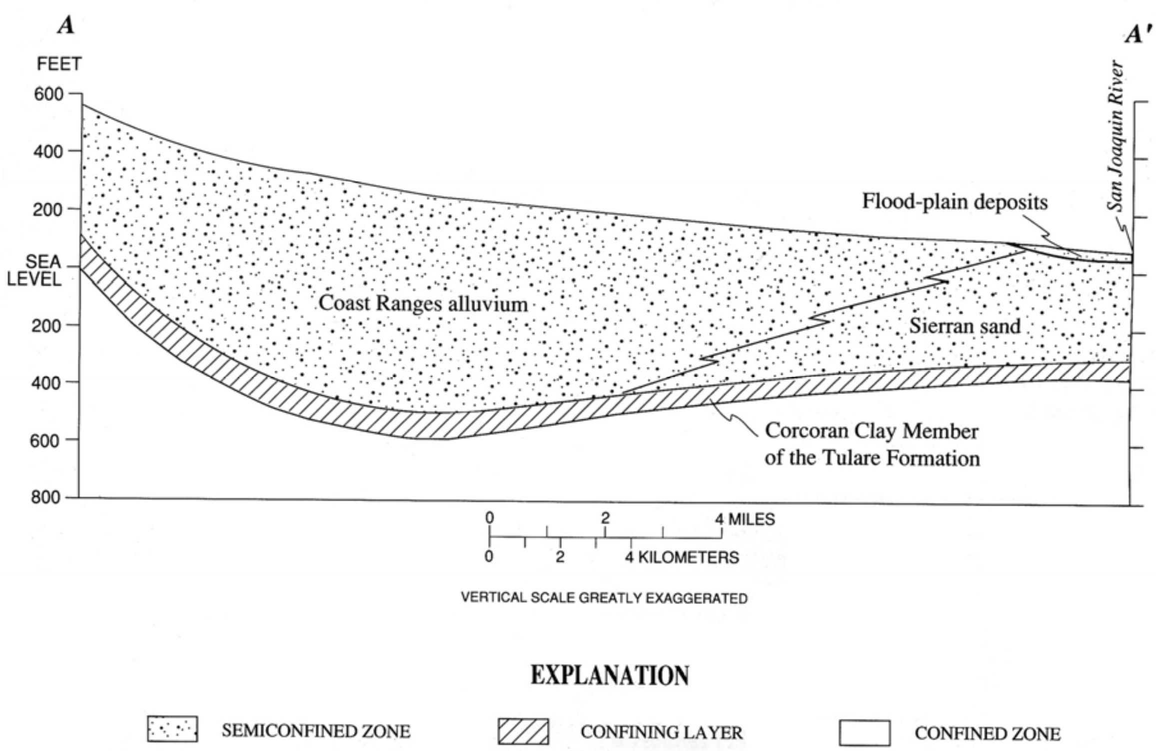


Figure 5-2 Geohydrologic Section of the Western San Joaquin Valley (modified after Belitz et al. 1993)

Prior to agricultural development, groundwater recharge occurred primarily by infiltration of runoff in Coast Range streams. Under natural conditions, rainfall was an insignificant recharge source (Davis and Poland 1957). Rantz (1969) reported that average annual precipitation is only 6.5 to 8 inches per year on the valley floor, but annual precipitation can vary considerably from the long-term average. For example, since 1950 reported annual precipitation in Panoche Drainage District has ranged from 3 to almost 16 inches per year.

During the past 40 years, recharge has increased dramatically as a result of imported irrigation water. For example, during 2002–2007 approximately 160,000 acre-feet per year of surface water was applied to the 97,400-acre GDA (URS 2008). Irrigation recharge increases the volume of water beneath the land surface and causes the water table to rise.

Under natural conditions, the shallow water table existed in eastern portions of the GDA and in areas along the valley floor and adjacent to the San Joaquin River (Belitz and Heimes 1990). Groundwater discharge was primarily by evapotranspiration and water table seepage to the San Joaquin River. Presently, groundwater discharge is predominantly by tile drainage systems and water table evaporation; on the average, historical groundwater pumpage as a supplemental irrigation water supply was reportedly small in the GDA, but is increasing as a result of reduced surface water deliveries.

Brush and others (2006) constructed and reported long-term water level hydrographs (1972–2000). Water-table well-water levels remained fairly constant, whereas confined-aquifer well water levels varied significantly from year to year, declining in years of greater-than-average groundwater pumpage and recovering in years of reduced pumpage. Prior to 1993, significant withdrawals from storage occurred only during drought years (1977 and 1990–92); however, since 1993 growers have increasingly relied on the groundwater flow system to supplement diminished surface-water supplies. Shallow water levels since 2000 continue to show spatial and seasonal variability, but have remained fairly stable over time (Figure 5-3); in some wells, water levels may have declined slightly as a result of long-term reductions in water table recharge and possible increases in pumpage (for example, Well 12S/12E-32J3).

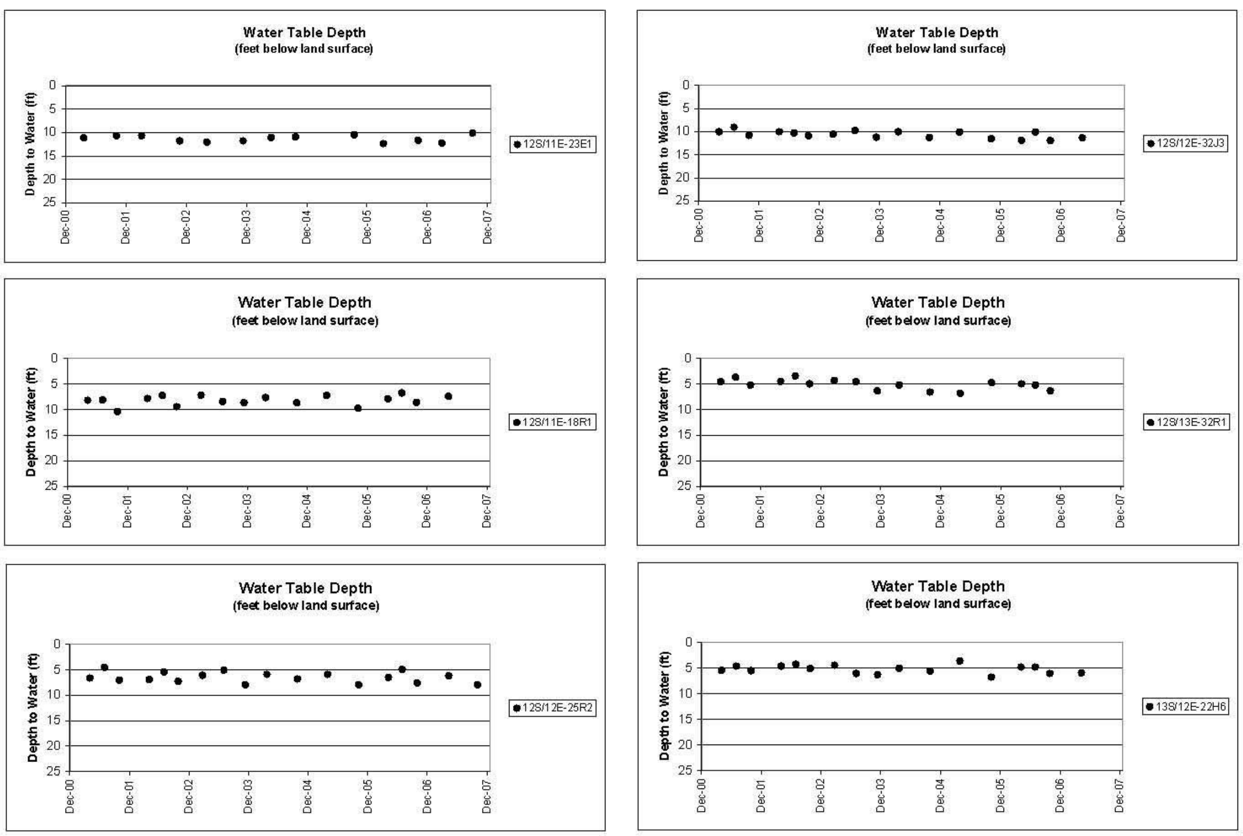


Figure 5-3 Depth to Water in Select Water Table Wells (2000–2007)

5.1.2 Drainage System Hydrology

Tile drainage systems affect groundwater flow in upper parts of the semiconfined aquifer. Seasonal changes in groundwater levels and drainflow indicate field conditions are affected by upslope irrigation activities. Furthermore, observation well data show that groundwater movement is upward towards the drainage systems from depths as great as 50 feet below land surface (Deverel and Fio 1991, Fio 1994). Therefore, drainflow estimates require geohydrologic information for areas considerably larger than single fields and depth intervals substantially deeper than the water table. In particular, estimates of irrigation recharge for drained and/or undrained areas upslope of the field, and delineation of regional groundwater flow paths intercepted by the drainage systems, are necessary to describe drainflow.

5.1.3 Soil Resources

Soil salinity is an important consideration for irrigated agriculture and drainwater management. Irrigation dissolves soil salts and leaches them to the water table. Salts present in the irrigation water further increase salt loading to soil and groundwater. For example in 1999, the dissolved solids concentration in delivered irrigation water averaged 244 milligrams per liter (mg/L), translating into more than 76,000 tons of imported salt applied in the GDA.

Most of the GDA soils are derived from marine sediments in the Coast Range, and contain salts and trace elements such as boron, molybdenum, and selenium. Under natural conditions, stormwater runoff from precipitation in the Coast Range infiltrated to the groundwater system. Harradine (1950) mapped the lowest soil salinities in the upper fan areas where they were partially leached by infiltration (Gilliom 1987). In the downslope areas, precipitation was an insignificant recharge mechanism. Harradine (1950) mapped the highest soil salinities in the downslope areas where recharge and subsequent leaching rates were low.

The presence of solid phase minerals like gypsum and calcite influences changes in soil and groundwater salinity. Based on soil samples from 17 sites in Panoche Drainage District, Tanji (1977) reported for the upper 6 feet of soil, 1 to 9 tons of native gypsum per acre-foot of soil. Soil saturation extracts and geochemical modeling results indicate soils are saturated with calcite and gypsum (Deverel and Fujii 1988), and HydroFocus visibly identified salts in unsaturated and saturated-zone core samples.

An exact correlation between soil and groundwater high in salts and selenium is not observed (Gilliom 1987). The highest concentrations occur in places where hydrologic processes, such as evaporative concentration, contribute to the accumulation of soluble salts and selenium in water and soil. To evaluate salt and selenium distributions in groundwater and soil it is necessary to understand the natural distribution of constituents and their redistribution by irrigated agriculture.

5.2 ENVIRONMENTAL CONSEQUENCES

5.2.1 Key Impact and Evaluation Criteria

Water table rise is the primary impact to soil and groundwater. The rising water table produces several soil- and groundwater-related effects. The following criteria were used to assess the potential water table impact:

- **Drainwater production**. Drainwater production, or tile drainage system sump flow, is proportional to water table depth, and the flow increases as the water table rises. Potential drainwater production impacts are associated with its volume and quality. A 10 percent increase in annual drainwater production volume and salinity is considered a potentially significant adverse impact.
- **Bare soil evaporation**. As the water table rises, the area underlain by the shallow water table increases and water table evaporation rate increases. In the GDA, evaporation from the shallow water table causes significant salinity increases in groundwater and soil (Deverel and Fujii 1988). Belitz et al. (1993) utilized a large amount of soil moisture, soil tension, and hydraulic conductivity data for Panoche clay loam and concluded bare-soil evaporation is significant when the water table is within 7 feet of land surface.

  Estimated water table depth is most reliable at the water district scale. Therefore, a 20-square-mile-or-greater increase in area underlain by a shallow water table (within 7 feet of land surface) is a significant adverse impact; area changes less than several square miles were considered no impact. Estimated evaporation rate is most reliable in the range between 0.0 to 0.4 foot/year, which corresponds to water table depths from 7 to 4 feet below land surface. If the water table rises above the 4-foot depth, the evaporation rate increases rapidly above 0.4 foot/year and the high evaporation rates maximize salinity increases in soil and groundwater. Therefore, evaporation rates greater than 0.4 foot/year are a significant adverse impact, and changes in the evaporation rate of less than about 0.05 foot/year (approximately 10 percent) are assumed to have no impact.
- **Uncontrolled seepage and subsurface discharge**. Seepage and subsurface discharge into unlined ditches and drainage canals are proportional to water table depth, and increase as the water table rises. The impacts are associated with the volume and quality of uncontrolled seepage and subsurface discharge. A 10-percent increase in the volume and quality of annual seepage or subsurface discharge is a potentially significant adverse impact. The analysis does not include other waters and drainwater that cannot be recycled that enters drainage canals. Uncontrolled seepage is therefore a minimum estimate of uncontrolled discharge.
- **Soil salinity**. Increased soil salinity decreases crop yields, and the threshold salinity level is crop specific. For example, melon and tomato yields decline when soil salinity increases above 2.5 deciSiemens per meter (dS/m); whereas, wheat, sugar beets, and cotton yields decline when soil salinity increases above 6.0, 7.0, and 7.7 dS/m, respectively (Tanji 1990). The analysis starts in the beginning of Water Year 2008 (fall of calendar year 2007).

  Initial soil salinity for the GDA and SJRIP soils was estimated using soil extract data provided by Summers Engineering. Soil salinity is spatially variable, and a soil salinity of 0.9 dS/m was used to represent average conditions in the primary agricultural areas of the GDA. Soil saturation extract data reported for the SJRIP suggested an initial representative soil salinity of 5.2 dS/m. Mean soil salinity increases above 10 percent of these levels are likely to negatively impact soil productivity and are considered a potentially significant adverse impact. In 2001 and 2002, saturation extracts from 32 sampling sites located in two SJRIP fields were analyzed for major ions and electrical conductivity. These extract data were also used to estimate the representative constituent concentrations contributing to the total salinity in the soil.
- **Groundwater salinity**. Groundwater salinity changes affect drainwater and seepage quality, which in turn affect constituent loads potentially discharged to the Grassland Bypass and

adjacent wetlands. Groundwater salinity increases greater than 10 percent are considered as a potentially significant adverse impact.

5.2.2 Methods Used to Evaluate Impacts

The impact analysis focuses on changes in groundwater levels, soil salinity, and groundwater salinity. Existing groundwater flow and geochemical models estimated these changes for the No Action, the Proposed Action, and the 2001 Requirements Alternatives. These models are described in the Groundwater and Soils Resources Technical Report (Appendix D) prepared by HydroFocus and briefly discussed below.

5.2.2.1 Groundwater Flow Model

A numerical groundwater flow model was used to project changes in mean depth to the water table. The U.S. Geological Survey developed the model for the San Joaquin Valley Drainage Program (Belitz et al. 1993)[1]. It is a transient, three-dimensional, finite-difference model and utilizes mean recharge and pumpage data to project long-term changes in water table depth and drainflow. The U.S. Geological Survey model represents groundwater conditions within about 88,000 acres of the GDA, which is 90 percent of the irrigated area (see Figure 5-1 for a comparison between model boundaries and approximate GDA boundaries).

5.2.2.1.1 Recharge

Water table recharge is computed as applied water less consumptive use by plants. The reported GDA water budget components are summarized in Table 5-1, and indicate 2000–2007 average recharge was 0.90 foot/year. Estimated 2000–2007 average recharge is used to represent existing GDA conditions for the impact analysis.

Table 5-1 Reported 2000–2007 Average Water Budget Components for Grassland Drainage Area Subareas of the Groundwater-Flow Model

Model Subarea	Model Area (acres)	Irrigation Delivery (feet)		Effective Precipitation (feet)	Recycled Water (feet)	Applied Drainwater (feet)	Consumptive Use (feet)	Water Table Recharge (feet)
		Canal	Wells					
Firebaugh	42,880	2.14	0.02	0.36	0.05	0.00	1.41	1.16
Panoche	30,720	1.88	0.19	0.36	0.04	0.00	1.63	0.84
SJRIP	3,840	0.40	0.40	0.36	0.00	1.77	2.11	0.82
Broadview	10,240	0.00	0.00	0.36	0.00	0.00	0.36	0.00
Sum/Average	87,680	1.72	0.09	0.36	0.04	0.08	1.40	0.90

Note: Water budget components are spatially averaged over model budget subareas, which include both irrigated and nonirrigated land areas.

[1] In 2005, Brush and others (2006) updated the 1993 groundwater-flow model utilized for this study. Their update extended the model grid to incorporate a larger geographic area, utilized a finer spatial and temporal discretization, and employed an annually varying water budget for Water Years 1973–2000. The calibrated model input files necessary to reproduce their reported results were not available at the time of this study.

5.2.2.1.2 Drainflow

Tile drainage systems consist of a parallel network of perforated drain laterals buried at variable depths and spacings. The drain laterals are typically installed at depths ranging from 6 to 9 feet below land surface, and spaced horizontally from 100 to 600 feet apart. Drainwater production is proportional to the hydraulic gradient between the water table and the drain laterals; drainflow increases as the water table rises, decreases as the water table declines, and is zero when the water table is below the drain laterals.

The groundwater flow model and a district drainage model are used to calculate drainwater production during the period 2008 through 2019. The two models are indirectly linked by annual mean water table depth. The groundwater flow model is a regional model, and provides annual water levels and drainwater production resulting from regional hydraulic stresses. In contrast, the district drainwater production model correlated monthly district sump flow to monthly water table depth. Additional information on drainage system representation in the groundwater model is provided in Appendix D.

5.2.2.2 District Drainflow Model

Estimated monthly sump flow is determined with a district drainwater production model. The model assumes monthly drainflow is proportional to the difference between water table and drain lateral depths. The proportionality constant, which represents a district-wide drain conductance, incorporates variable sediment permeability, variable numbers of drainage systems, and variable drain lateral spacing. Monthly water table depths were calculated from annual depths and seasonal changes in measured water levels. The groundwater flow model determined the annual water table depth, which was adjusted to monthly values by month-specific factors.

Figure 5-4 shows that drainflow is proportional to water table depth. The plotted water levels represent mean monthly values computed from 950 biweekly measurements collected in Panoche Drainage District. Monthly drainflows are the reported 1991 district discharge from Panoche Drainage District. Minimum water table depth and maximum drainflow occurred during March (preirrigation) and July (the peak of the irrigation season). Maximum water table depth and minimum drainflow occurred during October and November, after the harvest and before the winter rains. The regression equation indicates drainflow ceases when the water table falls to a depth of about 9 feet below land surface. This agrees with reported maximum drain lateral depths in Panoche Drainage District, and probably represents the deeper collector lines and unlined ditches in the district.

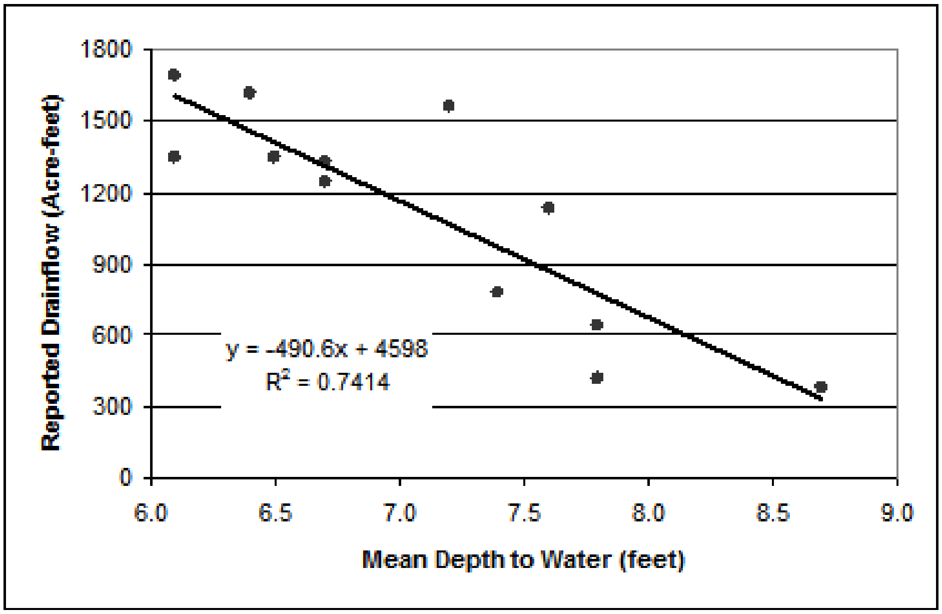


Figure 5-4 Relationships between Mean Monthly Water Table Depth and District Discharge from Panoche Drainage District, 1991

5.2.2.3 Soil Salinity Model

The unsaturated zone salt balance for No Action, the Proposed Action, and the Alternative Action Alternatives was calculated as explained in Appendix D. The concentration of soil salts is estimated as the mass of salts divided by the final soil moisture. The electrical conductivity of the soil saturation extract is used to represent soil water salinity.

Initial soil salinity for the GDA and SJRIP soils was estimated from soil extract data (Appendix D, Table D-2). The representative soil salinity in the primary agricultural areas of the GDA is 0.9 dS/m, and the representative soil salinity for the SJRIP fields is 5.2 dS/m. Water extract data were also used to estimate representative constituent concentrations in the soil that contribute to total soil salinity.

A comparison of data collected in one GDA field, first by Wichelns (1989) and then by Ayars et al. (1996), suggested that soil salinity increased from 1987 to 1995. The field is located in the southeastern portion of Broadview Water District (Township 13S, Range 13E). Wichelns (1989) reported an average soil salinity of 2.0 dS/m (sample values range from 2 to 8 dS/m) and Ayars et al. (1996) reported an average soil salinity of 4.9 dS/m (sample values range from 2 to 28 dS/m). These data suggest that soil salinity may have been increasing under the drainwater recycling conditions practiced in that area at the time.

Fujii et al. (1988) and Deverel and Fujii (1988) indicated calcite and gypsum are the primary minerals affecting soil and groundwater salinity in the GDA.

5.2.2.4 Groundwater Quality Model

HydroFocus used a mass balance approach to estimate changes in groundwater quality over time. The soil salinity model and groundwater flow model results provided salt loads to the saturated zone. Selenium and boron concentrations in western San Joaquin Valley groundwater samples are significantly correlated with salinity (Deverel and Millard 1988). HydroFocus utilized Deverel and Millard's (1988) published regression equations to estimate selenium and boron concentration changes due to simulated groundwater salinity changes. The equations describe the relationship among electrical conductivity, selenium, and boron concentrations in western San Joaquin Valley alluvial-fan groundwater.

5.2.2.5 Wetlands Water Quality

Grassland wetlands are typically seasonally flooded; inundation occurs in the fall and drainage in the early spring. Under these water management conditions, wetland drainage water salinity and its effects on receiving waters is influenced by soil conditions, the salinity of the input water, and water management practices. Study of the Grassland wetlands and discharge to the San Joaquin River illustrate these interacting factors (Grober et al. 1995). Approximately 10 percent of the salt in the San Joaquin River is derived from these wetland discharges. Grober and others (1995) identified evapotranspiration of soil water, drainage of poorly drained soils, and leaching soil salts leftover from when the wetlands received more saline agricultural drainage water as the primary processes resulting in saline discharges. Quinn and Karkoski (1998) and Quinn and Hanna (2002) demonstrated that early winter wetland discharges during high San Joaquin River flows substantially reduced salinity impacts to the river. Water quality impacts of permanently and reverse flooded wetlands have not been evaluated.

5.2.3 Environmental Impacts and Mitigation

5.2.3.1 No Use Agreement (No Action)

The No Action Alternative represents probable environmental conditions without the Grassland Bypass Project. Without the Grassland Bypass Project, the collection of drainwater into a single outlet for discharge ceases. Tile drainage systems continue to operate, but the drainwater presumably remains within the GDA. Some subsurface water would continue to seep into unlined drainage ditches and migrate uncontrolled into downslope wetlands.

HydroFocus employed average 2000–2007 water supply and consumptive use data to estimate groundwater and soil conditions under the No Action Alternative. Conditions at the beginning of Water Year 2008 (fall of calendar year 2007) were assumed to represent existing conditions. The analysis considers the projected changes in soil and groundwater conditions beginning in 2010, when the current Use Agreement expires, until 2019 when the Proposed Project is scheduled to end. Under No Action conditions, sump flows remain within the GDA, and the water is assumed to be recycled in a way that displaces an equal volume of canal water. Hence, the water application rate remains the same but the irrigation water salinity increases. The increase in irrigation water salinity is proportional to the fractional contribution of the canal water and drainwater. Excess drainwater that is not recycled within the districts was assumed to be used for irrigation in the SJRIP reuse facility. Beginning in 2010, no drainage water was allowed to leave the SJRIP facility.

5.2.3.1.1 Groundwater Effects

Under the No Action Alternative, the groundwater flow model projects a 0.9 foot decrease in mean water table depth beneath GDA tile drainage systems by 2019 relative to existing water table depths in 2008. Beneath the SJRIP, model results indicate the mean water table depth would decrease from about 5 feet in 2010 to less than 2.8 feet in 2019. These decreases in water table depth correspond to a water table rise and expansion of shallow groundwater conditions. The simulated water table changes have the following potential groundwater effects:

- In the drained areas, a decrease in water table depth corresponds to an increase in drainwater production (sump flow). The projected 2019 drainwater production is 1.65 feet per year and represents an increase of 0.74 foot per year relative to existing conditions. The 80-percent increase in drainwater production is a significant adverse impact to the GDA.
- Model results indicated a one square-mile net increase in area affected by a water table within 7 feet of land surface (increase from 114 to 115 square miles). The rising water table increased the evaporation rate from 0.26 foot per year in 2008 to 0.34 foot per year in 2019. The 30 percent increase in evaporation rate would be considered a significant adverse impact to the GDA.
- Uncontrolled discharge includes seepage and other water that cannot be recycled that enters into unlined drainage ditches. Flow model results indicate seepage into unlined ditches more than doubles relative to existing conditions. Unlike current conditions, the seepage and other discharges would not be collected and controlled. This would be considered a potentially significant adverse impact to adjacent areas.
- Groundwater beneath the GDA naturally moves to the northeast towards the wetlands and San Joaquin River. The subsurface flow either discharges uncontrolled to the adjacent wetlands or the San Joaquin River, or moves downward and recharges the deeper aquifer system. Model results indicate no significant change in subsurface flow northeast towards the wetlands and San Joaquin River. Deep aquifer recharge leaving the GDA decreases from 0.32 foot per year in 2008 to 0.29 foot per year in 2019.

5.2.3.1.2 Salinity Effects

Under the No Action Alternative, soil salinity increases as a result of increased drainwater recycling.

In the GDA, annual soil salinity increases from about 1.0 dS/m in 2008 (existing conditions) to 3.2 dS/m in 2019 (soil selenium increases from 11 to 35 micrograms per liter [µg/L], and boron increases from 0.9 to 1.9 mg/L). In the SJRIP, annual soil salinity increases from 6.6 dS/m in 2008 to 13.9 dS/m in 2019 (soil selenium increases from 73 to 152 µg/L, and boron increases from 3.4 to 6.6 mg/L). The more than three-fold soil salinity increase would be considered a significant adverse impact.

In the GDA, representative groundwater salinity decreases from almost 6 dS/m in 2008 (existing conditions) to about 5 dS/m in 2019 (soil selenium decreases from 47 to 34 µg/L, and boron decreases from 6.0 to 4.9 mg/L). The reduction in groundwater salinity, selenium, and boron concentrations would be considered a significant beneficial impact. In the SJRIP, representative annual groundwater salinity also decreases but to a lesser extent. SJRIP groundwater salinity decreases from 23 dS/m to 22 dS/m (soil selenium decreases from 816 to 742 µg/L, and boron decreases from 38.9 to 36.5 mg/L). These decreases in salinity and constituent concentrations would be considered less-than-significant beneficial impacts.

5.2.3.2 Grassland Bypass Project, 2010–2019 (Proposed Action)

The continuation of the Grassland Bypass Project is the Proposed Action. One project feature is the SJRIP reuse facility designed to meet the substantial load reductions due to revised water quality objectives that began October 1, 2005. The Proposed Action intends to increase drainage reuse and expand the drainwater reuse/treatment facility up to 6,900 acres to help meet the new objectives. The SJRIP grows salt-tolerant crops on dedicated lands irrigated with drainwater. The treatment element is to be designed to further reduce drainwater volume; remove salt, selenium, and boron from concentrated drainwater; and utilize in-valley salt disposal to prevent discharge to the San Joaquin River after 2019.

In the groundwater-flow model, the SJRIP reuse facility is simulated to begin operating in 2000 with less than 4,000 acres in operation. Only 50 percent of the facility was initially simulated as having tile drains. Tile drains were added to the existing facility in 2010, 2012, and 2014 until the entire area was drained. In 2015, the facility was simulated as expanding to over 6,000 acres with tile drains existing under the entire facility.

The proposed 2010 Use Agreement also contains two proposals by the California Department of Fish and Game (CDFG) and U.S. Fish and Wildlife Service (Service) to expand wetland habitat by 31.6 to 76.8 acres as “mitigation” for continued discharges to Mud Slough. The Grassland Area Farmers and CDFG propose the development of mitigation reverse flooded wetlands adjacent to the San Joaquin River and Mud Slough at the CDFG China Island facility, and the Service proposal establishes year-round wetland marsh habitat. Shallow groundwater quality changes due to these wetlands were calculated assuming steady-state, well-mixed wetland water and shallow groundwater and are, thus, applicable to long-term conditions (several years to decades).

HydroFocus employed average 2000–2007 water supply and consumptive use data to identify potentially significant impacts. The analysis period is 2010–2019. For the purposes of the groundwater analysis, annual water application rates are held constant.

5.2.3.2.1 Groundwater Effects

The groundwater flow model projects no net change in mean water table depth beneath the drained areas of the GDA during the project period (Figure 5-5a). The mean depth to water beneath drained areas remains at 6.4 feet below land surface. Beneath the SJRIP reuse facility, the mean depth to groundwater increases 1.5 feet during the project period (Figure 5-5b). The increased depth to water is the result of the additional tile drainage systems added to presently undrained land areas as part of the continued Grassland Bypass Project. The new drainage systems remove excess water table recharge and, therefore, lower the water table. Simulated water table conditions have the following potential groundwater effects:

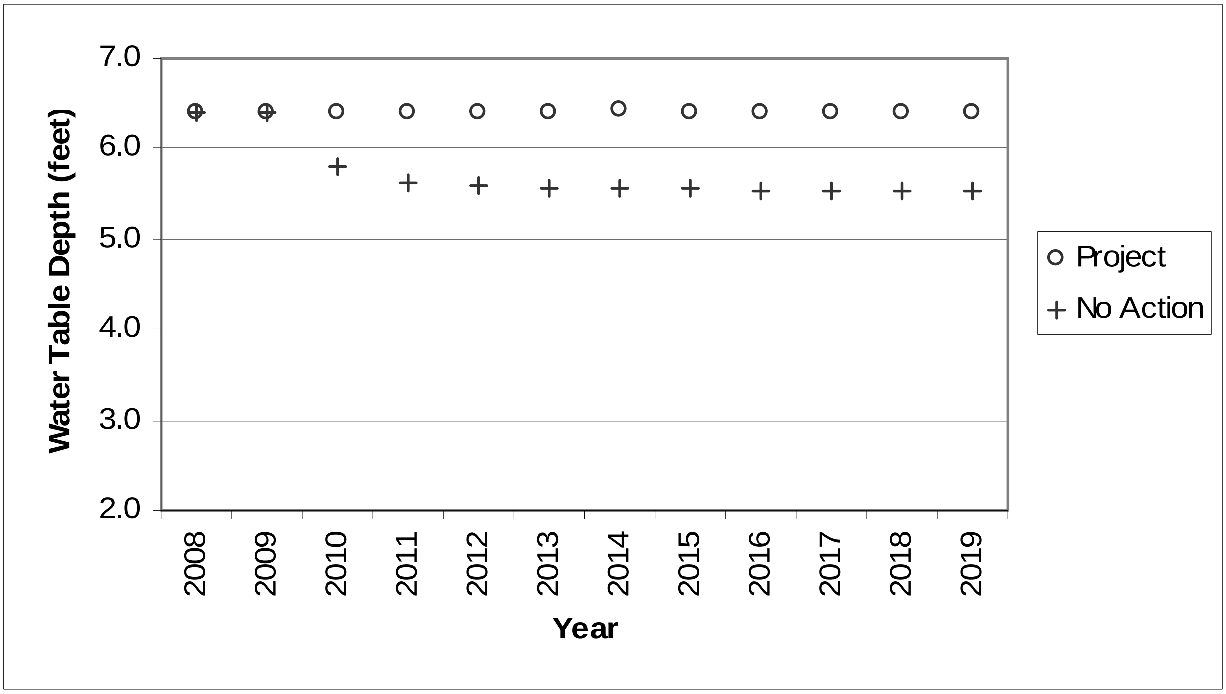


Figure 5-5a Simulated Mean Water Table Depth beneath the GDA for Proposed Action and No Action, 2008–2019

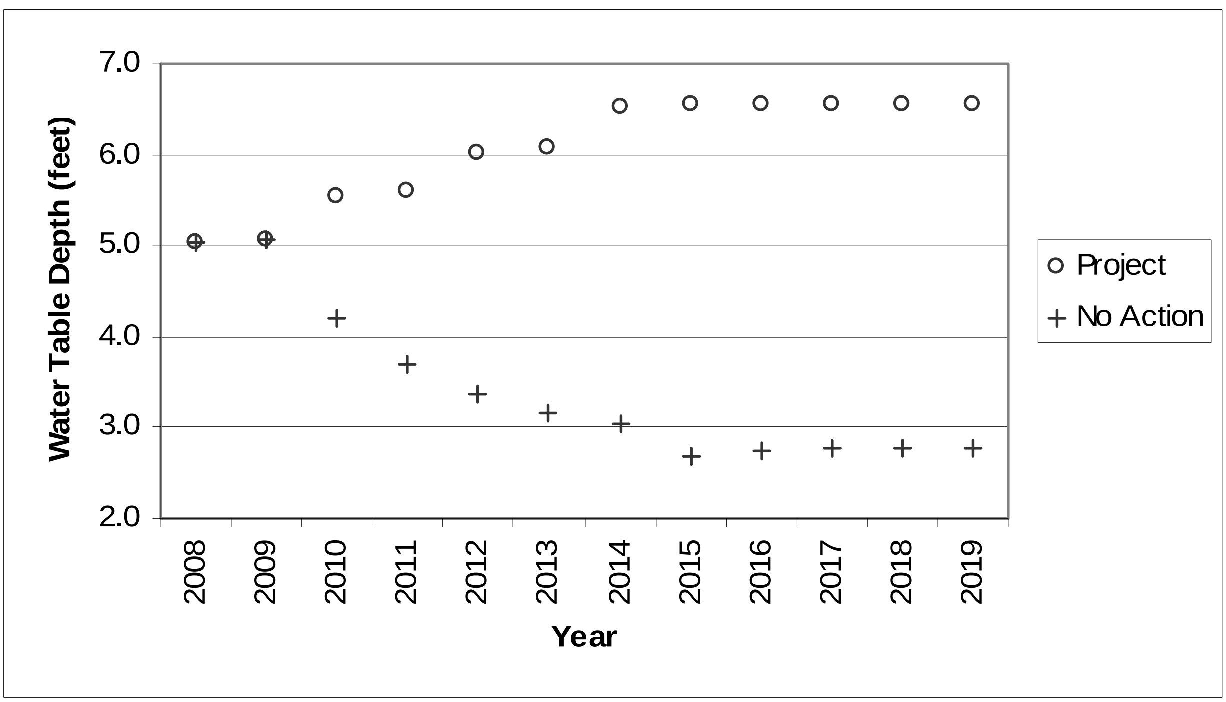


Figure 5-5b Simulated Mean Water Table Depth beneath the SJRIP reuse facility for Proposed Action and No Action, 2008–2019

- No net change in GDA water table depth beneath the drained areas corresponds to no net change in drainwater production rates. Simulated sump flows in 2010 and 2019 are both 0.9 foot per year, which is the same as existing (2008) conditions. In 2019, projected sump flows are about 0.75 foot per year less than estimated for the No Action Alternative. The continuation of the Grassland Bypass Project, 2010–2019, is considered, therefore, to have a positive effect on drainwater production relative to the No Action Alternative, and no impact relative to existing conditions.
- Model results indicate that about 138 square miles would be affected by a water table within 7 feet of land surface, which is the same condition as the No Action Alternative. Under simulated project conditions, the net bare-soil evaporation rate increased from 0.26 foot per year in 2008 to 0.27 foot per year in 2019 (an increase of 0.01 foot per year, or less than 4 percent). The Proposed Action is therefore considered to have a less than significant impact on evaporation rates relative to existing conditions. The net bare-soil evaporation rate in 2019 is 0.07 foot per year less for the Proposed Action than for the No Action Alternative. The Proposed Action is considered, therefore, to have a positive effect on bare-soil evaporation rates relative to the No Action Alternative.
- Uncontrolled discharge includes seepage into unlined drainage ditches. Flow model results for the Proposed Action indicate an almost 75 percent decrease in seepage to unlined canals compared to existing conditions (2008), and a 90 percent decrease in 2019 seepage rates compared to the No Action Alternative. Unlike the No Action Alternative, seepage and other nonrecyclable waters that enter the drainage ditches would be collected and discharged to the Grassland Bypass. The Grassland Bypass Project, 2010–2019, is considered, therefore, to have a significant beneficial impact relative to existing conditions and positive effect relative to the No Action Alternative by reducing and controlling these discharges.
- Model results indicate there is no significant change in subsurface flow northeast towards the wetlands and San Joaquin River. Deep aquifer recharge decreases from 0.32 foot per year under current conditions (2008) to 0.30 foot per year in 2019 (a reduction of less than 7-percent), and therefore the Proposed Project is considered to have a beneficial impact. Deep aquifer recharge decreases from 0.32 foot per year to 0.29 foot per year for the No Action Alternative, and therefore the Proposed Action is considered to have a positive effect relative to the No Action Alternative.

5.2.3.2.2 Salinity Effects

In the western San Joaquin Valley minerals are present in the unsaturated zone. As the crop uses water, and soluble salts are evapoconcentrated, gypsum and calcite minerals are precipitated. Rain, salt dilution by applied water, and salt removal by drainage systems offset the salinity increases due to evapoconcentration. Therefore, soil salinity will approach a constant value; and the final salinity represents a new chemical equilibrium under simulated steady-state soil moisture conditions.

For the 2010–2019 project period, the analysis indicates that soil salinity would increase as a result of current drainwater recycling. This conclusion is supported by data reported by Wichelns (1989) indicating an average soil salinity of 2.0 dS/m for a field located in what was formerly Broadview Water District. Ayers et al. (1996) reported an average soil salinity of 4.9 dS/m for the same field. These data suggest soil salinity may have increased under the past drainwater recycling conditions practiced in Broadview Water District. Presently, irrigated agriculture is no longer conducted in the former Broadview Water District.

For the continued Grassland Bypass Project, 2010–2019, the salinity modeling identified the following potential impacts to soil and groundwater:

- Simulated unsaturated-zone soil salinity for the GDA increases from 1.0 dS/m in 2008 (existing conditions) to 1.9 dS/m in 2019 (Figure 5-6), which is substantially less than estimated for the No Action Alternative (an estimated soil salinity increase from 1.0 to 3.2 dS/m by 2019). The increase in unsaturated-zone soil salinity relative to existing conditions is considered to be a less-than-significant impact because the soil remains productive. The unsaturated zone soil salinity increases in the GDA are substantially less than for the No Action Alternative. Therefore, the Grassland Bypass Project is considered to have a positive effect on soil salinity relative to the No Action Alternative. Because the observed coefficient of variation in western San Joaquin Valley soil salinity is large, the simulated soil salinity increases would not be observable over a short-time period (for example, 10 years) without extensive sampling.

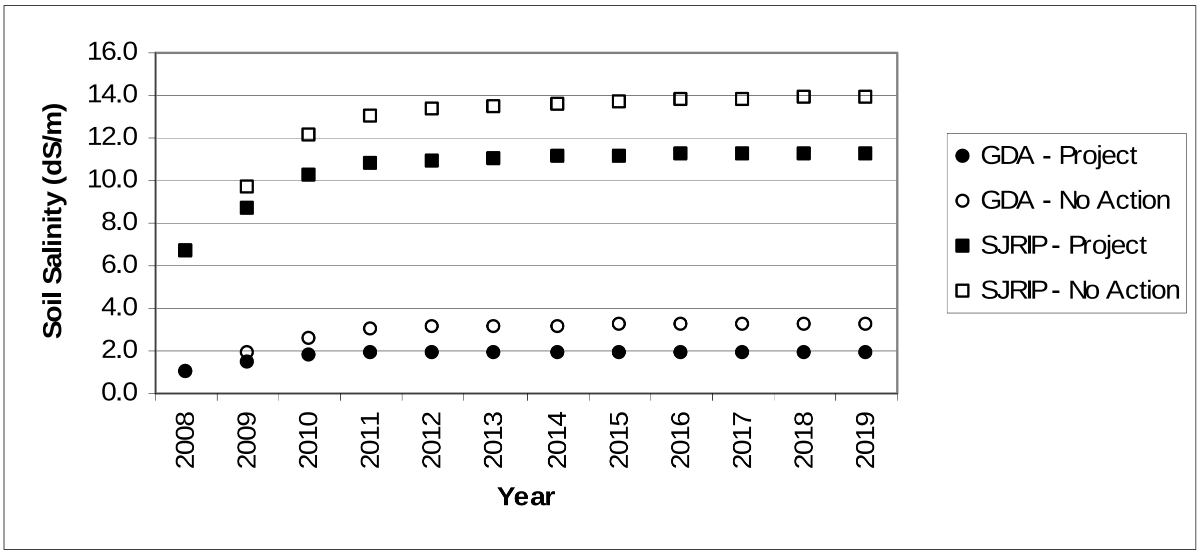


Figure 5-6 Simulated Annual Soil Salinity Changes for Proposed Action and No Action, 2008–2019

- In the GDA, estimated soil selenium increases from 11 µg/L in 2008 to 21 µg/L in 2019, and boron increases from 0.9 to 1.3 mg/L. In the SJRIP during the same time period, soil selenium concentrations increase from 73 to 124 µg/L, and boron concentrations increase from 3.4 to 5.5 mg/L. The increase in selenium and boron concentrations relative to existing conditions is considered to be a significant unavoidable impact of irrigating western San Joaquin Valley soils. The concentrations will not affect agricultural productivity, but may with time influence selenium concentrations in underlying shallow groundwater and agricultural drainwater. However, the drainwater is treated by the SJRIP, which will include as part of its Phase III development salt and selenium treatment. The selenium and boron concentration increases are less than the No Action Alternative. The continuation of the Grassland Bypass Project is considered, therefore, to have a positive effect on soil selenium and boron concentrations relative to the No Action Alternative.

- Groundwater salinity in the GDA decreases from 6 dS/m in 2008 to 4 dS/m in 2019 (Figure 5-7), which is a greater salinity reduction than estimated for the No Action Alternative (a decrease from 6 to 5 dS/m by 2019). The continuation of the Grassland Bypass Project is considered to have a significant beneficial impact relative to existing conditions because the groundwater salinity decreases over time. The groundwater salinity also decreases by 2019 relative to the No Action Alternative, although not as much. Therefore, the continuation of the Grassland Bypass Project is considered to have a positive effect on groundwater salinity relative to the No Action Alternative.

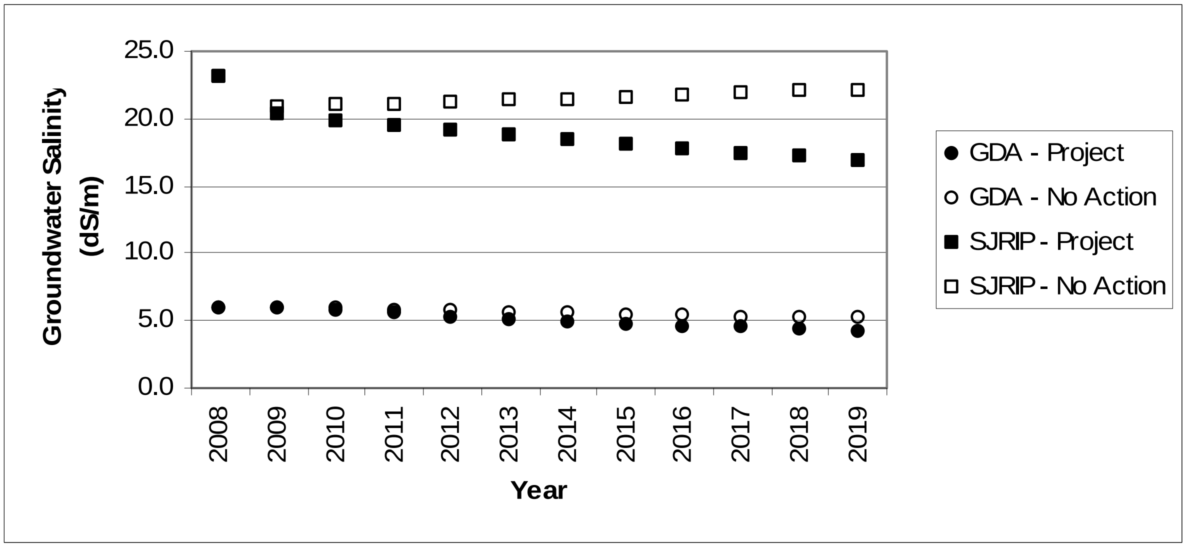


Figure 5-7 Simulated Annual Groundwater Salinity Changes for Proposed Action and No Action, 2008–2019

The coefficient of variation for groundwater salinity is more than 40 percent, meaning a large number of samples would be needed to detect the simulated salinity changes. Drainwater data are limited for representing groundwater quality because salt transport, mixing along groundwater flow paths, and irrigation management practices can conceal short-term salinity changes.

- In the GDA, simulated groundwater selenium concentrations decrease from 47 to 22 µg/L, and boron concentrations decrease from 6.0 to 3.7 mg/L. The continuation of the Grassland Bypass Project is, therefore, considered to have a significant beneficial impact on selenium and boron concentrations relative to existing conditions. Selenium and boron concentrations in 2019 are less than under the No Action Alternative and the Grassland Bypass Project is considered to have a potentially positive effect on groundwater quality relative to the No Action Alternative.

- In the SJRIP, the unsaturated-zone soil salinity increases from 6.6 dS/m in 2008 to 11.2 dS/m in 2019, but the salinity increases are substantially less than estimated for the No Action Alternative (a soil salinity increase from 6.6 to 13.9 dS/m) (Figure 5-5). Although the soil salinity increases under Proposed Action conditions represent significant changes, they are less than what is expected under the No Action Alternative and are spatially limited to at most 6,900 acres (6 percent of the GDA). The soil salinity changes are also considered reversible; impacted soils could be reclaimed and saline shallow groundwater removed when an alternative means of salt disposal becomes available under Phase III. The continuation of the Grassland Bypass Project is therefore considered to have a less-than-significant adverse impact on unsaturated zone soil salinity in the GDA relative to existing conditions, and a positive effect on GDA soil salinity relative to the No Action Alternative.

- Under the Proposed Action, simulated groundwater salinity concentrations beneath the SJRIP decrease from 23 dS/m in 2008 to almost 17 dS/m by 2019, and the salinity reduction is substantially greater than estimated for the No Action Alternative (a decrease from 23 to 22 dS/m) (Figure 5-7). Simulated groundwater selenium concentrations therefore also decrease from 816 to 419 µg/L, and boron concentrations decrease from 38.9 to 25.2 mg/L. Compared to existing conditions, the continuation of the Grassland Bypass Project is considered to have a significant beneficial impact effect on groundwater quality beneath the SJRIP. The continuation of the Grassland Bypass Project is considered to have a positive effect on groundwater quality beneath the SJRIP relative to the No Action Alternative.

  The SJRIP reuse facility's operational objective is not agricultural production but water consumption. Treatment facility fields would be planted with salt-tolerant crops and managed to limit soil salinity impacts. Therefore, the area-limited application of undiluted drainwater is a less-than-significant impact to the GDA. Soil and drainwater quality monitoring are being conducted to track salinity changes beneath the treatment facility.

5.2.3.2.3 Wetlands Effects

Water delivered to the CDFG wetland complex for Mud Slough mitigation in the 2010 Use Agreement would initially saturate the soil and fill swales and ponds. Continued water supply would meet evapotranspiration and seepage. Water in excess of evapotranspiration would move by way of the subsurface towards the San Joaquin River. Historically, this area was inundated by flood water from the San Joaquin River about every 6 years (Joseph McGahan, pers. comm., 2008). This will provide periodic flushing of saline water.

The salinity of the shallow groundwater would be less than the current average shallow groundwater salinity that probably flows to the San Joaquin River (Appendix D). Potential water quality effects of groundwater deliveries to the Service facility were not calculated due to lack of information about irrigation water quality and water management practices. However, if managed similarly to the CDFG facility (large volumes of irrigation and seepage water), there would likely be no net salinity increase over the long term. The key uncertainties in the estimate are the impacts of short-term and transient changes in wetland salinity and water quality. The calculations assume steady-state, well-mixed wetland water and shallow groundwater, and are thus applicable to the long term (several years to decades). Additional analysis is required to assess short-term (seasonal and annual) changes. See Appendix D, Section D.4.2.3 for a more detailed analysis of the wetland mitigation component of the 2010 Use Agreement.

5.2.3.3 2001 Requirements Alternative (Alternative Action)

The 2001 Requirements Alternative is the same as the Proposed Action except the selenium and salt loads discharged to Mud Slough would be limited to those in the 2001 Use Agreement (i.e., less stringent allowances). Drainwater would continue to be collected and discharged from the GDA. Accordingly, estimated groundwater and soil impacts within the GDA are identical to the Proposed Action.

5.2.4 Cumulative Effects

Cumulative effects are impacts that are minor or insignificant on their own but when combined with other incremental effects can become significant. Although the Proposed Action and 2001 Requirements Alternatives are projected to have no adverse water table, soil, and groundwater impacts, GDA irrigation recharge contributes to ongoing regional increases in water table elevation, soil salinity, and groundwater salinity (Belitz et al. 1993). Conversely, irrigation recharge in adjacent and upslope areas contributes to water table elevation, soil salinity, and groundwater salinity increases in the GDA.

In the Grassland and Westland subbasins, California Department of Water Resources (2000) reported the area underlain by a water table within 10 feet of land surface has on the average increased by about 20,000 acres per year during the period 1991–97. The San Joaquin Valley Drainage Implementation Program (1998) reported that in 1990 alone, almost 1.5 million tons of salt were imported and deposited into western San Joaquin Valley soils and water. The water table rise and salinization of soil and groundwater is a significant regional problem.

5.2.5 Impact and Mitigation Summary

Table 5-2 summarizes the groundwater and soil impacts listed in Section 5.2.5.1. The impacts are evaluated relative to the No Action Alternative and existing conditions.

Impacts and mitigation (for action alternatives only) are presented for the different alternatives. Impacts are discussed by affected area. Significance determinations under CEQA are based on comparisons to existing conditions. NEPA requires a comparison of the Action Alternatives with No Action. The NEPA comparisons use the following terms: “negative” for adverse effect, “neutral” for no effect or minimal effect, and “positive” for a beneficial effect. These impacts are discussed below.

Table 5-2 Summary Comparison of Groundwater and Soil Impacts

Parameter or Anticipated Environmental Effect	No Action Compared to Existing Condition	Proposed Action Compared to No Action	Proposed Action Compared to Existing Condition	Alternative Action Compared to No Action	Alternative Action Compared to Existing Condition
Drainwater production	*Significant Adverse Impact* Decrease in water table depth corresponds to an increase in drainwater production	*Positive* In 2019, projected drainflow is about 45 percent of drainflow projected under No Action	*No Impact* In 2019, projected drainflow is similar to existing conditions	*Positive* In 2019, projected drainflow is about 45 percent of drainflow projected under No Action	*No Impact* In 2019, projected drainflow is similar to existing conditions
Area affected by shallow water	*Less-Than-Significant Adverse Impact* Minimal projected net increases in the area affected by a shallow water table (1 sq. mi.)	*Neutral* Minimal projected net increases in the area affected by a shallow water table (1 sq. mi.)	*Less-Than-Significant Adverse Impact* Minimal projected net increases in the area affected by a shallow water table (1 sq. mi.)	*Neutral* Minimal projected net increases in the area affected by a shallow water table (1 sq. mi.)	*Less-Than-Significant Adverse Impact* Minimal projected net increases in the area affected by a shallow water table (1 sq. mi.)
Bare-soil evaporation rate	*Significant Adverse Impact* Increase in bare-soil evaporation rate	*Positive* 20 percent decrease in the bare-soil evaporation rate	*Less-Than-Significant Adverse Impact* Small increase in the bare-soil evaporation rate	*Positive* 20 percent decrease in the bare-soil evaporation rate	*Less-Than-Significant Adverse Impact* Small increase in the bare-soil evaporation rate

Table 5-2 Summary Comparison of Groundwater and Soil Impacts

Parameter or Anticipated Environmental Effect	No Action Compared to Existing Condition	Proposed Action Compared to No Action	Proposed Action Compared to Existing Condition	Alternative Action Compared to No Action	Alternative Action Compared to Existing Condition
Unmanaged seepage and other discharges	*Significant Adverse Impact* Seepage into unlined ditches more than doubles and unmanaged flows would not be collected and impact adjacent areas	*Positive* 90 percent decrease in seepage to unlined canals	*Significant Beneficial Impact* 75 percent decrease in seepage to unlined canals	*Positive* 90 percent decrease in seepage to unlined canals	*Significant Beneficial Impact* 75 percent decrease in seepage to unlined canals
Soil salinity*	*Significant Adverse Impact* Threefold increase in soil salinity	*Positive* Unsaturated-zone soil salinity increases in the GDA are substantially less	*Less-Than-Significant Adverse Impact* Unsaturated-zone soil salinity in the GDA doubles but soil remains productive	*Positive* Unsaturated-zone soil salinity increases in the GDA are substantially less	*Less-Than-Significant Adverse Impact* Unsaturated-zone soil salinity in the GDA doubles but soil remains productive
Soil selenium and boron	*Significant Beneficial Impact* Reductions in selenium and boron concentrations	*Positive* Selenium and boron concentrations are less	*Significant Adverse Impact/Unavoidable* Increase in selenium and boron concentrations	*Positive* Selenium and boron concentrations are less	*Significant Adverse Impact/Unavoidable* Increase in selenium and boron concentrations
Groundwater salinity*	*Significant Beneficial/ Less-Than-Significant Beneficial Impact* Groundwater salinity decreased slightly	*Positive* Salinity decreases over time	*Significant Beneficial Impact* Salinity decreases over time	*Positive* Salinity decreases over time	*Significant Beneficial Impact* Salinity decreases over time
Wetlands enhancement for continued discharge to Mud Slough	*No impact* There would be no wetlands enhancement	*Minimal/Neutral* Short-term transient changes/No net salinity increases over long term.	*Less-Than-Significant Adverse Impact/No Impact* Short-term transient changes/No net salinity increases over long term.	*Neutral* There would be no wetlands enhancement	*No Impact* There would be no wetlands enhancement

*GDA drained area/SJRIP reuse facility

5.2.5.1 No Action

The No Action Alternative represents probable environmental conditions without the continuation of the Grassland Bypass Project, 2010–2019. Tile drainage systems continue to operate, but the drainwater produced presumably remains within the GDA.

- A decrease in water table depth corresponds to an increase in drainwater production and a significant adverse impact to the GDA.
- Minimal projected net increases in the area affected by a shallow water table (1 square mile) indicate a less-than-significant adverse impact to the GDA.
- In contrast, the increase in bare-soil evaporation rate was considered a significant adverse impact to the GDA.
- Flow model results indicate seepage into unlined ditches more than doubles relative to existing conditions. Unlike current conditions, unmanaged flows would not be collected, and therefore the seepage increases represent a significant adverse impact to adjacent areas.
- The threefold increase in soil salinity represents a significant adverse impact.

- Estimated groundwater salinity decreased slightly relative to existing conditions. This is a less-than-significant to significant beneficial impact on the GDA. However, the results may indicate assumed initial groundwater salinity values are too high relative to representative soil salinity levels and the prescribed chemical compositions of the different water sources.

5.2.5.2 Proposed Action

The continuation of the Grassland Bypass Project, 2010–2019, is the Proposed Action. The analysis indicated the following effects:

- In 2019, projected drainflow under the Proposed Action is similar to existing conditions and is about 45 percent of the drainflow projected under the No Action Alternative. The Proposed Project is considered, therefore, to have no impact relative to existing conditions and a positive effect on drainwater production relative to the No Action Alternative. No mitigation is required.
- Minimal projected net increases in the area affected by a shallow water table (1 square mile) indicate that the Proposed Action has a less-than-significant adverse impact relative to existing conditions (no mitigation required) and no impact/neutral relative to the No Action Alternative.
- A small increase in the bare-soil evaporation rate compared to existing conditions is considered to be a less-than-significant impact relative to current evaporation rates. A 20 percent decrease in the bare-soil evaporation rate relative to the No Action Alternative is considered to be a positive effect from the Proposed Action. No mitigation is required.
- Flow model results for the Proposed Action indicate an almost 75 percent decrease in seepage to unlined canals compared to existing conditions (2008), and a 90 percent decrease in 2019 seepage rates compared to the No Action Alternative. The Proposed Action is considered, therefore, to have a significant beneficial impact relative to existing conditions and positive effect compared to the No Action Alternative. No mitigation is required.
- Simulated unsaturated-zone soil salinity increases in the GDA are substantially less relative to the No Action Alternative. The Proposed Action is considered, therefore, to have a positive effect on soil salinity relative to the No Action Alternative. No mitigation is required. Simulated unsaturated-zone soil salinity almost doubles relative to existing conditions, but is considered a less-than-significant adverse impact because the soil remains productive. Soil and groundwater monitoring of the GDA is recommended to identify these impacts and potential salinity changes at GDA boundaries, if any. No mitigation is required.
- In the GDA, the increase in selenium and boron concentrations relative to existing conditions is considered to be a significant unavoidable impact of irrigating western San Joaquin Valley soils. The concentrations will not affect agricultural productivity, but may with time influence selenium concentrations in underlying shallow groundwater and agricultural drainwater. However, the drainwater is treated by the SJRIP, which will include as part of its Phase III development salt and selenium treatment. The selenium and boron concentration increases are less than the No Action Alternative. The continuation of the Grassland Bypass Project is considered, therefore, to have a positive effect on soil selenium and boron concentrations relative to the No Action Alternative.

- Simulated groundwater salinity decreases over time and is less than simulated for the No Action Alternative. The Proposed Action is considered, therefore, to have a potentially positive effect on groundwater salinity relative to the No Action Alternative. Simulated groundwater salinity also decreases relative to existing conditions and is considered to be a significant beneficial impact. However, the results may indicate assumed initial groundwater salinity values are too high relative to representative soil salinity levels and the prescribed chemical composition of the different water sources. No mitigation is required.
- Soil and groundwater salinity would increase more dramatically where drainwater is applied directly to fields. In the SJRIP reuse facility, undiluted drainwater is applied directly to fields. The increase in projected soil salinity concentrations is less than simulated under the No Action Alternative and therefore the Proposed Action is considered to have a positive effect. In the Proposed Action, groundwater salinity decreases relative to both existing conditions and the No Action Alternative, and the Proposed Action is considered to provide a significant beneficial impact/positive effect.

  Projected soil salinity concentrations at the SJRIP facility increase. The impacts would be limited to at most 6,900 acres (6 percent of the GDA). The treatment facility would be managed to optimize consumptive use of water, and impacted soils could be reclaimed and saline shallow groundwater removed when an alternative means for salt disposal becomes available under Phase III. The Proposed Action is therefore considered to have a less-than-significant adverse impact relative to existing conditions. Soil and groundwater monitoring of the SJRIP reuse facility is recommended to identify impacts and potential salinity changes at facility boundaries, if any.
- The wetlands enhancement component of the 2010 Use Agreement would cause no net salinity increase over the long term. The key uncertainties in the calculations are the impacts of short-term and transient changes in wetland salinity and water quality.

5.2.5.3 Alternative Action

The 2001 Requirements Alternative is the same as the Proposed Action except the selenium and salt loads discharged to Mud Slough would be limited to those in the 2001 Use Agreement (i.e., less stringent allowances). Drainwater would continue to be collected and discharged from the GDA. The SJRIP reuse facility would be included. The estimated groundwater and soil impacts are therefore identical to the continuation of the Grassland Bypass Project, 2010–2019.

SECTION 6

Biological Resources

This section describes the biological resources in the Project Area and evaluates potential impacts to these resources from implementation of the Proposed or Alternative Actions.

6.1 AFFECTED ENVIRONMENT

6.1.1 Introduction

Before settlement of the Central Valley began in the 19th century, a diverse landscape supported large populations of both resident and migratory species of fish and wildlife. Today, most of these aquatic, wetland, and riparian forest habitats have been converted to agricultural, municipal, and other uses. Perhaps less than 1 percent of the freshwater lakes, only about 7 percent of the riparian forests, and less than 15 percent of the original wetlands remain (SJVDP 1990). As a result, some native plants and animals have vanished from the landscape, and the continued existence of many others is in serious jeopardy. The populations of birds that once lived in or visited the valley as migrants have been drastically reduced; and the grizzly bear, the prong-horned antelope, and the gray wolf have disappeared entirely (SJVDP 1990). See Appendix E1 for scientific names of species used in the text.

Impoundments and diversions from the San Joaquin River and its tributaries have altered the fisheries of the San Joaquin Valley. Native fish have declined, and introduced species now are dominant. Chinook salmon, once sufficiently abundant to have at least a spring run and a fall run, have been greatly reduced in population.

About 200,000 acres of private and public land and water in San Joaquin Valley are presently managed as parks, refuges, and preserves, primarily for the benefit of fish and wildlife (Service 1990). These areas, which support native habitats, include state and federal wildlife areas (as shown on Figure 7-1 [in Section 7, Land Uses] and summarized in Table 6-1), state fishery facilities, private duck clubs, special management areas, and private nature preserves. Figure 7-1 shows the federal and state wildlife areas in the Project Area as well as the Grassland Water District (GWD) boundary. Until recently, more than half the water supplies for wildlife habitat within the Project Area was provided by agricultural drainage, but use of drainwater for such purposes has been discontinued on wildlife areas and replaced with freshwater supplies.

Table 6-1 State and Federal Wildlife Areas in the Project Vicinity

Federal	State
San Luis National Wildlife Refuge Complex	North Grasslands Wildlife Area
▪ Kesterson Unit	▪ China Island Unit
▪ Freitas Unit	▪ Salt Slough Unit
▪ Blue Goose Unit	▪ Gadwall Unit
▪ West Bear Creek Unit	
▪ East Bear Creek Unit*	Los Banos Wildlife Area
▪ San Luis Unit	▪ Los Banos Unit
	▪ Mud Slough Unit
Merced National Wildlife Refuge*	
▪ Arena Plains Unit*	Volta Wildlife Management Area
▪ Merced Unit	
▪ Snobird Unit	Mendota Wildlife Area
▪ Lonetree Unit	

*East side of San Joaquin River

The total Project Area is subdivided into three subareas as discussed in Section 2.1.2, Project Location, and shown on Figure 2-1, Project Location and Features Map. The three sections of the Project Area are:

- **Area 1 (the GDA):** the 97,400-acre source zone known as the Grassland Drainage Area (GDA), located in the Central Valley of California, specifically in Merced and Fresno Counties.
- **Area 2 (Area 2):** 93 miles of wetlands channels, Salt Slough, and the San Joaquin River from the confluence of Salt Slough downstream to Mud Slough. This area is located within the GWD and state/federal wildlife management areas, and under current conditions does not receive water directly from the source zone.
- **Area 3 (Area 3):** the San Luis Drain (Drain) from Russell Avenue on the south to its northern terminus at Mud Slough, 6 miles of Mud Slough upstream of its confluence with the San Joaquin River, and the San Joaquin River downstream from Mud Slough to Crows Landing. This area comprises the drainage pathway from the source zone through the San Joaquin River, and, under current conditions, includes those habitats affected by selenium (Se)- and salt-rich drainage water.

Laboratory and field research has demonstrated that elevated waterborne and/or dietary concentrations of several trace elements in the San Joaquin Valley drainwaters are toxic to fish and wildlife. Se is the most toxic of these; other constituents include arsenic, boron, chromium, mercury, molybdenum, and salts (SJVDP 1990). The bioaccumulative food chain threat of Se contamination on fish and aquatic birds has been well documented. Though few data specifically address the toxicity of Se, mercury, or metals to reptiles, it is hypothesized that reptiles have toxicity thresholds similar to fish and birds (58 FR 54053 under Factor E - Contaminants).

6.1.2 Existing Habitats and Communities

6.1.2.1 Native Habitats

Native habitat types within the Project Area are identified and described in this section. Where present, these habitats are utilized by and support numerous plant and wildlife species, including threatened and endangered (T&E) species. Habitat types have generally been classified according to the standard descriptions used in the Wildlife Habitats Relationship system (Mayer and Laudenslayer 1988). However, some of the habitat types are derived from the natural community classification utilized by the California Natural Diversity Data Base (CNDDB 2000). Descriptions of each habitat type, including relative location and distribution, and dominant vegetative structure, are provided below.

6.1.2.1.1 Annual and Perennial Grasslands

These habitats occur throughout the Central Valley, mostly on level plains to gently rolling foothills. Annual grasslands are composed primarily of annual grass and forb species and occur at elevations immediately higher than or surrounding valley-foothill riparian and iodine bush scrub habitats. Perennial grasses, such as purple needle grass and alkali sacaton, are typically found in moist, lightly grazed relict area within the annual grassland habitat. Annual grasses found in grassland habitats include wild oats, soft chess, ripgut brome, medusa head, wild barley, red brome, and slender fescue. Perennial grasses comprising grasslands include purple needlegrass and alkali sacaton. Forbs common within grasslands include long-beaked filaree, redstem filaree, clover, Mariposa lily, popcornflower, and California poppy.

Grassland habitats are important foraging areas for white-tailed kite, red-tailed hawk, Swainson’s hawk, northern harrier, American kestrel, yellow-billed magpie, loggerhead shrike, savannah sparrow, American pipit, mourning dove, Brewer’s blackbird, red-winged blackbird, and a variety of swallows. Birds such as killdeer, ring-necked pheasant, western kingbird, western meadowlark, and horned lark nest in grassland habitats. Blunt-nosed leopard lizards may inhabit grassland areas and use abandoned or occupied rodent burrows to avoid predators and temperature extremes (Service 1998). San Joaquin kit foxes, as well as giant and Fresno kangaroo rats, will utilize grassland habitats in areas of gentle slopes and well-drained, fine loam and sandy-loam soils, which support nonnative annual grasses and forbs. Areas within these grasslands that are dominated by prickly lettuce (*Lactuca serriola*) or Russian thistle (*Salsola kali*) are typically avoided by these species (S. Hagen, pers. comm., 2008).

6.1.2.1.2 Vernal Pools

Vernal pools are a special form of wetland found within grassland habitats throughout California and occur within the Grassland Wetlands area. Vernal pools are shallow depressions filled with water from winter storms that subsequently dry during spring or early summer. The length of time that the water persists, salinity, and alkalinity generally determine herbaceous plant species composition., which is characterized by annuals (Holland and Keil 1987).

Vernal pools a flora dominated by annual species that germinate when the pools become saturated or inundated and complete their flowering, set seed, and die as the pool dries. Vernal pool species flower along the drying margins of the pools, resulting in conspicuous zonation patterns formed by consecutively blooming species. Characteristic dominant plants include popcornflowers, low barley, downingia, coyote thistle, goldfields, meadowfoam, owl’s clover, pogogyne, woolly marble, and navarretia.

Although vernal pools are an ephemeral aquatic habitat, invertebrates and amphibians adapted to seasonal wetting and drying use them. When standing water is available, the California tiger salamander, western spadefoot toad, and Pacific treefrog may use the pools for egglaying and for larval development. Aquatic invertebrates such as cladocerans, copepods, branchiopods, and crawling water beetles may also inhabit vernal pools. In winter and spring, waterbirds such as mallard, cinnamon teal, killdeer, California gull, green-backed heron, great blue heron, and great egret may use vernal pools for resting and foraging. Western kingbird, black phoebe, and Say’s phoebe feed on flying insects above vernal pools. Several federally listed branchiopods, including longhorn fairy shrimp, conservancy fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp occur in vernal pools.

6.1.2.1.3 Iodine Bush Scrub

This type of chenopod shrub habitat is dominated by iodine bush. Plant species comprising this habitat include alkali heath, alkali weed, pickleweed, alkali sacaton, and saltgrass. In addition, plant species such as greasewood, rusty molly, samphire, bush seepwood, and shadscale may be present (Sawyer and Keeler-Wolf 1995). This vegetation type is included in the Holland classification of alkali scrub or alkali sink shrubland. Iodine bush scrub occurs in San Joaquin Valley in areas with low precipitation and low relative humidity, hot summer and cool winter temperatures, and high levels of solar radiation. Plant species composition varies along moisture, salinity, and microtopographic gradients (Holland and Keil 1987). Vegetation structure can vary greatly within short distances in this type (Kuchler 1977).

Common birds foraging or nesting in iodine bush scrub include roadrunner, mourning dove, blue-gray gnatcatcher, common raven, sage sparrow, white-crowned sparrow, house finch, and American and lesser goldfinch. Common mammals include pocket gopher, California ground squirrel, desert cottontail, deer mouse, California vole, Heermann’s kangaroo rat, black-tailed hare, striped skunk, badger, and coyote. Reptiles, such as side-blotched lizard, western whiptail, western fence lizard, gopher snake, and western rattlesnake, are commonly observed in iodine bush habitat. Special-status reptile species such as the blunt-nosed leopard lizard and coast horned lizard may also inhabit this habitat type. Flocks of the mountain plover, a CDFG Species of Special Concern, may be observed wintering in this habitat. Kangaroo rats, as well as other rodent species such as pocket mice and grasshopper mice, commonly occupy scrub habitats. Scrub habitats are regularly used by kit foxes for foraging and occasionally as denning sites (S. Hagen, pers. comm., 2008).

6.1.2.1.4 Great Valley Mixed Riparian Forest

This habitat, also described as riparian forest by Kuchler (1977), is found in association with annual and perennial grasslands and other habitats, and ranges in elevation from sea level to 3,000 feet. Riparian forest habitats occur along creeks, canals, and rivers throughout the Project Area. This vegetation type has adapted wide yearly and seasonal fluctuations in flow volumes, abundant floodplain moisture, and a dynamic erosion-deposition cycle. Great Valley mixed riparian forest habitats typically occur in valleys bordered by gently sloping alluvial fans, lower foothills, and coastal plains (Holland and Keil 1987). Riparian forest habitats typically support diverse wildlife species because they comprise a unique combination of surface and groundwater, fertile soils, high nutrient availability, and vegetation layering, which form a variety of microclimates (Warner 1979). The linear nature of riparian corridors contributing to the high species diversity and abundance in these habitats; the "edge effect" of transitions between two habitat zones such as riparian and annual grassland promotes greater wildlife diversity than in either habitat alone (Odum 1978).

The vegetation composition typically consists of broadleaved winter-deciduous hardwood trees as the overstory, with a variety of shrubs and vines composing the midstory and an understory of a few grasses and forbs in combination with vines.

Dominant species include cottonwood, California sycamore, and valley oak. Typical shrubs include California wild grape, wild rose, California blackberry, blue elderberry, and willows. Hoary nettle, poison hemlock, rushes, and grasses commonly comprise the herbaceous layer (Reclamation 1991a). The threatened valley elderberry longhorn beetle lives in elderberry shrubs that grow in riparian areas. The endangered riparian brush rabbit and riparian woodrat historically occupied the dense riparian forests along the lower San Joaquin River and its tributaries.

Remnant riparian forests in the northern portion of the Project Area are restricted to the San Joaquin River channel, isolated stands along some intermittent tributaries (such as Los Banos Creek and Panoche Creek), and some of the larger sloughs. Approximately 500 acres of riparian habitat are located along Mud and Salt sloughs (Reclamation 1991a).

6.1.2.1.5 Freshwater Marsh Wetlands

Freshwater marsh wetlands are characterized by erect, rooted, herbaceous, water-seeking vegetation. Freshwater marsh wetlands are inundated or saturated for a significant period of time, and anaerobic conditions exist in the root zone. Vegetation within this wetland type varies from small isolated clumps within a waterbody to large uninterrupted expanses covering many acres. Freshwater marsh develops where fine-textured sandy and silty soils are inundated or saturated for long periods during the growing season. The community is intolerant of quickly flowing water, water depths exceeding 5 feet, rapid or wide fluctuations in water level, and saltwater. This community is restricted to ponds, canals, sloughs, and river backwaters.

Freshwater marshes within the Central Valley provide important habitat for waterfowl and a variety of other wildlife species, including Aleutian Canada geese, grebes, herons, egrets, bitterns, coots, shorebirds, rails, hawks, owls, muskrat, raccoon, opossum, and beaver. Many other upland species such as ring-necked pheasant, California quail, black-tailed hare, and desert cottontail take cover and forage at the margins of wetland habitats. Many amphibians and reptiles such as common garter snake, aquatic garter snake, giant garter snake, Pacific treefrog, and bullfrog also breed and feed in freshwater marsh habitats of the region.

6.1.2.1.6 Aquatic Habitat

Aquatic habitat in the Project Area is divided into nine subareas (see Section 4.1.5): (1) San Luis Drain and GDA channels, (1) Mud Slough (North), (2) San Joaquin River between Mud Slough and Merced River, (8) San Joaquin River between Merced River and Crows Landing. These subareas are in Area 3 as described in Section 6.1.1. Other channels in the Project Area that are not expected to be affected by the Project include (1) Salt Slough, (2) Wetland channels, and (3) San Joaquin River upstream of Mud Slough. With the exception of the Drain and GDA channels, which are constructed transport facilities for agricultural drainage, the aquatic habitat for fish species within these subareas is generally similar and fish species composition overlaps to a large extent. Because of the physical characteristics and artificial nature of the Drain and GDA channels, these features provide limited aquatic habitat for fish species. Typical species found in the Drain include nonnative species such as bullfrog, mosquitofish, carp, inland silverside, and fathead minnow. The remaining subareas are composed of either riverine or wetland aquatic habitats and are far more valuable to fish species.

Mud and Salt sloughs are tributaries to the San Joaquin River that receive drainage from within their watersheds. Mud Slough also receives drainage from the GDA. The San Joaquin River in the vicinity of the Project Area has a variety of aquatic habitats including slow-moving backwaters with emergent vegetation and shallow tule beds and deep pools of slow-moving water in the main river (Moyle 1976). The natural habitat and water quality of the San Joaquin River and Mud and Salt sloughs is highly modified by the addition of canals and agricultural drainwater (Saiki 1998, Reclamation 1991a). These additions have resulted in poorer quality water (accumulations of salt, trace elements, and nutrients) downstream of Mud Slough.

A list of fish species likely to occur in the Project Area is provided in Appendix E. The species list includes those species reported by Saiki (1998) as part of an ecological assessment of the Grassland Bypass Project along with those from other studies focusing on the presence, interactions, and distribution of native species found within the San Joaquin River Basin (Brown and Moyle 1992, Saiki 1984). The taxonomic composition of fishes within the Project Area did not change in response to the implementation of the Grassland Bypass Project in 1996, and the existing composition is similar to taxa present in 1980-81 and 1986 (Saiki 1998). The species listed were surveyed using a variety of sampling equipment, including bag seine, beach seine, electroshocker, and gill net. Of the 25 species reported by Sakai (1998), only two native species (Sacramento blackfish and prickly sculpin) were found in the Project Area. The most common species detected were inland silverside, green sunfish, fathead minnow, and western mosquitofish. The most abundant species were bluegill, redear sunfish, largemouth bass, threadfin shad, goldfish, red shiner, common carp, and black bullhead. None of these common or abundant fish are native to California. Other native fish species that may reside within the Project Area but were not observed by Saiki are Sacramento sucker, hitch, hardhead, Sacramento pikeminnow, and tule perch. The Sacramento splittail, a native species whose distribution is mainly found in the lower reaches of the San Joaquin River, may be found in the Project Area during high flow years and flood events.

The decline of native fish species in the San Joaquin River Basin is well documented and can be traced to historical disturbances that occurred in most of the watersheds throughout the basin. The resultant populations of introduced species evident in the Project Area parallels what has been shown to occur in similar habitats elsewhere in the basin (Brown and Moyle 1992).

The aquatic habitat for fish species within the Project Area can be summarized as being comprised of (1) irrigated agricultural land and artificial water transport facilities, (2) riverine ecosystems, including sloughs, backwaters, and mainstem river, and (3) wetland ecosystems. The

Project Area includes 93 miles of natural or seminatural open wetland channels. The San Luis Drain includes 28 miles of concrete-lined open-water channels.

Aquatic habitat conditions existing within the Project Area are degraded and more favorable to introduced species. Introduced species exhibit opportunistic life history traits (broad environmental tolerances, high fecundity, early sexual maturation, long reproductive season, omnivorous diet, and relatively short life span) that help them survive in conditions where less tolerant native species cannot (Brown 1998). The fish species observed in the Project Area are tolerant to a wide range of environmental conditions and have shown resilience to those conditions and the ability to sustain their populations through natural reproduction.

Aquatic habitats in the Project Area are primarily maintained by rainfall runoff and water imported for wetland management, and these habitats are subject to wide flow fluctuations depending on the water year (Reclamation et al. 1996). Flow monitoring stations are located throughout the Project Area and are used primarily in conjunction with water quality monitoring to compute Se, boron, and salt loads. These stations can also be used to monitor the varying seasonal flows through the Project Area and serve as a means to evaluate spawning and rearing conditions available for fish species. Flows in the Project Area are described in Section 4.1.5.

6.1.2.2 Induced Habitats

The natural habitats in the San Joaquin Valley have been greatly altered from pristine lands and replaced with urban and agricultural landscapes. These agricultural and urban habitats provide limited habitat value compared to pristine environments, and vary greatly in their wildlife.

6.1.2.2.1 Agricultural Lands

Agricultural fields provide suitable, albeit limited, habitat for some native species. Crops that supply food and cover for wildlife and require less frequent tilling have greater habitat value than those that are tilled frequently and/or lack food and cover. Cereal grains and alfalfa are perhaps the most valuable as wildlife food, and some cover is provided to ducks, pheasant, nongame birds, and small mammals. The presence of potential prey attracts raptors and carnivores to these fields. In general, row crops, orchards, vineyards, and vegetable crops are intensively managed and have limited values as wildlife habitat. Rice and grain crops are considered, in specific situations, to be of high value because of the importance of waste grain to foraging for specific wildlife species. Flooded ricefields tend to provide habitat elements similar to some natural wetlands. Pasture and row crops provide moderate quality habitat due to limited cover and foraging opportunities. Orchard-vineyard and cotton crops provide low-quality habitat due to limited foraging opportunities, lack of cover, or overly dense cover.

6.1.2.2.2 Ruderal

This community type is interspersed with urban and agricultural areas and comprises urban development and highly eroded/disturbed areas. Ruderal areas in the Project Area occur intermittently and have a high incidence of exotic plant invasion. This is the most common community type found in abandoned vacant lots and along the margins of agricultural lands and roadsides. Common plant species occurring in ruderal habitat are yellow star thistle, milk thistle, Bermuda grass, and ripgut brome.

6.1.2.2.3 Managed Wetlands

Approximately 79 percent of the managed wetlands in the San Joaquin Valley are located in the Project Area and vicinity (Moore et al. 1990). This is the largest contiguous block of wetlands in the San Joaquin Valley. Managed wetlands are used by private hunting clubs and federal and state wildlife refuges to provide habitat for waterfowl and other wetland-dependent wildlife. Managed wetlands can be broadly categorized into seasonal wetlands, semipermanent wetlands, and permanent wetlands.

SEASONAL WETLANDS

Seasonal wetlands typically occur in depressions that are flooded in fall and maintained through winter or spring but allowed to dry or are drained through summer. They support a variety of species by providing a seasonal water source and providing habitat both while dry and wet.

SEMIPERMANENT WETLANDS

Semipermanent wetlands typically comprise the low portions of seasonal wetlands that remain flooded after these wetlands dry or are drained. The management maintains water on the site for 8 to 12 months annually and provides important summer water and brood ponds for resident waterfowl and other wildlife.

PERMANENT WETLANDS

Permanent wetlands are flooded throughout the year, with periodic drainage to control emergent vegetation and increase productivity. Water is maintained at a depth from 30 to 48 inches. Dominant vegetation includes cattails, tules, and pondweeds.

Many of these managed wetlands have detectable levels of trace elements such as arsenic, boron, cadmium, chromium, copper, lead, manganese, magnesium, molybdenum, and Se; pesticides such as DDE and Aroclor; fertilizer residues; and high salinity expressed as total dissolved solids (Moore et al. 1990). The source of many of these chemicals is generally believed to be agricultural drainwater, which is characterized by alkaline pH; elevated concentrations of salts, trace elements, and nitrogen compounds; and low pesticide levels. Agricultural return flows, including subsurface drainage, served as a water supply for many of the area’s wetlands for many years. The concentrations and interactions among these various elements, generally characterized by elevated levels of Se, boron, and total dissolved solids, are major concerns to managers of fish and wildlife resources. Poor quality waters occur or have occurred in the San Joaquin River and Mud and Salt sloughs.

6.1.3 Selenium and Other Water Quality Constituents

Although arsenic, boron, mercury, and other contaminants can adversely affect fish and wildlife, Se has been associated with most adverse biological effects observed from subsurface drainwater contamination. As a result, Se is the most intensely studied trace element contaminant in agricultural drainwater (Ohlendorf and Hothem 1995).

6.1.3.1 Selenium in the Environment

6.1.3.1.1 Selenium Sources

Se is a semimetallic trace element with biochemical properties very similar to sulfur. Se is widely distributed in the earth's crust, usually at trace concentrations (<1 microgram per gram (µg/g) Wilber 1980; Eisler 1985). Some geologic formations, however, are particularly seleniferous (e.g., Presser and Ohlendorf 1987, Presser et al. 1994, Piper and Medrano 1994, Seiler 1997, Presser and Piper 1998) and when disturbed by anthropogenic activity provide pathways for accelerated mobilization of Se into aquatic ecosystems. Abnormally high concentrations of Se in aquatic environments are most typically associated with the use of fossil fuels, with intensive irrigation and overgrazing of arid lands, and with mining of sulfide ores (Skorupa 1998).

Agricultural irrigation of seleniferous areas of the western U.S. causes accelerated leaching of Se from soils into groundwater. Natural and anthropogenic discharge of subsurface agricultural drainwater to surface waters is a major pathway for the mass loading of Se into aquatic ecosystems (Presser et al. 1994; Seiler 1997; Presser and Piper 1998; Skorupa 1998).

6.1.3.1.2 Toxicity

For vertebrates, Se is an essential nutrient (Wilber 1980). Inadequate dietary uptake (food and water) of Se results in Se deficiency syndromes such as reproductive impairment, poor body condition, and immune system dysfunction (Oldfield 1990, CAST 1994). However, excessive dietary uptake of Se results in toxicity syndromes that are similar to the deficiency syndromes (Koller and Exon 1986). Thus, Se is an ahormetic chemical, i.e., a chemical for which levels of safe dietary uptake are bounded on both sides by adverse-effects thresholds. Most essential nutrients are hormetic; what distinguishes Se from other nutrients is the very narrow range between the deficiency threshold and the toxicity threshold (Wilber 1980; Sorensen 1991). Nutritionally adequate dietary uptake (from feed) is generally reported as 0.1 to 0.3 µg/g on a dry feed basis, whereas, the toxicity threshold for sensitive vertebrate animals is generally reported as 2 µg/g. Therefore, dietary toxicity threshold is only1 order of magnitude above nutritionally adequate exposure levels (see review in Skorupa et al. 1996, Reclamation et al. 1998).

Se can exist in several oxidation states (IV, VI, 0, -II) as well as in organic and inorganic forms, and can exist as a dissolved species, or can be attached to suspended particulate matter in the water column, or to bedded sediment and detritus. The following oxidation states can occur in the dissolved phase:

- Selenide or organoselenium (-II), substituting for S (-II) in proteins seleno-methionine, or seleno-cysteine
- Selenite, SeO_3^{-2} (IV), an analog to sulfite
- Selenate (VI), an analog to sulfate
- Elemental selenium, which has low solubility although it may exist as a suspended colloidal species

The reduced organic, elemental, or selenite forms of inorganic Se are converted to the selenite or selenate forms through the oxidation process. Methylation is the process by which inorganic or organic Se is converted to an organic form that contains one or more methyl groups (usually resulting in a volatile form). Assimilative reduction is the process in which oxidized forms are taken into cells and reduced to organic species such as seleno-methionine and seleno-cysteine. These organoselenium forms can then be released to the water column following death or depuration. These processes are responsible for converting relatively less bioavailable inorganic forms of Se to highly bioavailable organic forms.

Four oxidation and methylation processes also contribute to the bioavailability of Se in aquatic systems:

- Oxidation and methylation of inorganic and organic Se by plant roots and microorganisms
- Biological mixing and associated oxidation of sediments that results from burrowing of benthic invertebrates and foraging activities of wildlife
- Physical agitation and chemical oxidation associated with water circulation and mixing (e.g., wind, current, stratification)
- Oxidation of sediments through plant photosynthesis (Lemly 1999)

6.1.3.1.3 Direct Waterborne Contact Toxicity

Most aquatic organisms are relatively insensitive to waterborne contact exposure to the prevalent forms of waterborne Se: dissolved selenate (predominant in agricultural drainwater) or dissolved selenite (predominant in effluent from fossil-fuel extraction, refining, and waste disposal). Adverse-effects concentrations generally are above 1,000 micrograms per liter (µg/L) (review in Moore et al. 1990). Se, however, is bioaccumulative and, therefore, direct contact exposure is only a minor exposure pathway for aquatic organisms (review in Lemly 1996).

6.1.3.1.4 Bioaccumulative Dietary Toxicity

The major pathway leading to toxicity of Se to fish and wildlife is through the organisms that they eat. At the lowest levels of the aquatic food chain, plants and microorganisms not only bioaccumulate Se, they may also convert Se to forms that are more available for assimilation by higher order consumers; they oxidize and methylate the relatively unavailable forms of Se in water and sediment (Lemly and Smith 1987). Aquatic food-chain items (algae, zooplankton, macroinvertebrates) typically have Se concentrations between 1,000 and 10,000 higher (on dry weight basis) than the water in which they live (Lillebo et al. 1988, Lemly 1996). Successive trophic levels (invertebrates, forage fish, predatory fish, birds, and mammals) biomagnify Se to progressively higher concentrations.

6.1.3.2 Other Constituents of Potential Ecological Concern

Trace elements such as arsenic, boron, and molybdenum have been documented to occur at elevated concentrations in drainwater. However, they generally do not occur at concentrations associated with adverse effects (Ohlendorf and Hothem 1995; Hothem and Welsh 1994; Skorupa and Ohlendorf 1991), and no significant risk of adverse effect to wildlife as a result of exposure to these constituents within evaporation basin water has been documented (Hanson Environmental 2003). However, the potential for these elements to cause adverse ecological effect to wildlife utilizing evaporation basins has not been ruled out. Potential effects of these constituents on birds are discussed briefly in the following sections, but a quantitative assessment was not conducted as part of this evaluation.

6.1.3.2.1 Arsenic

Signs of inorganic trivalent arsenite poisoning in birds include muscular incoordination, debility, slowness, jerkiness, falling hyperactivity, fluffed feathers, drooped eyelid, huddled position, unkempt appearance, loss of righting reflex, immobility, and seizures. Arsenic typically acts by destroying the blood vessels that line the gut, resulting in decreased blood pressure and shock. Arsenic is a teratogen (a substance that causes developmental malformations) and carcinogen, and malformations through placental barrier transfer and fetal death have been noted. Arsenic has the potential to bioaccumulate, but is not known to biomagnify (Eisler 1988).

In the Grasslands Wildlife Management Area only 2 of 64 eggs analyzed for arsenic in 1986 contained detectable levels of arsenic. Results of laboratory studies indicate that the embrotoxicity threshold for dietary exposure to arsenic is greater than 1.3 mg/kg (Ohlendorf and Hothem 1995).

6.1.3.2.2 Boron

Boric acid accumulates in the brain, liver, kidney, and white muscle. Forty-eight-hour symptoms of boron toxicosis include diarrhea, ataxia, incoordination, hypertonia, and sometimes death. Consumption causes decrease in growth, decreased hematocrit and hemoglobin, decreased liver and spleen weights, reduced egg fertility, and increased embryo mortality (Sample et al. 1997). Boron is a potent teratogen to domestic chicken embryos when injected into eggs. Injection of boron into the yolk sac of chicken embryos during the first 96 hours produced a wide range of developmental abnormalities, including rumplessness, facial defects, and melanin formations. Consumption of boron by mallards adversely affected mallard growth, behavior, and brain biochemistry (Eisler 1990).

Boron concentrations in eggs of shorebirds and ducks collected at the Grasslands area were below levels associated with reduced hatchability in laboratory mallards (Ohlendorf and Hothem 1995).

6.1.3.2.3 Molybdenum

Molybdenum is found in all living organisms and is considered to be an essential or beneficial micronutrient. However, molybdenum poisoning has been reported in several areas of the world. Molybdenum poisoning in chickens results in reduced egg production, severe growth depression, weight loss, and mortality (Eisler 1989). Elevated levels of molybdenum in bird eggs collected from evaporation basins in the San Joaquin Valley are usually well below thresholds for avian embryotoxicity (Skorupa and Ohlendorf 1991).

6.1.4 Special-Status Species

Table 6-2 presents a list of federally and state-listed species with potential to occur in any of the three Project subareas (explained in Section 6.1.1). Data for this list is derived from species lists generated on September 10, 2008, from the U.S. Fish and Wildlife Service (Service), California Native Plant Society (CNPS), and the California Natural Diversity Data Base (CNDDB), in addition to field observations and biological reports specific to this ongoing project, and a published bird checklist for San Luis National Wildlife Refuge (Service 1996). The summary of species (Table 6-2) is utilized to determine the potential presence of special-status fish, wildlife, and plant species in the Project Area, and its vicinity.

Table 6-2 Special-Status Species Observed or Expected to Inhabit the Grassland Bypass Project Area, 2010–2019

Common Name	Scientific Name	Species Status			Potential to Occur	
		Federal	State	CNPS	GDA	Areas 2 & 3
Mammals						
Pallid bat	*Antrozous pallidus*	—	SC	—	p	p
Western red bat	*Lasiurus blossevillii*	—	SC	—	p	p
American badger	*Taxidea taxus*	—	SC	—	p	p
San Joaquin kit fox	*Vulpes macrotis mutica*	FE	ST	—	p	k
Birds						
Tricolored blackbird	*Agelaius tricolor*	—	SC	—	k	k
Bald eagle	*Haliaeetus leucocephalus*	FD	SE	—	p	p
Black tern	*Chlidonias niger*	—	SC	—	p	k
Burrowing owl	*Athene cunicularia*	—	SC	—	k	l
Lesser sandhill crane	*Grus canadensis canadensis*	—	SC	—	p	k
Greater sandhill crane	*Grus canadensis tabida*	—	ST		p	k
Loggerhead shrike	*Lanius ludovicianus*	—	SC	—	k	k
Mountain plover	*Charadrius montanus*	—	SC	—	k	l
Northern harrier	*Circus cyaneus*	—	SC	—	k	k
Peregrine falcon	*Falco peregrinus*	FD	SE	—	u	p
Swainson’s hawk	*Buteo swainsoni*	—	ST	—	k	k
Least bell’s vireo	*Vireo belli pusillus*	FE	SE	—	u	p
Willow flycatcher	*Empidonax traillii estimus*	—	SE	—	u	l
Reptiles						
Silvery legless lizard	*Anniella pulchra pulchra*	—	SC	—	np	p
Western pond turtle	*Actineyms marmorata*	—	SC	—	k	k
Giant garter snake	*Thamnophis gigas*	FT	ST	—	p	l
Amphibians						
California tiger salamander	*Ambystoma californiense*	FT	SC	—	u	k
Western spadefoot	*Spea hammondii*	—	SC	—	u	p
Invertebrates						
Conservancy fairy shrimp	*Branchinecta conservatio*	FE	—	—	np	k
Longhorn fairy shrimp	*Branchinecta longiantenna*	FE	—	—	np	k
Vernal pool fairy shrimp	*Branchinecta lynchi*	FT	—	—	np	k
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	FT	—	—	p	p
Vernal pool tadpole shrimp	*Lepidurus packardi*	FE	—	—	np	k
Plants						
Slender-leaved pondweed	*Potamogeton filiformis*	—	—	2	np	p
Sanford’s arrowhead	*Sagittaria sanfordii*	—	—	1B	np	p

Table 6-2 Special-Status Species Observed or Expected to Inhabit the Grassland Bypass Project Area, 2010–2019

Common Name	Scientific Name	Species Status			Potential to Occur	
		Federal	State	CNPS	GDA	Areas 2 & 3
Fish						
Central Valley steelhead	*Oncorhynchus mykiss*	FT	SE	-	u	u
Sacramento splittail	*Pogonichthys macrolepidotus*	—	CL-1	-	k	k
Central Valley fall-run Chinook salmon	*Oncorhynchus tshawytscha*	FC		-	np	np
Hardhead	*Mylopharodon conocephalus*		SC	-	u	u

Federal Status
FE = endangered
FT = threatened
FD = Federally Delisted

State Status
SE = endangered
ST = threatened
SC = State Species of Concern
CL-1 = Class 1. Qualifies as threatened
CNPS = California Native Plant Society.

CNPS Status
1B = rare, threatened or endangered in California and elsewhere
2 = rare, threatened or endangered in California but not elsewhere

Potential to Occur
k = known to occur
l = likely to occur
p = potential to occur
u = unlikely to occur
np = no potential to occur.

Project Area includes the following USGS 7.5 minute quadrangles:
Broadview Farms, Chaney Ranch, Charleston School, Crows Landing, Delta Ranch, Dos Palos, Firebaugh, Gustine, Hammonds Ranch, Hatch, Ingomar, Los Banos, Oxalis, Poso Farm, San Luis Ranch, Stevinson

The following profiled species may inhabit the Project Area or may be affected by the Project Alternatives. They are designated as endangered, threatened, proposed, candidates for listing, species of concern, or are listed as rare by the CNPS. Loss of habitat or habitat degradation is the primary reason for their decline.

6.1.4.1 Mammals

6.1.4.1.1 Pallid Bat and Western Red Bat

Both the pallid and the western red bat species are California Department of Fish and Game (CDFG) Species of Special Concern that may occur in the study area. The pallid bat occurs in a variety of low to mid-elevation habitats, including desert shrublands, juniper woodlands, grasslands, oak woodlands, riparian forests, and occasionally coniferous forests. This species is commonly found foraging near water, especially in arid regions. During summer, pallid bats will roost in rock crevices and buildings, as well as rock piles, tree cavities, shallow caves, and abandoned mines. The western red bat is a solitary, foliage-roosting species that prefers to forage in riparian forests with an open understory, especially those dominated by native deciduous trees. Common roost trees for western red pat include walnut, oak, willow, cottonwood, and sycamore, although eucalyptus, fruit trees, and other nonnative trees may also be used. Both the pallid and the western red bats are found in Areas 1 ,2, and 3.

The CNDDB lists two occurrences of western red bat and one of the pallid bats within the Project Area in 1999. These insectivorous bat species may forage over the entire Project Area, particularly over wet areas such as canals, vernal pools, and seasonal drainages. Grasslands or cropland areas may also provide suitable foraging habitat for these species.

6.1.4.1.2 American Badger

American badger is a CDFG Species of Special Concern. A member of the weasel family (Mustelidae), American badger is widely distributed in North America, spanning from Alberta to

Mexico and from the Pacific Coast to the Great Lakes. With the exception of the humid coastal forests of Del Norte County and the northwestern portion of Humboldt County, the species is known to occur throughout California. In California, the badger occupies a diversity of habitats, including grasslands, shrublands, savannas, chaparral, and riparian habitats, with typically less than 50 percent plant cover. Badgers require friable soils for digging burrows that are used for cover and reproduction (Zeiner et al. 1990). Largely nocturnal, the American badger primarily feeds on burrowing rodents, including gophers (*Thomomys* sp.), California ground squirrels, and kangaroo rats (*Dipodomys* sp.) (Williams 1986).

Appropriate habitat for the American badger exists in Project Areas 2 and 3, and the CNDDB lists several occurrences of American badger within the Project Area, the most recent of which was in 1989. This species is likely to be found in Areas 2 and 3.

6.1.4.1.3 San Joaquin Kit Fox

San Joaquin kit foxes are a federally endangered and state threatened species which historically lived in most of San Joaquin Valley. They are known to have occurred in the entire Project Area. Today, kit fox populations have been reduced by more than half, with the largest portion of the range remaining in the southern and western parts of the valley (Service 1998). In the central portion of their range, kit foxes are associated with Valley sink scrub, Interior Coast Range saltbrush scrub, Upper Sonoran subshrub scrub, annual grassland, and the remaining native grasslands. Kit foxes primarily occupy grazed, nonirrigated grasslands, especially where multiple escape dens are established and a sustainable prey base occurs. Agricultural habitats are occasionally used as foraging resources when proximal to suitable habitat. Common prey species include kangaroo rats, desert cottontails, black-tailed jackrabbits, pocket mice, deer mice, reptiles, ground-nesting birds, and insects.

While recent biotic studies (H. T. Harvey 2005, URS 2007b) showed no evidence of kit fox in the GDA, suitable foraging, dispersal, and den habitat exists for kit fox throughout the entire Project Area, which is within dispersal range of recent kit fox records (CNDDB 2008). The nearest record occurs at the limits of the published range, which is 6 miles southwest of the project site along the California Aqueduct (sighting dated May 14, 1998, CNDDB 2008). The nearest kit fox core area is the Ciervo-Panoche Natural Area, approximately 17 miles southwest of the project site. It is possible the San Joaquin kit fox could occur within Areas 1, 2, or 3.

6.1.4.2 Birds

6.1.4.2.1 Tricolored Blackbird

The tricolored blackbird is a CDFG species of special concern. Their range extends from Oregon to Baja California, but more than 99 percent breed in California, primarily in the Sacramento and San Joaquin Valleys, but also in the foothills of Sierra Nevada and Coast Ranges, and some coastal areas (Beedy and Hamilton 1999). Tricolored blackbirds are locally common in the Central Valley, breeding near freshwater, preferably in emergent wetland vegetation. The species also nests in upland and agricultural areas and forages in grassy fields, croplands, and the periphery of ponds (CDFG 2002). The species is known to occur in all Project Areas.

6.1.4.2.2 Bald Eagle

The bald eagle, a federally delisted but state endangered species, is the only North American representative of the fish or sea eagles, and is endemic to North America. The breeding range of the bald eagle includes most of the continent, but they now nest mainly in Alaska, Canada, the Pacific Northwest states, the Great Lake states, Florida, and Chesapeake Bay. The winter range includes most of the breeding range. Scattered smaller groups of wintering eagles occur throughout the state near reservoirs, and typically in close proximity to large concentrations of overwintering migratory waterfowl. Wintering eagles forage on fish, waterfowl, mammals, and a variety of carrion. Bald eagles are occasional winter visitors to the San Luis National Wildlife Refuge complex and have been observed in the GDA and vicinity (Reclamation 1991b).

6.1.4.2.3 Western Burrowing Owl

The burrowing owl is listed as a species of special concern in California (CDFG 2008a). Burrowing owls typically occupy annual and perennial grasslands with sparse or nonexistent tree or shrub canopies. In California, burrowing owls are found in close association with California ground squirrel burrows, which provide them with year-round shelter and seasonal nesting habitat. Burrowing owls also use human-made structures such as culverts, debris piles, or openings beneath pavement as shelter and nesting habitat. Burrowing owls exhibit a high degree of nest site fidelity and as habitat becomes increasingly fragmented and isolated by development, these sites become increasingly inhospitable for breeding burrowing owls. Burrowing owls eat insects, rodents, lizards, and other birds (Ehrlich et al. 1988).

6.1.4.2.4 Lesser Sandhill Crane

The lesser sandhill crane is a CDFG Species of Special Concern. The lesser sandhill crane is widely distributed in North America and Eastern Siberia (Littlefield and Ivey 2002). Lesser sandhill cranes are very similar to greater sandhill cranes in both feeding ecology and habitat use (below). However, unlike the greater sandhill crane, the population that winters in the Central Valley breeds in southcentral and southwestern Alaska (Littlefield and Ivey 2002). The lesser sandhill crane is known to visit the GDA.

6.1.4.2.5 Greater Sandhill Crane

Greater sandhill cranes are listed as threatened in California. The greater sandhill crane is widely distributed in North America. They utilize sites with freshwater near grasslands, open wetlands, moist croplands, rice, or corn stubble. During their summer migration, cranes frequent breeding grounds in wet meadows, shallow lacustrine, or fresh emergent wetland habitats in Northern California. The cranes feed on plants, including waste grain, small vertebrates and invertebrates. The China Island Unit of the North Grasslands Wildlife Area provides winter habitat for greater sandhill cranes that consists of irrigated pasture and annual grasslands (Reclamation et al. 2000). The greater sandhill crane is known to visit the GDA

6.1.4.2.6 Loggerhead Shrike

The loggerhead shrike is a CDFG Species of Special Concern. This bird is found in lowlands and foothills throughout California and usually only nests in trees from Mendocino County northward. This species prefers open habitats with scattered shrubs, trees, posts, fences, utility lines, or other perches. The loggerhead shrike feeds mostly on large insects, but it also eats small birds, mammals, amphibians, reptiles, fish, carrion, and various other invertebrates and is known for catching prey by skewering it on thorns, sharp twigs, and barbed wire fencing (CDFG 2002). This species is known to occur in all Project Areas.

6.1.4.2.7 Black Tern

The black tern is a CDFG species of special concern. Their range extends from northern British Columbia and Alberta south to Arizona and Kansas and east to New Jersey. In California, breeding occurs in the northeastern portion of the state and throughout the Central Valley. The black tern can nest near water or on dry land using abandoned muskrat houses (CDFG 2008a). They typically forage over croplands feeding on insects but occasionally adults will dive into water for tadpoles, crayfish, and small fish (CDFG 1985). This species has been observed foraging but not nesting on the project site, and is an occasional spring and summer visitor to the San Luis National Wildlife Refuge (Service 1996). The black tern is known to breed on the Project site (H.T. Harvey and Associates 2005).

6.1.4.2.8 Mountain Plover

The mountain plover is a CDFG Species of Special Concern and is found in dry upland habitats. The mountain plover nests in high elevation grasslands primarily in Montana, Wyoming, Colorado, and northeastern New Mexico. During the winter, this plover uses open habitats such as sparse or short grasslands and recently plowed or sprouting agricultural fields in California’s Central Valley, the Imperial Valley, southern Arizona, and Northern Mexico. Diet consists primarily of beetles, crickets, and ants.

Mountain plovers have been detected using bare fields in the GDA during winter surveys conducted on the existing project site (H.T. Harvey 2003-2008). These surveys indicated that suitable habitat in the project vicinity received incidental use by mountain plovers for short periods in winter. The GDA may initially be attractive to wintering plovers as fields are bare during conversion from row crops to pasture. As pastures and alfalfa fields mature, however, the suitability of the project site as foraging habitat will diminish. Mountain plovers are also known from the San Luis National Wildlife Refuge (Service 1996), and any suitable habitat in Areas 2 and 3 will remain attractive to this species.

6.1.4.2.9 Northern Harrier

The northern harrier is a CDFG Species of Special Concern. It nests in scattered locations throughout California in grasslands, marshes, fallow agricultural fields, and open rangelands (CDFG 2002). Nests are often in emergent wetlands along rivers or lakes, but it may also nest in grassland or grain fields several miles from water. Northern harriers forage over marshes, grasslands, fields, and shrubland with moderate to heavy cover. Diet consists of mammals, birds, reptiles, insects, and carrion. The northern harrier is known to occur in all Project Areas.

6.1.4.2.10 Peregrine Falcon

Peregrine falcons are a federally delisted but California endangered species. One of the most global birds of prey, it occurs throughout the world except in antarctic regions and tropical rainforests. The peregrine lives year-round within California. Once believed to be a creature of open habitats, it inhabits forests, and increasingly cities. It preys primarily on birds, but will occasionally eat small mammals, reptiles, and insects (Service 1996). Peregrine falcons are rare visitors to the San Luis National Wildlife Refuge in spring, fall, and winter.

6.1.4.2.11 Swainson's Hawk

Swainson's hawks are listed as threatened in California. They are a migratory species that moves south through southern and central California in September and October and north in March through May (Grinnell and Miller 1944). They roost in large trees in open riparian habitat, and usually are found near water in the Central Valley (Bloom 1980). Swainson's hawks prey on mice and other rodents, normally foraging in grassland areas or in grain or alfalfa fields. They are recorded as uncommon but nesting visitors to the San Luis National Wildlife Refuge (Service 1996). CNDDB (2008) documents multiple recent occurrences of foraging and nesting Swainson's hawks throughout the Project Area, and they are likely to forage within the GDA.

6.1.4.2.12 Least Bell's Vireo

Least Bell's vireos are a federally and California state-listed endangered species. Least Bell's vireos are native to California and northern Mexico, and historically bred throughout much of California. Breeding habitat consists of dense, shrubby riparian forests and scrub, and diet consists of insects and spiders (Brown 1993). Although extirpated from the Central Valley for 60 years, habitat restoration has created suitable conditions, and least Bell's vireos returned to the San Joaquin River National Wildlife Refuge in 2005, and successfully nested in 2006 (http://www.fws.gov/sacramento/ea/news_releases/2006%20News percent20Releases/LBV_return_SJNWR_NR.htm). As the San Joaquin River National Wildlife Refuge is approximately 25 miles from the northern edge of the Project Area, least Bell's vireos may occur or nest within the limited suitable habitat in the Project Area.

6.1.4.2.13 Willow Flycatcher

Willow flycatchers are a California state-listed endangered species. This species returns to California from its wintering grounds in Central and South America in May and June, and typically remains in California throughout the summer and into the fall (Grinnell and Miller 1944; Gaines 1977a, 1977b; Remsen 1978; McCaskie et al. 1979). The willow flycatcher has been eradicated from the Central Valley as a breeding species. It does not breed at San Luis National Wildlife Refuge (Service 1996). It is present in the Central Valley only as a migrant. They feed primarily on flying insects, with less than 5 percent of their diet comprising caterpillars or berries (Sumner and Dixon 1953). Willow flycatchers occur at the San Luis National Wildlife Refuge complex as occasional fall and uncommon spring visitors (Service 1996). They may forage in the GDA.

6.1.4.3 Reptiles

6.1.4.3.1 Silvery Legless Lizard

The silvery legless lizard, a CDFG Species of Special Concern, is one of two species of legless lizard along the west coast of North America. Near-endemic to California, it is found from the southern bank of the San Joaquin River, south, to islands off the Baja Coast. The silvery legless lizard is typically restricted to moist, loose, mulchy, sandy soils such as sand, loam, or humus (Stebbins 2003) in preferably undisturbed, loose soils with a high fraction of sand in the soil and mature leaf litter. They're commonly found in washes, loose soil near the base of slopes, and in the vicinity of streams. It lives mostly underground and forages for insects, beetles, and spiders in loose soils and leaf litter.

Appropriate habitat occurs within Project Area 2 and 3. The CNDDB lists one occurrence in 1994 of two individual silvery legless lizards in a dry irrigation channel approximately 3.2 miles northeast of the confluence of Salt Slough with the San Joaquin River. This species is unlikely to occur within the GDA, but may occur in Project Areas 2 or 3.

6.1.4.3.2 Western Pond Turtle

Western pond turtles, including both the northwestern (ssp. *marmorata*) and southwestern (ssp. *pallida*) subspecies, are a CDFG Species of Special Concern. Western pond turtles range throughout California, from southern coastal California and the Central Valley, east to the Cascade and Sierra Nevada mountains. Western pond turtles occur in a variety of permanent and intermittent aquatic habitats, such as ponds, marshes, rivers, streams, and ephemeral pools. Pond turtles require suitable basking and haulout sites, such as emergent rocks or floating logs, which they use to regulate their temperature throughout the day (Holland 1994). In addition to appropriate aquatic habitat, these turtles require an upland oviposition site in the vicinity of the aquatic habitat, often within 200 meters (656 feet). Nests are typically dug in grassy, open fields with soils that are high in clay or silt (CDFG 1985). They are omnivorous and scavengers, eating fish, invertebrates, frogs, tadpoles, carrion, and plant material.

While no suitable habitat exists within the GDA, the CNDDB lists 22 occurrences in the Project Area and immediate vicinity between the GDA and northern terminus of the Project Area. Western pond turtle has been documented in the Project Area as recently as 2006 (CNDDB 2008).

6.1.4.3.3 Giant Garter Snake

Giant garter snakes are endemic to wetlands in the Sacramento and San Joaquin valleys. During their active season (early spring through mid-fall), giant garter snakes may occur in permanently aquatic or seasonally flooded habitats such as marshes, sloughs, ponds, low gradient streams, irrigation and drainage canals, and ricefields. Giant garter snakes prefer open, wide channels with emergent vegetation along the margins. Although not substantiated by evidence, Se is suspected as being a contributing factor in the decline of giant garter snake populations particularly for the north and south Grassland subpopulation (USEPA 2000) (i.e., Kesterson Unit of San Luis National Wildlife Refuge complex). From 1995 to 2006, the CDFG, Service, and several other agencies conducted surveys for giant garter snakes in the San Joaquin Valley between Crows Landing and Mendota. Survey methods included trapping, capturing by hand, and visual observations. Table 6-3 provides the number of giant garter snakes found, their location, date they were found, and the reference in which they were described.

Table 6-3 Giant Garter Snakes in the Project Vicinity

Area 1	Location of Refuge or Wildlife Area	Date	# Trapped	# Recaptured	Visual Sightings	Dead	Total Observed	Believed to Support Populations	Source
Area 1	Mendota Wildlife Area	1995	0	0	3	1	4	yes	Miller and Hornaday 1999
	Mendota Wildlife Area	2001	13	0	0	0	13	yes	CNDDB 2008
Area 2	Kesterson National Wildlife Refuge	1998	7	0	0	0	7	yes	Miller and Hornaday 1999
	West of the town Dos Palos	1998	1	0	0	0	1	yes	Miller and Hornaday 1999
	Southern Grasslands Wildlife Area	2001	1	0	0	0	1	yes	Dickert 2005
	Volta and Los Banos Wildlife Refuge	2006	7	1	0	0	8	yes	CDFG 2006
Area 3	None of the above studies conducted trapping in Area 3								

Separate from the surveys above, both a male and female were captured in 2000 in a Mud Slough, 3 miles east northeast of Los Banos (CNDDB 2008). This Mud Slough shares a name with, but is not the same as, the Mud Slough that connects the San Luis Drain to the San Joaquin River in Area 3. More recent CNDDB records, in 2001 and 2006, recorded in the Delta Ranch and Ingomar quadrangles, respectively, have exact locations suppressed due to location sensitivity. Suitable habitat for the giant garter snake exists in 4.7 acres of freshwater marsh in the GDA directly adjacent to the new acquisition area for the IVTDR, and in several irrigation canals within the potential acquisition area.

6.1.4.4 Amphibians

6.1.4.4.1 California Tiger Salamander

California tiger salamanders are a federally threatened species and a CDFG Species of Special Concern. Endemic to California, their range historically extended through central and central coastal regions of the state. They prefer to breed in natural ephemeral pools, large vernal pools, or ponds that mimic ephemeral pools (stock ponds that go dry). They spend much of their life aestivating in underground retreats where it is moist and dark. They are poor burrowers, and require dry season refugia provided by ground squirrels, gophers, and other burrowing mammals. From April to June, as the ponds dry up, they disperse to upland burrows. They prey primarily on invertebrates but may also eat small fish and tadpoles.

California tiger salamanders have been found in surveys of vernal pools in the San Luis National Wildlife Refuge complex in the vicinity of the Project Area (D. Woolington, pers. comm., 2000). They are unlikely to occur within the GDA.

6.1.4.4.2 Western Spadefoot

The western spadefoot toad is a CDFG Species of Special Concern. The western spadefoot is primarily a species of the lowlands, frequenting washes, floodplains of rivers, alluvial fans, playas, and alkali flats, but also ranges into the foothills and mountains (CDFG 1988). It is common throughout the Central Valley and Sierra Nevada foothills. This species spends most of the year in underground burrows. The western spadefoot eats a variety of invertebrates and occurs primarily in grasslands, but is known to occur in valley and foothill hardwood woodlands. Breeding and egg-laying occur almost exclusively in shallow, temporary pools from late winter until the end of March. Within the Project Area, six occurrences of the western spadefoot are recorded in the CNDDB between 1993 and 1995, primarily in the northern reaches of Area 2.

6.1.4.5 Fish

Individual special-status fish species are described below.

6.1.4.5.1 Central Valley Fall/Late Fall-Run Chinook Salmon

Central Valley fall-/late fall-run Chinook salmon is a federal candidate species[1]. It was proposed for listing in the late 1990s. The National Marine Fisheries Service (NMFS) determined that listing was not warranted at that time and placed them on the candidate list (NMFS 2005). Fall-run Chinook salmon use the Delta and the San Joaquin River for migration, and its five major tributaries (Merced, Tuolumne, Stanislaus, Mokelumne, and Cosumnes rivers) for migration, spawning, incubation and early rearing. Late-fall-run Chinook use only the Sacramento River and its tributaries, as do some stocks of fall-run Chinook salmon. The CDFG installs and operates a barrier across the San Joaquin River at the mouth of the Merced River each year from October through December. This barrier is used to direct adult fall-run Chinook salmon into the Merced River each year and prevent them from going further upstream in the San Joaquin River. These fish therefore cannot access Mud Slough or the Grassland wetlands. Agricultural runoff from the Project Area and adjacent areas flows into the San Joaquin River and eventually makes its way through the Delta and, as a result, might impact populations of Central Valley fall-run Chinook salmon.

Fall-run Chinook are fully mature as they move up from the ocean in late summer and early fall, typically spawning within days or weeks of reaching their spawning grounds (Moyle 2002) with eggs deposited into depressions in gravel substrate (redds) created by the female. Juveniles emerge from the gravel in spring and disperse downstream within a few months of emergence and may rear for weeks to a few months in the major rivers or the Delta before heading out to sea. They generally spend 2 to 4 years in the ocean, and upon reaching or approaching maturity, return to freshwater to spawn

[1] Other races of Chinook salmon include winter-run and spring-run. These runs are found in the Sacramento River and/or its tributaries and do not use the Project Area. These races are not discussed further in this document.

6.1.4.5.2 Central Valley Steelhead

The Central Valley Steelhead Distinct Population Segment was listed as threatened by NMFS under the Endangered Species Act in 1998 (NMFS 1998). Steelhead are widespread, although not abundant, in Central Valley streams, including the major tributaries to the San Joaquin River (NMFS 2005). The Hills Ferry Barrier on the San Joaquin River may preclude adults from entering the San Joaquin River above this point during September through December, but they may enter the immediate Project Area from January through June. No steelhead or rainbow trout have been observed in the Project Area in historic surveys (Sakai 1998). Steelhead are the anadromous form of rainbow trout (McEwan and Jackson 1996). Central Valley steelhead are ‘winter steelhead’. Winter steelhead mature in the ocean and arrive on the spawning grounds nearly ready to spawn (Moyle 2002). The steelhead spawning migration up the river begins in early fall (sometimes as early as mid-August), peaking in October and November and extending through March. Spawning occurs in December through April with eggs deposited into depressions in the substrate (redds) created by the female. Unlike other Pacific salmonids, steelhead are capable of spawning more than once before dying (McEwan and Jackson 1996). The time required for egg development is dependant on temperature; they typically hatch within 3-4 weeks at 10-15°C (Moyle 2002). After hatching, the yolk-sac fry or alevins remain in the gravel for several weeks until they deplete the yolk and their mouth parts are developed. Following yolk sac absorption, fry emerge from the gravel and begin to feed. Juvenile steelhead may remain in the river for 1 to 3 years before smolting and migrating towards the ocean. They remain at sea for between 1 and 3 years at sea before making the return journey into freshwater to their natal streams to spawn (McEwan 2001).

6.1.4.5.3 Hardhead

Hardhead are identified as a species of concern, specifically on the Class 3-Watch List, by CDFG (Moyle et al. 1995). They are not listed as threatened or endangered by either the state or federal governments. Hardhead were not observed in the Project Area by Sakai (1998), and habitat conditions there do not appear to be conducive to this species, but they could potentially be present.

Hardhead are large, omnivorous, freshwater cyprinids found in undisturbed portions of larger low- to mid-elevation streams and some reservoirs throughout the Central Valley and the foothills on the western side of the Sierra Nevada. They prefer well-oxygenated water with summer water temperatures in excess of 20°C and deep pools (greater than 1 meter deep) with a sand-gravel-boulder substrate and slow water velocities. Hardhead are rarely found in environments that have well-established centrarchid populations or environments that have been heavily impacted by man (Moyle 2002). Spawning occurs throughout the spring and early summer when adult hardhead (3 years or older) are thought to migrate into tributaries to lay eggs over gravel beds in riffles, runs, or the heads of pools (Moyle 2002).

The early life history of the hardhead is not well known. Presumably, larval and postlarval hardhead remain along stream edges in dense cover of flooded vegetation or fallen branches, before moving into deeper habitats or are swept downstream into main rivers and perhaps concentrate in low-velocity areas near the mouth of rivers (Moyle 2002).

6.1.4.5.4 Sacramento Splittail

The Sacramento splittail was federally listed as threatened on February 8, 1999 (Service 1999), and delisted on September 22, 2003 (Service 2003). The splittail is listed as a species of special concern (Class 1 Qualify as threatened) by the State of California (Moyle et al. 1995).

The Sacramento splittail is primarily associated with sloughs and rivers in the Delta, but may occur within the Project Area sporadically, especially in high flow years. Recent sampling has documented the presence of splittail in Salt Slough (URS 2001). Sacramento splittail live in freshwater and some estuarine systems in California. Splittail were historically found as far north as Redding on the Sacramento River and as far south as the site of Friant Dam on the San Joaquin River (Rutter 1908).

Splittail usually spawn on submerged vegetation in temporarily flooded upland and riparian habitat. Larval splittail are commonly found in shallow, vegetated areas near spawning habitat. Larvae eventually move into deeper and more open-water habitat as they grow and become juveniles (DWR and Reclamation 2005). Developing juveniles migrate downstream to shallow, brackish water, year-round rearing grounds from March through August.

Splittail were caught in Mud and Salt sloughs in June 1998, an El Niño year (Beckon et al. 1999). At that time all samples of splittail from Mud Slough had concentrations of Se high enough to be of concern; the highest Se concentration was found in the sample from Mud Slough just below the San Luis Drain discharge (Figure 6-1).

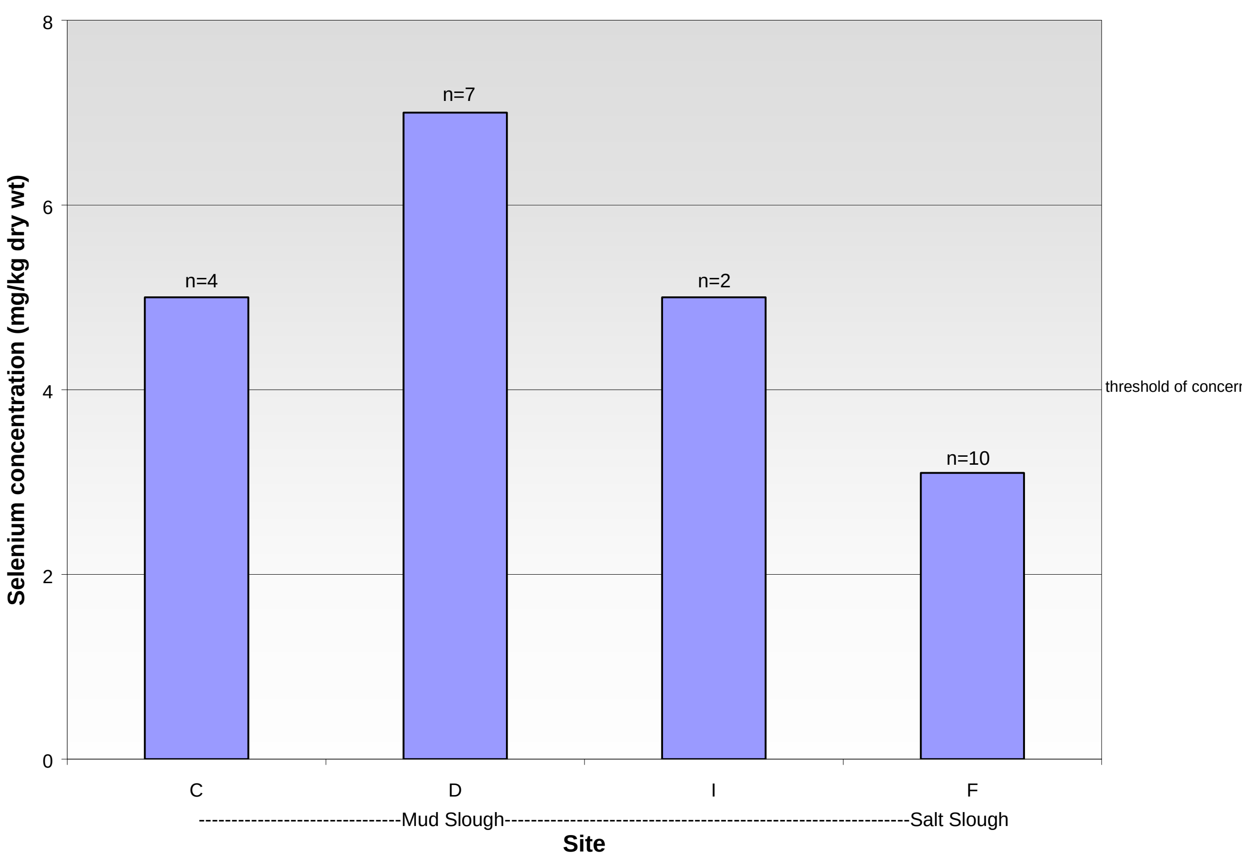


Figure 6-1 Selenium in Sacramento Splittail Sampled in Mud and Salt Sloughs, June 1998

6.1.4.6 Invertebrates

6.1.4.6.1 Vernal Pool Branchiopods

Conservancy fairy shrimp, longhorn fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp are all members of the class Branchiopoda. Many elements of the life cycles of the branchiopod species are similar. Hatching begins shortly after temporary pools have been inundated by runoff from fall and winter rains. Newly hatched larvae develop through a juvenile stage and eventually become sexually mature adults. After males and females mate, the female releases her cysts, which remain in the bottom of the dry pool through the summer.

- The Conservancy fairy shrimp is a federally listed endangered species. This fairy shrimp is endemic to California, and is found in grasslands in the northern two-thirds of the Central Valley (Eriksen and Belk 1999).
- The Longhorn fairy shrimp is a federally listed endangered species which inhabits clear to rather turbid vernal pools, including grass-bottomed pools in Merced County (Eriksen and Belk 1999).
- The vernal pool fairy shrimp is a federally listed threatened species. This species is rather widely distributed through the grasslands of California, from Shasta County south to Riverside County.
- The vernal pool tadpole shrimp is a federally listed endangered species. This species is found mainly in the northern and eastern portions of the Central Valley, in vernal pools and swales containing highly turbid water, often in unplowed grasslands.

All vernal pool and seasonal wetlands in Project Areas 2 and 3 are considered to be suitable habitat for the vernal pool branchiopods and the species are assumed to be present.

6.1.4.6.2 Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle is federally listed threatened species endemic to the Central Valley region of California, and it is dependent on a single host plant, the blue elderberry shrub (*Sambucus mexicana*). This species is currently proposed for delisting, although the 5-year review documents that the current status and population trends of this species are unknown. The shrubs are a common component of riparian areas and nearby uplands throughout the Central Valley. However, fragmentation of suitable habitat has restricted the valley elderberry longhorn beetle to a few locations (Thelander 1994). The beetle’s current distribution is patchy throughout the remaining habitat of the Central Valley from Redding to Bakersfield. It may be found near riparian habitat throughout the Project Area.

6.1.4.7 Plants

6.1.4.7.1 Delta Button-Celery

Delta button-celery is a slender, prostrate, herbaceous perennial with greenish, rounded flower heads. This species typically occurs on clay soils in lowland areas of riparian and floodplain habitat (CDFG 1992). The historic distribution of Delta button-celery included Calaveras, Merced, Stanislaus, and San Joaquin counties. Most of the remaining occurrences of this species are located in Merced County along the San Joaquin River (CDFG 1992). Several of these populations are located on the CDFG's China Island Unit in the Project Area and in the Eastside Bypass, between Sandy Mush and Newhall roads.

6.1.4.7.2 Slender-leaved Pondweed

The slender-leaved pondweed is a wetland species that lives in permanently flooded to intermittently exposed freshwater channels. It may be found in ditches, lakes, ponds, or slow streams (CNPS 2008). This species may occur in either Area 2 or 3.

6.1.4.7.3 Sanford's Arrowhead

Sanford's arrowhead is a wetland species that lives in fresh to brackish water, seasonally flooded or saturated habitats with intermittently exposed water channels (CNPS 2008). This species may occur in either Area 2 or 3.

6.1.4.7.4 Colusa Grass

Colusa grass is a robust, tufted annual in the grass family that grows 3 to 12 inches tall and occurs in large or deep vernal pools with substrates of clay mud (Stone et al. 1988). It is restricted to the Sacramento and San Joaquin valleys. Approximately 44 populations remain along a 100-mile stretch of the eastern San Joaquin Valley that includes Merced and Stanislaus counties. Loss of habitat from conversion to agricultural use is the biggest threat to Colusa grass populations. Herbicide contaminated runoff and competition from introduced weed species are also threats. Occurrences of Colusa grass are documented from nonirrigated areas on the San Luis and West Bear Creek units of the San Luis National Wildlife Refuge complex in the vicinity of the Project Area (Reclamation et al. 2000). No occurrences of Colusa grass are known in the Project Area.

6.2 ENVIRONMENTAL CONSEQUENCES

This section evaluates the potential biological resource impacts of the No Action and Action Alternatives. Impacts are evaluated using the impact and evaluation criteria presented below for special-status species, wetlands and terrestrial vegetation, aquatic habitats, and ecological risk assessment.

6.2.1 Key Impact and Evaluation Criteria

Key impact and evaluation criteria are consistent with Appendix G of the California Environmental Quality Act (CEQA) guidelines for biological resources, state and federal laws that regulate impacts to special-status species and wetlands, and ecological risk guidelines for Se.

6.2.1.1 Special-Status Species

Adverse impacts to listed species are considered significant if project construction or operation would result in:

- A reduction in the number of individual listed plants, fish, or wildlife
- Long-term or permanent loss or alteration of habitat important for one or more listed species
- Temporary loss or alteration of habitat important for one or more listed species that could result in increased mortality or lowered reproductive success

Adverse impacts to candidate or sensitive species are considered significant if project construction or operation results in the following:

- Direct or indirect impacts on candidate or sensitive species population, or habitat that would contribute to or result in the federal or state listing of the species, e.g., by substantially reducing species numbers, or by resulting in the permanent loss of habitat essential for the continued existence of a species

6.2.1.2 Wetlands and Terrestrial Vegetation

Adverse impacts on wetlands and terrestrial vegetation are considered significant if project construction or operation would:

- Disturb a substantial portion of the vegetation type within a local region, and natural or enhanced regeneration could not restore this vegetation to its preconstruction condition within 3 to 5 years.
- Result in the long-term (more than 5 years) substantial reduction or alteration of unique, rare, or special concern vegetation types or natural communities.
- Lead to the expanded range of existing invasive exotic weed species or soil pests so that they interfere with successful revegetation of natural communities.
- Fill or alter a wetland, resulting in long-term change in hydrology, soils, or the composition of vegetation.

6.2.1.3 Aquatic Habitats

Flow and Se models for stations throughout the Project Area provide the primary means to evaluate impacts to aquatic habitat. Habitat vs. flow relationships are not available for the project waterbodies, however. Therefore, a qualitative evaluation based on modeled flow will be used to evaluate impacts to aquatic habitat and fish species within the Project Area rather than employing a threshold value or deriving some other type of numerical criteria.

Flow and Se concentrations at Stations B, D, and N (see Figure 4-1) were chosen to best represent the differences between the Alternatives. These stations represent conditions within the Project Area that the Project would impact. Station B is located in the San Luis Drain at the point where it discharges into Mud Slough and represents the amount of controlled agricultural drainwater flowing through the Project Area. For both the Grassland Bypass Project (2010-2019) and the 2001 Requirements Alternative, this amount is limited to 150 cubic feet per second (cfs). The No Action Alternative does not allow for the use of the Drain to convey drainwater, and the amount of flow entering Mud Slough is dependent on surface runoff and groundwater seepage.

Station D is located in lower Mud Slough below the Drain. This portion of Mud Slough conveys the runoff from the GDA to the San Joaquin River.

Station N is on the San Joaquin River at Crows Landing. This represents the downstream extent of the Project Area and represents conditions that salmon and steelhead might encounter during their migrations through the San Joaquin River.

Adverse impacts on aquatic habitats are considered significant if project operation would result in a long-term (more than 5-year) reduction in the populations of native aquatic species.

6.2.1.4 Ecological Risk Assessment

Assessment of the risks that Se poses to fish and wildlife can be difficult due to the complex nature of Se cycling in aquatic ecosystems (Lemly and Smith 1987). Early assessments developed avian risk thresholds through evaluating bird egg concentrations and relating those to levels of teratogenesis (developmental abnormalities) and reproductive impairment (Skorupa and Ohlendorf 1991). In 1993, to evaluate the risks of the Grassland Bypass Project on biotic resources in Mud and Salt Sloughs, a set of Ecological Risk Guidelines based on Se in water, sediment, and residues in several biotic tissues were developed by a subcommittee of the San Luis Drain Reuse Technical Advisory Committee (CAST 1994, Engberg et al. 1998). These guidelines (Table 6-4) are based on a large number of laboratory and field studies, most of which are summarized in Skorupa et al. (1996) and Lemly (1993). For water, sediment, and various biotic compartments, the guidelines identify ranges of Se concentrations associated with no effect, level of concern (risk to sensitive species), and toxicity likely to a broader range of species. Except those for avian eggs, the guidelines are intended to be population based. Therefore, they should be used for evaluating population means rather than contaminant concentrations in individuals. Guidelines for avian eggs are based on individual level response thresholds. An expanded discussion of the Se ecological risk guidelines is presented in Appendix E2.

Table 6-4 Recommended Ecological Risk Guidelines Based Upon Selenium Concentrations

Medium	Affected Component	Units	No Effect	Level of Concern	Toxicity
Warmwater Fish (whole body)	Fish growth/ survival	mg/kg (dry weight)	< 4	4-9	> 9
Vegetation (as diet)	Bird reproduction	mg/kg (dry weight)	< 3	3-7	> 7
Invertebrates (as diet)	Bird reproduction	mg/kg (dry weight)	< 3	3-7	> 7
Sediment	Fish and bird reproduction	mg/kg (dry weight)	< 2	2-4	> 4
Water (total recoverable Se)	Fish and bird reproduction	μg/L	< 2	2-5	> 5
Avian egg	Egg hatchability	mg/kg (dry weight)	< 6	6-10	> 10

Notes:

These guidelines are intended to be population based. Thus, trends in means over time should be evaluated.
A tiered approach is suggested with water being the least meaningful measure and whole body fish being the most meaningful in assessment of ecological risk in a flowing system.
The guidelines for vegetation and invertebrates are based on dietary effects on reproduction in chickens, quail, and ducks (Wilber 1980; Martin 1988r; Heinz 1996).
If invertebrate Se concentrations exceed 6 milligrams per kilogram (mg/kg) dry weight, then avian eggs should be monitored (Heinz et al. 1989; Stanley et al. 1996)

The water concentration guidelines presented in Table 6-4 are based on bioaccumulation data from a large dataset, and imply that a total recoverable Se concentration of 2 µg/L would correspond with fish tissue concentrations of 4 mg/kg, and a total recoverable Se concentration of 5 µg/L would correspond with fish tissue concentrations of 9 mg/kg. The bioaccumulation rates may be lower in situations where a high percentage of the Se in water is present in forms with lower bioavailability, such as selenate. This scenario is expected to occur in agricultural drainage from the GDP, where data indicate lower rates of bioaccumulation (see Appendix E2). Based on the bioaccumulation regression equations presented in Appendix E2, at a concentration of 2 µg/L Se in Mud Slough, the average predicted fish tissue concentration would be 3.1 mg/kg. At a concentration of 4 µg/L Se in Mud Slough, the average predicted fish tissue concentration would be 3.8 mg/kg.

6.2.2 Environmental Impacts and Mitigation

Biological resource impacts of the three Alternatives are evaluated below. The impact evaluation for each Alternative is divided into four parts:

- Special-status species
- Wetlands
- Aquatic habitats
- Bioaccumulation and food chain impacts

Areas 1, 2, and 3 could be differentially impacted by each Alternative. Therefore, potential impacts to special- status species, wetlands, aquatic habitats, and bioaccumulation are evaluated independently for each section of the Project Area as appropriate. Mitigation measures are described in Section 6.2.2.4.

6.2.2.1 No Use Agreement (No Action)

Under this Alternative, the Grassland Area Farmers (GAF) would not utilize the San Luis Drain (the Drain). Subsurface agricultural drainage would not be collected into a single drainage outlet (Grassland Bypass Channel) for conveyance to the Drain. However, the ongoing program for drainage management, including use of the initial phases of the In-Valley treatment/drainage reuse facility (reuse area), also known as the San Joaquin River Water Quality Improvement Project (SJRIP), would continue on just over 6,000 acres of salt-tolerant crops. Over time, the reuse capacity of the SJRIP would diminish as salt accumulated within the root zone, reducing the ability of the SJRIP to support salt-tolerant crops. Continued application to areas without subsurface drains could result in water table rise, seepage into canals and channels used to convey wetland water supplies, and seepage into wetland habitats in Area 2 that would violate water quality standards. Agricultural production on other lands would continue in the short term. As the reuse capacity diminished, fields in the lower portion of the GDA region would become waterlogged and unproductive and would be abandoned. Unmanageable ponding of high Se water would occur at the lower elevations on private property. All of these impacts would occur over an extended period of years and are discussed further below.

6.2.2.1.1 Special-Status Species

IMPACTS WITHIN AREA 1

The No Action Alternative would alter the types of crops that are cultivated in the GDA, and land would be taken out of production. Changes in cultivation patterns would affect special-status species that utilize specific crop types for foraging and nesting. The total area of cereal grains, alfalfa, and rice would decrease substantially, while the acreage of fallowed land would increase. Cereal grains and alfalfa provide high-quality foraging habitat for predatory birds because of high prey abundance. Alfalfa, in particular, is known to support an exceptional abundance and diversity of insects and small mammals, which in turn attract high numbers of insectivorous birds and raptors in concentrations (Smallwood and Geng 1993; Putnam 1998) Rice cultivation provides some foraging and dispersal habitat value for giant garter snake and breeding and foraging habitat for a variety of wetland and riparian bird species. Conversion of alfalfa and rice to fallowed and grazing land would decrease these habitat values for a number of species, but could provide increased habitat for species that prefer open, sparsely vegetated foraging habitat, such as mountain plover.

Removing lands from production is not considered beneficial for special-status species because ruderal vegetation with low habitat values would dominate these sites in the absence of cultivation, and high Se water could accumulate on lower elevation lands. The No Action Alternative would have a potentially significant adverse impact compared to existing conditions on some special-status species within the GDA, due to a reduction in the quality of foraging habitat. The impacted species from reductions in crops such as alfalfa would include Swainson's hawk, northern harrier, burrowing owl, tricolored blackbird, and pallid and western red bats. Species that could experience significant adverse impacts to foraging habitat as rice is taken out of production would include tricolored blackbirds, greater and lesser sandhill cranes, and giant garter snake. In addition, the reduction in rice cultivation would reduce potential habitats for nesting tricolored blackbirds, a potentially significant adverse impact compared to existing conditions.

Special-status species that forage in the GDA may also experience significant adverse impacts under the No Action Alternative compared to existing conditions due to increases in the soil concentrations of Se and potential increased surface ponding, resulting in higher Se bioaccumulation as described in Section 6.2.2.1.4. These species include the San Joaquin kit fox, bald eagle, Swainson's hawk, northern harrier, tricolored blackbird, loggerhead shrike, mountain plover, western burrowing owl, and pallid and western red bats.

The fish community in Area 1 does not include sensitive species, so no impacts to these species would occur.

IMPACTS WITHIN AREA 2

Currently, waterways and wetlands channels within Area 2 do not receive water from the GDA. Under the No Action Alternative, seepage of high Se water from the GDA to Area 2 would occur. Many of these waterways are located within state and federal wildlife management areas.

Some raptors and other predatory birds prey upon aquatic birds that consume fish or invertebrates from wetlands and small mammals that consume invertebrates and seeds along the ecotone of wetland and upland habitat. Aquatic birds that obtain a large amount of their diet from wetlands in the Project Area are likely to accumulate higher concentrations of Se in their tissue under the No Action Alternative. Therefore, predatory birds such as the American peregrine falcon, bald eagle, and northern harrier that potentially forage in Area 2 are likely to receive increased Se exposure by feeding on these birds, and may experience significant adverse impacts under the No Action Alternative compared to existing conditions.

Increased Se concentrations in the wetlands in Area 2 may also adversely affect other special-status birds, reptiles, mammals, and amphibians that forage in or near wetlands, including the tricolored blackbird, willow flycatcher, lesser and greater sandhill crane, least Bell's vireo, western pond turtle, giant garter snake, pallid and western red bats, American badger, and California tiger salamander. These species may experience significant adverse impacts under the No Action Alternative compared to existing conditions.

Slender-leaved pondweed, a special-status plant species that grows in freshwater wetlands and waterways, could be adversely affected by increased salinity. Therefore, the No Action Alternative, which would increase salinity within waterways in Area 2, would have a potential adverse impact on slender-leaved pondweed if it is present.

The fish community in Area 2 does not include sensitive species, so no impacts to these species would occur.

IMPACTS WITHIN AREA 3

Area 3 would no longer receive drainage water from the GDA under the No Action Alternative. The San Luis Drain would be dry for periods of each year, and high Se water from the GDA would not be discharged to Mud Slough or the San Joaquin River. The lack of drainage from the GDA would reduce annual flows in Mud Slough. Wildlife species that utilize aquatic habitats in Mud Slough are generally adapted to irregular flows and changing water levels that are typical of river floodplains. Therefore, decreased flows in Mud Slough are not likely to significantly impact special-status wildlife species such as the giant garter snake or western pond turtle, compared to existing conditions.

Two special-status plant species potentially occur in Mud Slough: the slender leaved pondweed and the Sanford's arrowhead. Both species tolerate seasonal water level fluctuations similar to the flow reductions that would occur under the No Action Alternative. Therefore, decreased flows in Mud Slough under the No Action Alternative are not likely to have a significant adverse impact on special-status plant species.

Se levels in both Mud Slough and the San Joaquin River would diminish (see Figure 2-2). Reduced Se levels would result in significant beneficial impacts, compared to existing conditions, to special-status species that utilize aquatic habitats in Mud Slough and the San Joaquin River, such as the giant garter snake. Based on limited toxicity data for reptiles, Beckon and Maurer (2008) concluded that an appropriate dietary Se toxicity threshold for the giant garter snake is probably below 10 µg/g. Se concentrations in fish in Mud Slough frequently exceed this value, but would be reduced under No Action, resulting in a beneficial impact.

The impacts described above would be relevant for fall-run Chinook salmon in the San Joaquin River. Central Valley steelhead, hardhead, and splittail could be affected in both the San Joaquin River and in Mud Slough (all in Area 3). The effects of the No Action Alternative would reduce

Se concentrations in the San Joaquin River and may be beneficial for all of these species. Se concentrations in juvenile Chinook salmon in the San Joaquin River downstream of the Merced River have historically been high enough to cause some mortality (Sakai 1998), but Se levels in water have decreased since the inception of the Grassland Bypass Project in 1996, to a current average of 2.2 µg/l (Beckon and Maurer 2008). This concentration in water is expected to produce concentrations in fish tissue below the level expected to cause substantial mortality (Beckon and Maurer 2008). The reduction in Se concentrations would reduce the bioaccumulation of this element.

The effects on hardhead and steelhead in Mud Slough are likely negligible, as the habitat is largely unsuitable for these species and they were not documented here in the most recent survey. Splittail have been documented in wet years (Beckon et al. 1999), which occur about 1 year in 3. During these wetter conditions, flow reductions would be less and therefore habitat is likely to remain widely available. Se concentrations within this habitat and downstream in the San Joaquin River would be reduced, which would likely benefit this species.

Overall, the No Action Alternative would have beneficial effects for special-status fish species. Under CEQA, these impacts would be less than significant.

6.2.2.1.2 Wetlands

The No Action Alternative would have a significant adverse impact on wetland water quality in Areas 1 and 2, and a significant beneficial impact on wetland water quality in Area 3, compared to existing conditions. Drainwater with high concentrations of Se and salts would cause uncontrolled ponding in lower elevation lands in Area 1, with significant adverse affects on water quality in the 4.7 acres of existing freshwater marsh within the 151 acres of alkali scrub habitat adjacent to the main canal. While increased ponding could expand the area of wetland vegetation within the alkali scrub, increased soil saturation and inundation might reduce the area of iodine bush scrub habitat, a significant adverse impact to this sensitive vegetation type.

Drainage water would also seep into canals and channels conveying water to wetlands in Area 2, which would cause significant adverse effects on water quality in all wetlands within those areas. As this water would contain higher salt levels, there is potential that this would degrade a substantial portion of the vegetation within these wetlands, a significant adverse impact to wetlands. Water with high concentrations of Se is not expected to reach Mud Slough, and with no Se input from the San Luis Drain, Mud Slough wetland water quality is expected to improve.

6.2.2.1.3 Aquatic Habitat

Under the No Action Alternative, no conveyance of agricultural drainage would occur in the San Luis Drain. Based on the flow model, no flow would remain (Figure 6-2) in all water year types. Because of the lack of an outlet, water may become ponded in lower areas within the GDA. This water would have elevated Se concentrations (see Section 4.2.2.3.1) and therefore would not provide suitable fish habitat. However, because the Drain and the associated canals provide only artificial habitat, this loss is not considered to be significant.

Flows in Mud Slough would also be reduced under the No Action Alternative (Figure 6-3). These reductions would range from 36 to 41 cfs on average, but could be as large as 66 cfs at times. These flow reductions are in the range of 35 to 45 percent of existing conditions on average, but can be as much as 95 percent on some occasions. Se concentrations in Mud Slough would be decreased significantly under this Alternative (see Section 4.2.2.3.4). The quantity of spatial habitat would be reduced by the change in flows, but the improvements in Se and water quality would result in improved habitat quality. It is not possible to determine how the loss of habitat quantity relative to the improvement in habitat quality would balance in terms of species population levels, with the information available. It is conservatively concluded (from the perspective of protection of fish), therefore, that the No Action Alternative would have an adverse effect on fish habitat in Mud Slough. This effect is potentially significant for purposes of CEQA.

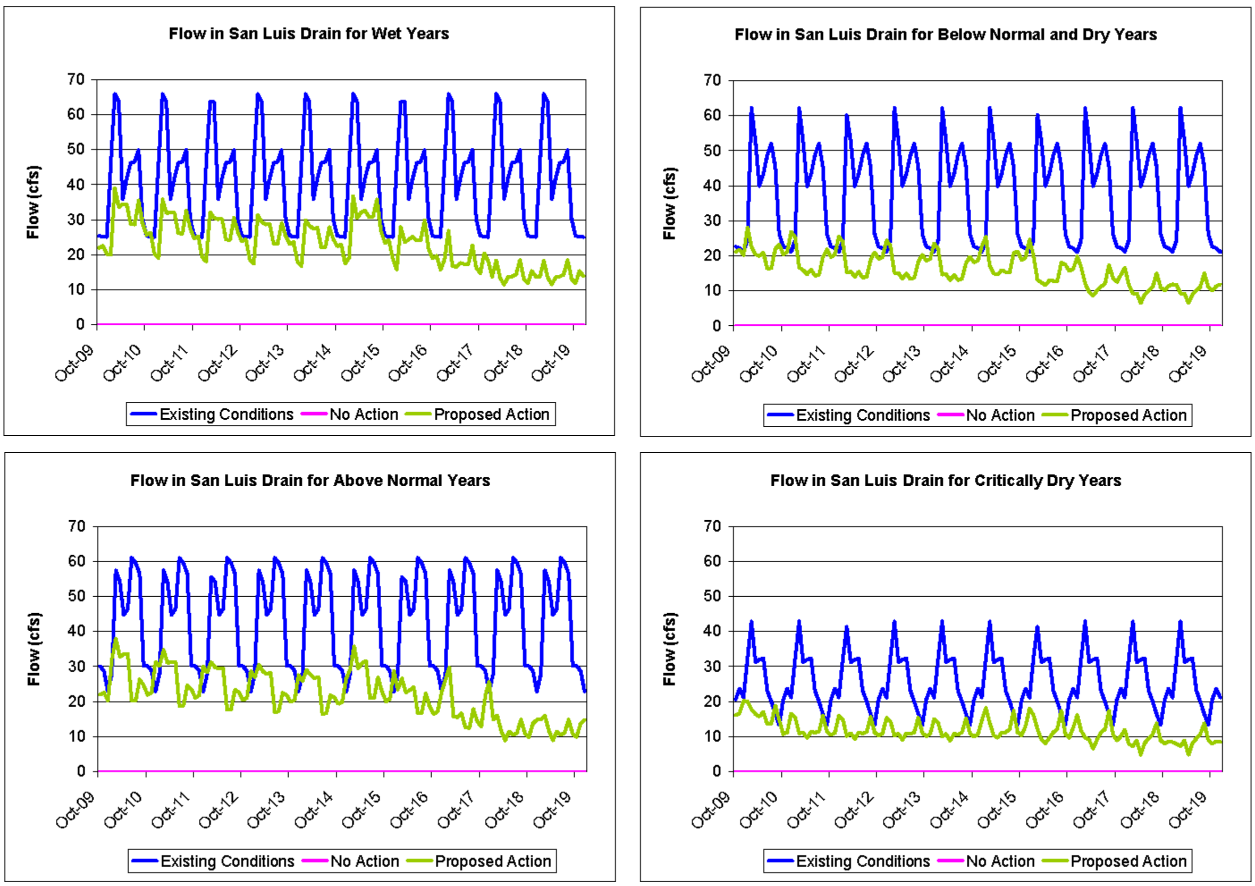


Figure 6-2 Flow in the San Luis Drain by Water Year Type

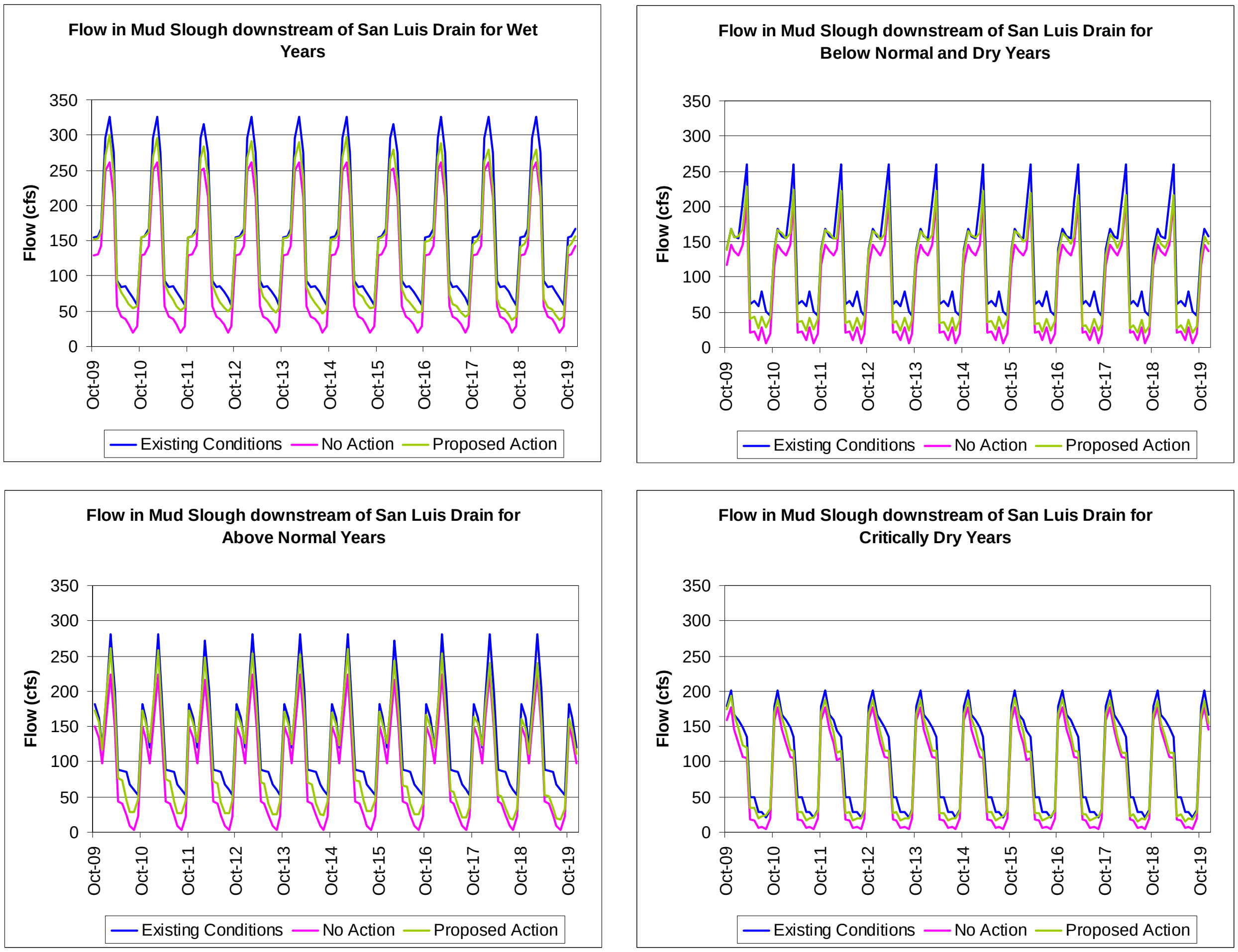


Figure 6-3 Flow in Mud Slough by Water Year Type

Flows in the San Joaquin River near Crows Landing would be reduced by similar amount to those described for Mud Slough. The percent change in flow would be imperceptible because of the much higher flows under existing conditions at this location due to flow contributions from the Merced River (Figure 6-4). Se concentrations would also be reduced at this location, although not to as great a degree as in Mud Slough. The effects of No Action would be beneficial at this location, as the reduction in the quantity of habitat would be negligible, while the improvements to water quality would be substantial. In comparison to existing conditions, this impact would be less than significant under CEQA.

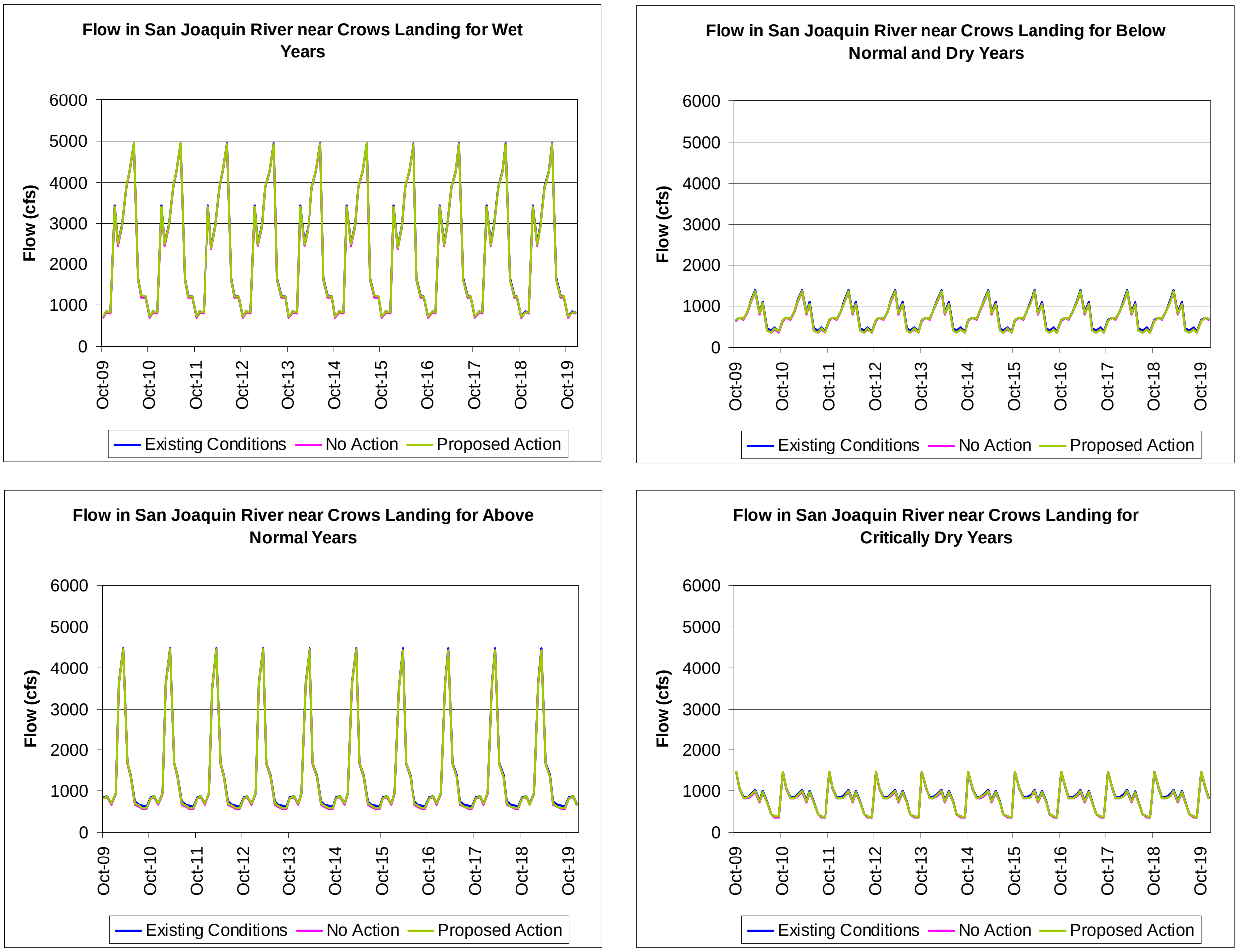


Figure 6-4 Flow in the San Joaquin River at Crows Landing by Water Year Type

6.2.2.1.4 Bioaccumulation and Food Chain Impacts

Under the No Action Alternative, cooperative interagency drainwater management would be limited to the SJRIP. Agricultural subsurface drainwater from the GDA would neither be channeled into the San Luis Drain, nor could it be legally discharged into wetland channels under the terms of applicable waste discharge requirements. However, some subsurface drainage may migrate laterally into wetland channels. In addition, some subsurface drainage may seep into open ditches in the agricultural areas within the GDA. During major storm events, these ditches may overtop their banks, and surface flow of floodwaters mixed with surface and subsurface drainwater may spill uncontrollably into wetlands channels. This is expected to have a significant adverse effect on refuge ecosystems in the Project Area due to recontamination of wetland water supply channels that have benefited from declining contaminant levels since the Grassland Bypass Project began in 1996. Aquatic communities in most of these channels would be subject to increased risks due to higher concentrations of Se, boron, manganese, and other salts. Similarly, wetlands that receive their water supply from these channels would experience increased risks. In terrestrial ecosystems surrounding the water channels and wetlands, species such as waterfowl and shorebirds that directly or indirectly use aquatic and wetland resources also would be subject to increased risks due to higher contaminant concentrations. These adverse effects are likely to be significant.

No managed outlet for subsurface drainwater that may overflow sumps and may seep into open ditches would be included under the No Action Alternative. Therefore, some ponding of drainwater on the surface of fields at the downslope edge of the GDA may occur where surface flow is blocked by roads and canals. Such ponding may be extensive and persistent following major storm events when drainwater flows would be augmented with surface runoff of rainwater. As these ponds infiltrate and evaporate, Se concentrations may reach the high levels found in evaporation basins. Aquatic invertebrates with elevated Se concentrations are likely to proliferate in these shallow ponded areas. These invertebrates may attract large numbers of feeding shorebirds and waterfowl. These migratory birds are the most sensitive wildlife to the adverse effects of Se in their diet. During the breeding season following winter rains, birds feeding on invertebrates in these ponds can be expected to suffer significant reproductive failure due to embryonic deformities and failure of eggs to hatch.

The lower portion of Mud Slough (North), below the current Drain discharge point, would be substantially dewatered, but water quality would be expected to improve in that segment of Mud Slough and in the San Joaquin River downstream of the confluence of Mud Slough with the San Joaquin River because the total load of drainwater contaminants due to uncontrollable seepage and floodflows is expected to be substantially less than the load currently discharged into lower Mud Slough (North) under the Grassland Bypass Project. Therefore, ecosystems in the vicinity of lower Mud Slough and the San Joaquin River are likely to experience a beneficial and potentially significant reduction in risks caused by agricultural drainwater contamination.

Due to elevated Se concentrations in soil, operation of the reuse areas without providing drainage could increase the risk of Se exposure for some terrestrial species (e.g., seed- and insect-eating species and the larger species that prey on them), potentially resulting in significant effects such as decreased reproduction. It is difficult to predict the likelihood or severity of effects due to terrestrial Se bioaccumulation as limited historical bioaccumulation monitoring data are available for reuse areas in the region. Egg Se tissue concentrations have been monitored at Panoche Drainage District (H.T. Harvey and Associates 2008) and Red Rock Ranch (Buchnoff 2006); however, these egg tissue monitoring events were focused on waterbirds (killdeer, black-necked stilt, and American avocet) and the red-winged blackbird (which forages in aquatic as well as terrestrial environments) and did not include terrestrial birds such as raptors. Se concentrations have also been measured in wheat grass, alfalfa, and pasture crops grown in the Panoche Drainage District/SJRIP reuse area. Concentrations ranged from 0.63 to 3.2 parts per million (ppm) (dry weight). Some values fell above the recommended ranges for cattle feed; however, wildlife may feed on specific portions of the plants (such as seeds), making it difficult to draw any general conclusions regarding effects to biological resources based on the limited data available.

The ecological risk assessment for Kesterson Reservoir (CH2M Hill and Lawrence Berkeley National Laboratory 2000) included a review of historical data on Se bioaccumulation in the terrestrial food chain. Although Se concentrations and conditions at the GDA may differ from Kesterson, the data from Kesterson provide some indication of Se bioaccumulation in the terrestrial food chain. The conclusions from this risk assessment indicated that although the terrestrial bird species (American kestrel, barn owl, and loggerhead shrike) would likely continue to have elevated Se egg tissue concentrations, the concentrations would be below those expected to cause reproductive effects. Predicted Se concentrations were below levels known to cause health or reproductive effects in small mammals. Se levels in terrestrial food chain items other than mushrooms and shrews were generally low. In contrast to Se bioaccumulation that occurs in waterbirds when ponding occurs, Se tissue concentrations in upper-trophic-level terrestrial receptors tend to be fairly stable.

Drainage reuse has the potential to result in highly seleniferous subsurface drainwater ponding in fields at the reuse facility, which can create a hazard to birds. Based on measured waterborne and egg-Se levels at Panoche Drainage District reuse areas, lethal and sublethal effects on waterbirds breeding at the site are probable under the No Action Alternative. Water samples from the sources of drainwater used to irrigate the existing reuse area ranged from 43 to 761 parts per billion (ppb) Se from 2003 to 2005 (H.T. Harvey and Associates 2008). These levels are well above the level of waterborne Se (32 ppb) associated with a high probability of reduced hatchability and increased probability of teratogenesis (embryo deformities) (CH2M Hill et al. 1993). Egg-Se monitoring at the existing reuse area has found elevated egg-Se levels in both recurvirostrids and killdeer. Egg-Se levels in both groups have been higher than in similar sets of reference eggs collected from the project vicinity. Annual geometric mean, egg-Se levels from recurvirostrid eggs have varied, but from 2003 to 2006, most means were also above the level (18-ppm) associated with an increased probability of reduced hatchability and teratogenesis (HT Harvey & Associates 2008).

However, careful management of irrigation water and tailwater may be sufficient to avoid or minimize the potential for ponding (H.T. Harvey & Associates 2007). Careful management practices include the installation of a subsurface drainage collection system, draining tailwater into the Grassland Bypass Channel, application rates that handle crop needs and avoid overwatering, and drainage treatment after the construction of the treatment facility. If ponding occurs despite careful management, wildlife risks will be evaluated, and if adverse wildlife exposure to contaminants is detected, irrigation of the field will cease until an irrigation method that does not cause ponding is identified and implemented. To respond to ponding that occurs despite careful management, a contingency plan was developed (H.T. Harvey & Associates 2007.

Beginning in 2006, Panoche Drainage District implemented the following mitigation measures to reduce impacts to nesting shorebirds in reuse areas:

- Dredging the bottom of open drains that had been consistently used by shorebirds to eliminate potential feeding and nesting substrates
- Filling in drains that had been consistently used by shorebirds to eliminate potential feeding and nesting substrates
- Temporarily netting drains that had been consistently used by shorebirds to eliminate potential feeding and nesting substrates
- Discharging cracker shells to discourage shorebird use where shorebird nesting had been concentrated in the past
- Enhancing habitat for nesting shorebirds outside the Project area at a site with clean (nonseleniferous) water

These measures were continued and enhanced in 2007, and the geometric mean of Se in recurvirostrid levels decreased from 23 ppm (dry weight) in 2006 to 16.7 ppm in 2007. Because significant interannual variability in Se concentrations in eggs occurred, it is not known whether this decrease can be attributed solely to mitigation measures. A decrease in Se concentrations in killdeer and red-winged blackbirds was also reported. No nest attempts were documented where bird access to open drains had been prevented by closure or netting.

Because the amount of reuse area would increase under the No Action Alternative and ponding would be more difficult to manage, there may be a significant increase in Se-related effects to both terrestrial birds and waterbirds utilizing the reuse areas.

6.2.2.2 Grassland Bypass Project, 2010–2019 (Proposed Action)

The continuation of the Grassland Bypass Project, 2010–2019, (Proposed Action) would continue the existing system of consolidation, conveyance, and discharge of subsurface drainage flows into Mud Slough. The San Luis Drain would convey the drainage flows to the northern terminus of the Drain at Mud Slough. From this point, the drainage water enters Mud Slough 6 miles upstream of its confluence with the San Joaquin River. This Alternative would complete construction of the drainage treatment and reuse facility, which would involve expansion of the existing 4,000-acre[2] SJRIP reuse area by 2,900 acres (Section 2.1.1). This Alternative would also install minor conveyance modifications and plant salt-tolerant crops on areas that currently support alfalfa, corn, cotton, tomatoes and grain. Continued degradation of aquatic habitats in Mud Slough and associated bioaccumulation and food chain impacts would occur under this Alternative.

6.2.2.2.1 Special-Status Species

IMPACTS WITHIN AREA 1

The acreage acquired for the expanded reuse area would gradually be planted with salt-tolerant crops. Changes in land use and crop patterns for the conversion of 2,900 acres to salt-tolerant crops could reduce the area of cultivated crops[3] that provide foraging habitat for Swainson's hawk, northern harrier, burrowing owl, tricolored blackbird, pallid bat, and western red bat, as discussed under the No Action Alternative. Conversion of cultivated lands to salt-tolerant crops could reduce the abundance of prey utilized by these special-status species, a potentially significant adverse impact compared to existing conditions. However, under the Proposed Action Alternative, crop pattern changes would occur over a smaller area than would occur under the No Action Alternative. Therefore, adverse effects to species based on crop conversion from high-quality foraging habitat to low-quality foraging habitat would be positive compared to the No Action Alternative. In addition, the Proposed Action does not include a reduction in the area of land cultivated for rice identified under the No Action Alternative. Therefore, this Alternative would have no impacts, compared to existing conditions, for special-status species that utilize rice field habitats such as tricolored blackbirds, greater and lesser cranes, and giant garter snake. Under NEPA, compared to the No Action Alternative, which would remove rice habitat, the Proposed Action is beneficial in providing increased acreages of rice habitat within the GDA for rice-utilizing species.

[2] In 2007, 3,800 acres were planted. By November 2008, 4,300 acres were planted. See Section 2.2.1.2.2.
[3] Reconcile assumption about existing use of lands in the reuse expansion area with assumption in economic analysis.

Construction and ground disturbance activities associated with the expansion of the reuse facilities could reduce the breeding success of burrowing owl or San Joaquin kit fox if burrows or dens that are utilized by these species are present within ground disturbance areas. Therefore, the reuse facilities would have unlikely but potentially significant adverse impacts to burrowing owl and San Joaquin kit fox, if these species are present, compared to existing conditions. Reclamation would engage in consultation with the Service under Section 7 of the Endangered Species Act to identify measures to avoid or reduce potential effects to the San Joaquin kit fox. Kit fox dens were not identified during an Initial Study in preparation for a draft Mitigated Negative Declaration for acquisition of up to 2,900 acres proposed as the expansion of the existing In-Valley Treatment/Drainage Reuse Facility (URS 2007b). Burrowing owls are known to breed within the GDA, and minimization and avoidance measures such as preconstruction surveys and seasonal construction avoidance would be necessary to reduce impacts to breeding burrowing owls. Loggerhead shrike and tricolored blackbirds may utilize cultivated and ruderal habitats in the proposed acquisition area for breeding. However, the Proposed Action Alternative would not adversely impact the habitats that are utilized by these species for breeding compared to existing conditions, and effects would be positive compared to the No Action Alternative, which would remove breeding habitat for these species.

Special-status species that forage in reuse areas may experience significant adverse impacts compared to existing conditions, due to increases in Se soil concentrations and potential for increased ponding, resulting in increased Se bioaccumulation as described in Section 6.2.2.2.4. These species include the San Joaquin kit fox, bald eagle, Swainson’s hawk, burrowing owl, northern harrier, tricolored blackbird, loggerhead shrike, mountain plover, giant garter snake, and pallid and western red bats. However, these species may be positively affected compared to the No Action Alternative because increases in Se bioaccumulation would be lower.

The fish community in Area 1 does not include sensitive species, so no impacts to these species would occur.

IMPACTS WITHIN AREA 2

Under the Proposed Action Alternative, agricultural drainage from the GDA would continue to be diverted away from Area 2 waterways except during high storm events. Predatory birds such as the American peregrine falcon, bald eagle, Swainson’s hawk, burrowing owl, and northern harrier that may forage in Area 2 are likely to receive lower Se exposure under this Alternative than under the No Action Alternative. Therefore, these species may be positively impacted under the Grassland Bypass Project compared to the No Action Alternative, but there would be no significant change compared to existing conditions.

Lower Se concentrations in the wetlands in Area 2 might improve conditions for other special-status birds, reptiles, mammals, and amphibians that forage in and den in the periphery of wetlands compared to the No Action Alternative. Species that might be positively impacted compared to the No Action Alternative would include the tricolored blackbird, lesser and greater sandhill cranes, least Bell’s vireo, western pond turtle, giant garter snake, pallid and western bats, American badger, and California tiger salamander. However, no significant impact would occur compared to existing conditions.

The fish community in Area 2 does not include sensitive species, so no impacts to these species would occur.

IMPACTS WITHIN AREA 3

Waterways in Area 3 would continue to convey agricultural drainage from the GDA. Water with high Se concentrations would continue to enter Mud Slough and the San Joaquin River, but loads would be reduced over time. In the lower portion of Mud Slough (North), listed species such as tricolored blackbird, greater and lesser sandhill cranes, least Bell's vireo, western pond turtle, giant garter snake, pallid and western red bats, American badger, and California tiger salamander may be exposed to higher Se concentrations under the Grassland Bypass Project, 2010–2019, than under the No Action Alternative (resulting in a negative effect compared to No Action), but lower concentrations than under existing conditions (resulting in a beneficial impact compared to existing conditions).

The impacts described above would be relevant for fall-run Chinook salmon in the San Joaquin River. Central Valley steelhead, hardhead, and splittail could be affected in both the San Joaquin River and in Mud Slough (all in Area 3). The effects of the Proposed Action would reduce Se concentrations in the San Joaquin River relative to existing conditions and might be beneficial for all of these species. Se concentrations would be higher than under the No Action Alternative, and may result in a potential adverse affect relative to existing conditions.

The effects of the Proposed Action on hardhead and steelhead in Mud Slough are likely negligible relative to either existing conditions or the No Action Alternative, as the habitat is largely unsuitable for these species, and they have not been documented to occupy this area in the most recent surveys available. Splittail have been documented in this area in wet years (Beckon et al. 1999), which occur about 1 year in 3. During these wetter conditions, flow reductions would be less and therefore the quantity of habitat is likely to be similar to that under existing conditions. Se concentrations would decrease relative to existing conditions. The Proposed Action would be beneficial to splittail relative to existing conditions for splittail. The Proposed Action would not, however, provide as much reduction in Se concentrations as the No Action Alternative, although it would result in the retention of a greater quantity of habitat. Because of the higher Se concentrations, this alternative would result in potentially negative effects for splittail relative to the No Action Alternative. However, because this habitat is used only occasionally by splittail and represents a small proportion of their available habitat throughout the watershed, this effect is minimal.

6.2.2.2.2 Wetlands

Freshwater marsh habitats in Area 1 that are part of a 151-acre parcel that also includes iodine bush scrub would not be utilized for the In-Valley Treatment/Drainage Reuse Facility under the Proposed Action Alternative compared to existing conditions. However, the Proposed Action Alternative would likely slightly improve habitat conditions within this area compared to the No Action Alternative because of potential degradation of this site under No Action.

Under the proposed continuation of the Grassland Bypass Project, agricultural drainage from the GDA would not enter waterways in Area 2 except when the Drain overflows during high storm events. Therefore, the Proposed Action Alternative would have no significant impacts to wetlands in Area 2 compared to existing conditions, and it would have a positive impact compared to the No Action Alternative.

The Proposed Action Alternative would continue to discharge drainage water containing Se and salts into Mud Slough (Area 3). These discharges would be similar to the existing conditions. Therefore, wetlands and aquatic habitats in Mud Slough would not be significantly impacted compared to existing conditions. However, the continued degradation of wetlands in Mud Slough by these discharges would be an adverse effect compared to the No Action Alternative.

6.2.2.2.3 Aquatic Habitat

Under the Proposed Action, flows would be reduced by 14 to 22 cfs on average, relative to existing conditions (see Figure 6-2). Flows would be increased by 12 to 23 cfs relative to the No Action Alternative. Se concentration would be similar to existing conditions in the short-term and decrease, as additional treatment measures were implemented, to low levels by 2019. Se concentrations would be higher than under the No Action Alternative.

In Mud Slough, the Proposed Action would result in improved conditions for fish relative to existing conditions. The diminished quantity of habitat relating to flow reductions would not be as substantial as those described previously for the No Action Alternative (see Figure 6-3), and Se concentrations would be similar to those under existing conditions initially and decline over time. The reduction in the quantity of habitat would not be significant.

Relative to the No Action Alternative, this Proposed Action would result in increased flows, but higher Se concentrations. Se concentrations in fish would continue to fall within the zone of concern and some samples may exceed toxicity thresholds. Thus, the Proposed Action would be adverse relative to the No Action Alternative.

In the San Joaquin River near Crows Landing, the Proposed Action would result in lower flows than under existing conditions (see Figure 6-4) and improved water quality. This would benefit fish, resulting in a less-than-significant impact relative to existing conditions under CEQA.

Relative to the No Action Alternative, flows at this location would be higher, but water quality would be reduced. The effects of this Alternative would be adverse relative to the No Action Alternative.

6.2.2.2.4 Bioaccumulation and Food Chain Impacts

The Proposed Action would continue the Grassland Bypass Project, which has been in operation since September 1996, but with new requirements under the proposed 2010 Use Agreement. The Proposed Action has increasingly stringent Se load targets to decrease Se discharges to comply with Se water quality objectives (WQOs) set by the *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins* (1998 Basin Plan; Regional Board 1998a) for the San Joaquin River. Therefore, the effects of Se and other drainwater contaminants on the ecosystem are initially expected to be about the same as the 2011 projected effects, but are expected to improve gradually in the San Joaquin River as loads delivered to the river are decreased. The 1998 Basin Plan specifies a schedule for compliance with the Se WQO in Mud Slough (North); compliance with this 5 µg/L 4-day average Se WQO is to occur by October 2010. The Proposed Action would fail to meet this objective by the given schedule; however, aggressive Se load reductions would occur and the frequency of exceedance would be reduced.

The extent to which the detrimental effects of Se on the Mud Slough ecosystem will be ameliorated depends on whether reductions in Se loads are achieved chiefly by reducing Se concentrations in the drainwater or by reducing the volume of drainwater. If load reductions are accomplished by reductions in volume of drainwater without reductions in Se concentrations, then adverse effects on fish and wildlife in and around Mud Slough may continue when other sources of flow in Mud Slough upstream of the San Luis Drain are limited.

Concentrations of Se in water have been modeled in various Project Area waterways through the year 2019 (Appendix C) based on the proposed Se load limits associated with the Proposed Action as described in Section 2.2.1.2. Modeled Se concentrations in water may be used to estimate effects on fish based on the method outlined in Appendix E2. This estimation procedure applied to Mud Slough below the outfall of the Drain (Site D) indicates that the Proposed Action would result in average concentrations of Se in fish dropping during the decade of 2010–2019. Highest Se concentrations are expected to occur in Above Normal and Wet years; the lowest Se concentrations are expected to occur in critical years. The average concentration in all samples of fish is expected to remain within the zone of concern for warmwater fish until April 2016, after which some months are predicted to be within the no effect zone (Figure 6-5). However, due to variation in Se concentrations among composite fish samples, some samples would exceed the threshold of toxicity while some samples would fall into the no-effect zone (Figures 6-6 to 6-9). About 7 to 24 percent of fish samples at Site D would exceed the threshold of toxicity if an Above Normal year were to occur in 2010. By 2019, the proportion of fish samples exceeding the toxicity threshold in an Above Normal year would be 2 to 6 percent (see Figure 6-4). If a Critical year were to occur in 2010, about 4 to 20 percent of fish samples at Site D would exceed the toxicity threshold; by 2019 about 0.4 to 5 percent of fish samples would exceed the toxicity threshold in a Critical year (see Figure 6-6). Therefore, the effects from the Proposed Action on Mud Slough (North) would be beneficial relative to existing conditions. However, those effects would be negative relative to the No Action Alternative.

The San Luis Drain has a capacity of 150 cfs, which is insufficient to fully accommodate the elevated drainwater flows resulting from major storm events. Drainwater flows induced by those events necessitated the release of some flood-borne drainwater into wetland supply channels. If such floods occur while the Grassland Bypass Project is in operation, it may be necessary to release the excess drainwater into wetland supply channels at Agatha Canal and/or Camp 13 Ditch, upstream of the Grassland Bypass. Therefore contamination of wetland supply channels with subsurface drainwater may occasionally recur under the continuation of the Grassland Bypass Project. Depending on the length of these events, they may pose significant contaminant risks to aquatic and associated terrestrial ecosystems along waterways in the Project Area.

Under the current operation of the Grassland Bypass Project, sediments that have high Se concentrations are accumulating in the Drain. If this Project is continued, further deposition of sediments may be expected. Eventually these sediments may occlude flows in the Drain to the extent that they have to be removed. Depending on the method of removal and disposal of the sediments, the dredging operation and the spoils may put local and downstream ecosystems at significantly increased risk of toxic contamination. A Sediment Management Plan is included in this Environmental Impact Statement/Environmental Impact Report (EIS/EIR) as Appendix B that is based on 10 years of sediment sampling. The draft plan includes criteria for acceptable concentrations of Se in sediments proposed for land application.

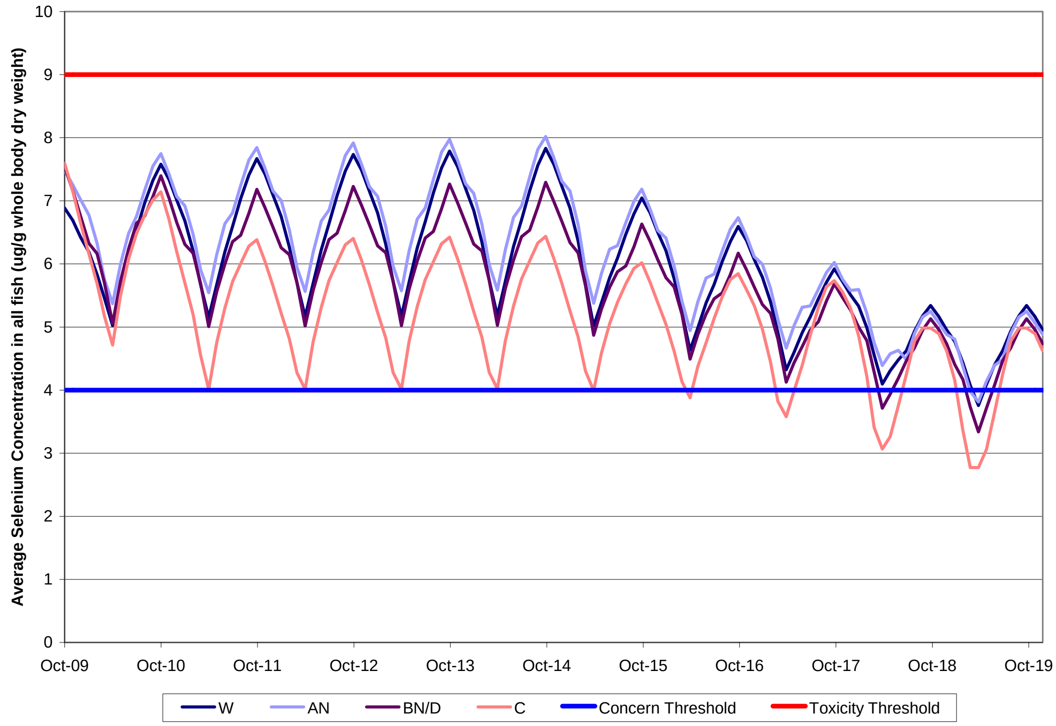


Figure 6-5 Projected Average Selenium Concentration in Fish in Mud Slough (North) downstream of the San Luis Drain (Site D) based on Selenium in Water modeled for the Proposed Action

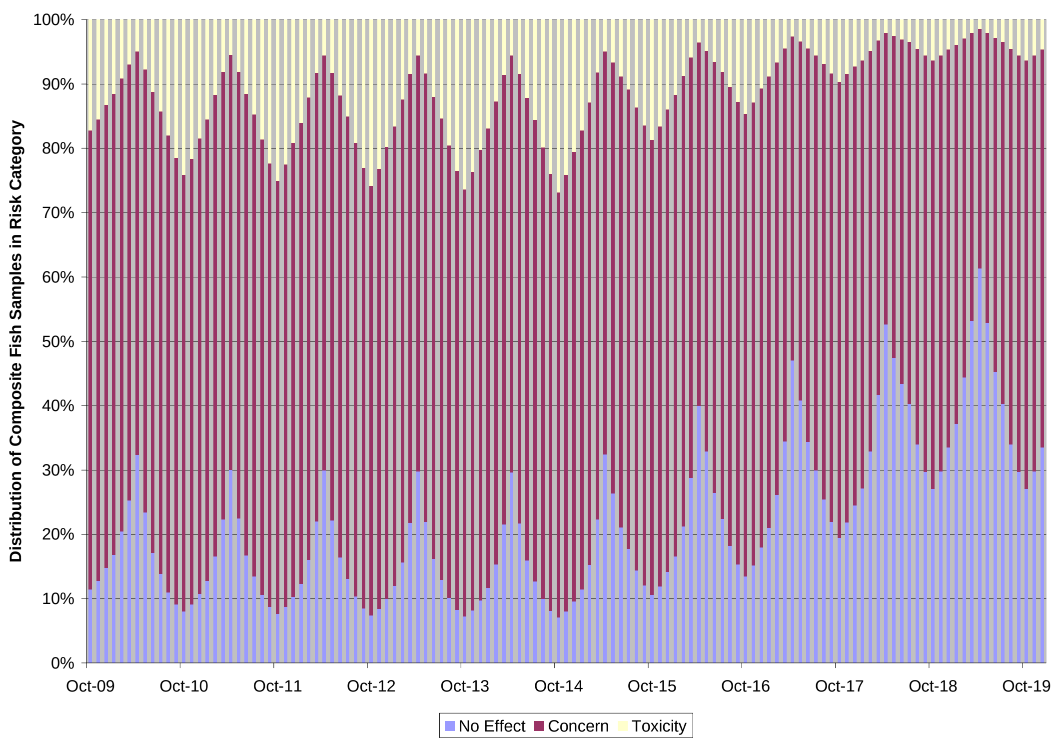


Figure 6-6 Projected Distribution of Composite Fish Samples in Risk Categories at Mud Slough (North) downstream of the San Luis Drain (Site D) based on Selenium in Water modeled for the Proposed Action for Wet Years

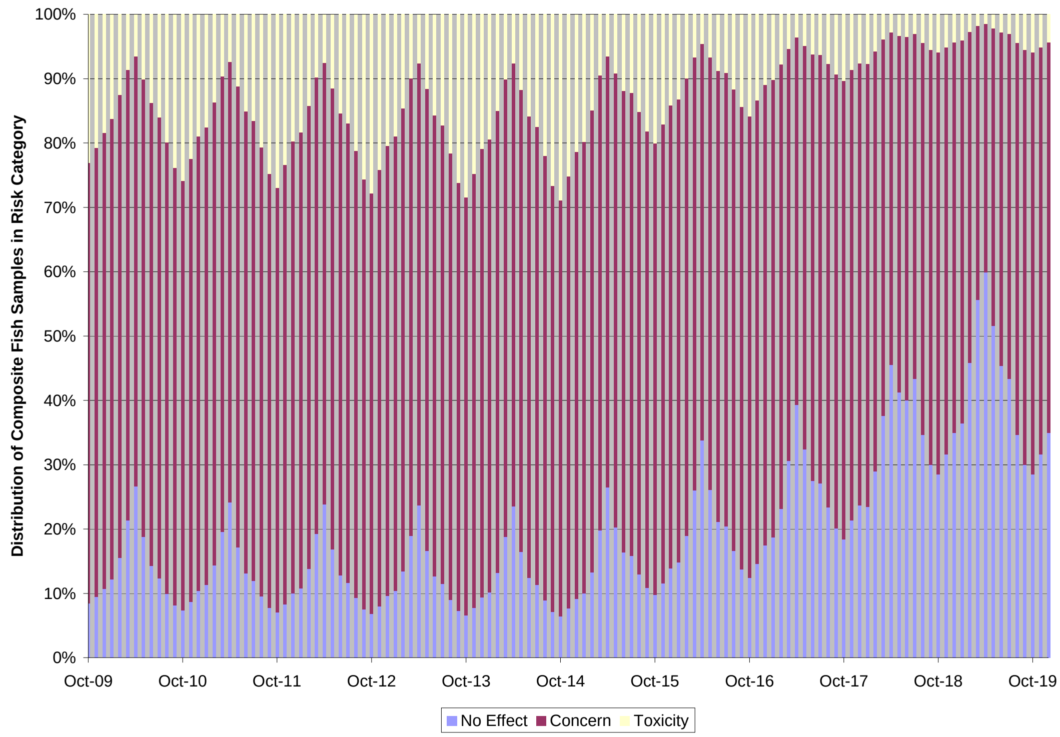


Figure 6-7 Projected Distribution of Composite Fish Samples in Risk Categories at Mud Slough (North) downstream of the San Luis Drain (Site D) based on Selenium in Water modeled for the Proposed Action for Above Normal Years

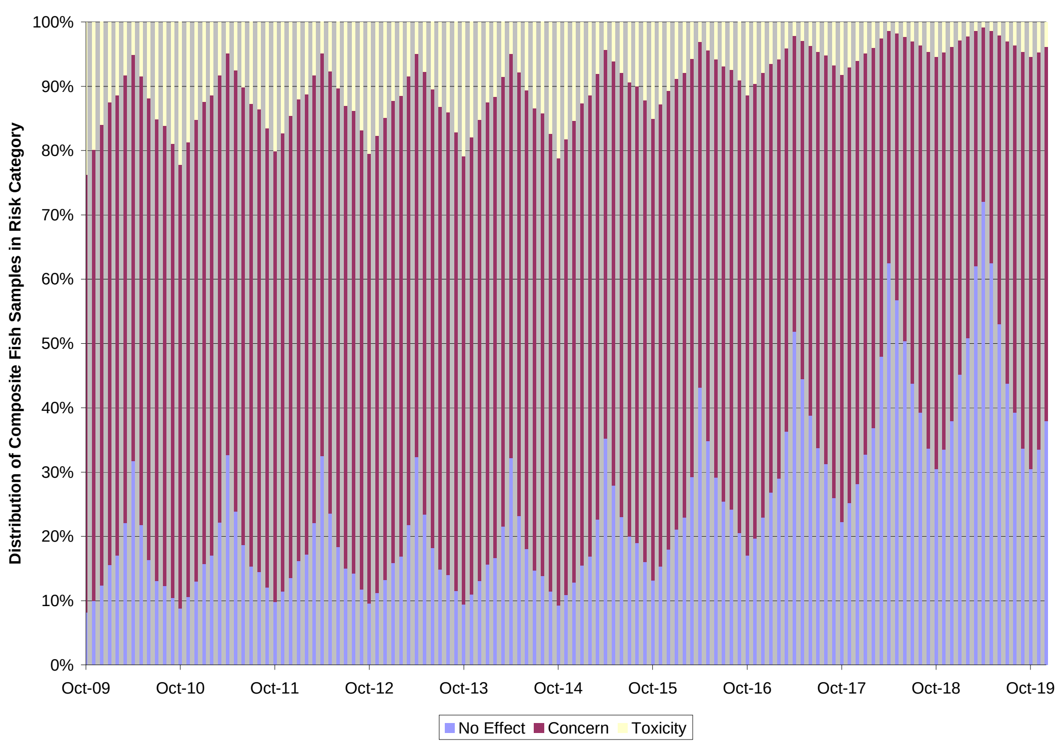


Figure 6-8 Projected Distribution of Composite Fish Samples in Risk Categories at Mud Slough (North) downstream of the San Luis Drain (Site D) based on Selenium in Water modeled for the Proposed Action for Below Normal/Dry Years

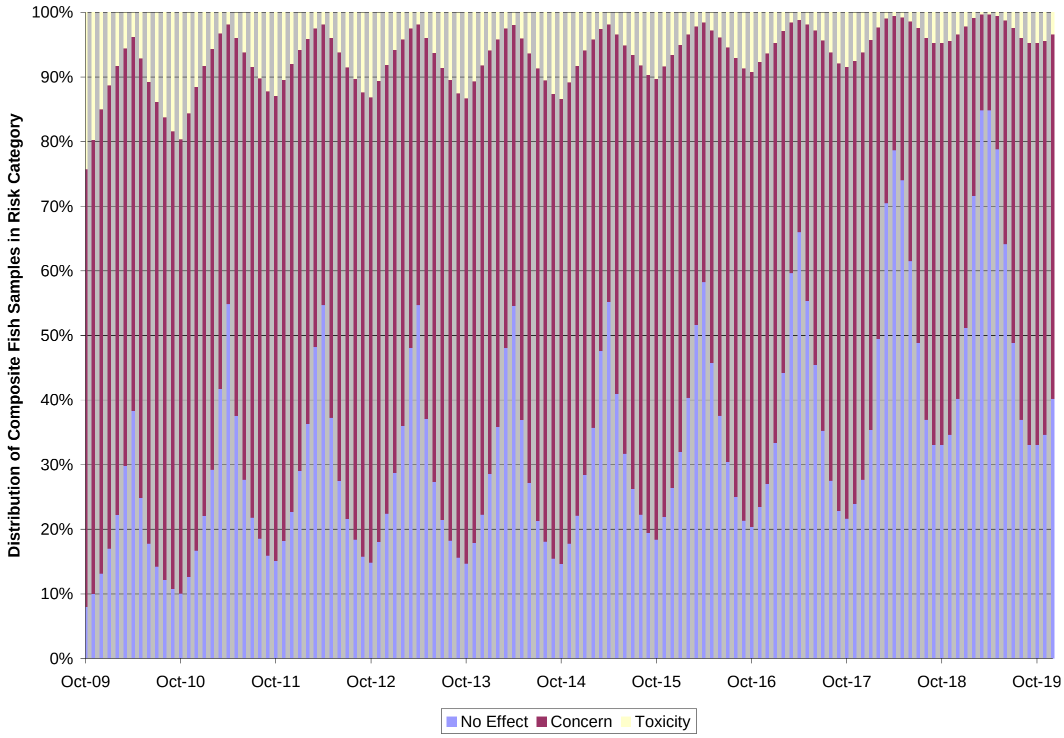


Figure 6-9 Projected Distribution of Composite Fish Samples in Risk Categories at Mud Slough (North) downstream of the San Luis Drain (Site D) based on Selenium in Water modeled for the Proposed Action for Critical Years

To achieve the Se load reductions that are required, GAF is expected to continue to implement drainage recycling and drainage reuse at the SJRIP In-Valley Treatment/Drainage Reuse Facility, which involves application of subsurface drainwater on the surface of fields to irrigate salt-tolerant crops. As described in Section 6.2.2.1.4, drainage reuse has the potential to result in highly seleniferous subsurface drainwater ponding in fields at the reuse facility, which can create a hazard to birds. However, careful management of irrigation water and tailwater (also described in Section 6.2.2.1.4) may be sufficient to avoid or minimize the potential for ponding. As described in Section 6.2.2.1.4, operation of the reuse areas could also increase the risk of Se exposure for some terrestrial species (e.g., seed- and insect-eating species and the larger species that prey on them), potentially resulting in significant effects such as decreased reproduction.

The effects from the Proposed Action on waterbirds and terrestrial birds utilizing reuse areas would be potentially significantly adverse relative to existing conditions, but can be mitigated to less-than-significant by the measures discussed in Section 6.2.2.1.4 and those in Section 6.2.2.4. Effects would be positive relative to the No Action Alternative.

6.2.2.3 2001 Requirements Alternative (Alternative Action)

The 2001 Requirements Alternative would include the same components as the Grassland Bypass Project (2010–2019) Alternative except that the Se and salt loads discharged to Mud Slough would be limited to the less stringent allowances described in the 2001 Use Agreement. This Alternative does not avoid or substantially reduce any potentially significant biological resource impacts of the Proposed Action. It does not include the Mud Slough mitigation requirement in the proposed 2010 Use Agreement.

6.2.2.3.1 Special-Status Species

IMPACTS WITHIN AREA 1

Impacts under this Alternative to special-status species from physical disruptions in the GDA, such as ground disturbance or crop rotation, would be similar to those under the Proposed Action Alternative. Swainson’s hawk, northern harrier, burrowing owl, tricolored blackbird, pallid bat, and western red bat, would experience decreased acreages of high-quality foraging habitat under this Alternative than under existing conditions, but increased acreages of high-quality foraging habitat compared to the No Action Alternative. These changes would be significantly adverse compared to existing conditions, but beneficial compared to the No Action Alternative. As in the Proposed Project Alternative, ground disturbance may present significant adverse impacts to the breeding success of San Joaquin kit fox and western burrowing owl compared to existing conditions, and have no effect compared to No Action. These impacts are unlikely and could be avoided through appropriate minimization and mitigation measures that would reduce significant impacts to less than significant.

Special-status species that forage in reuse areas may experience significant negative impacts as compared to existing conditions, due to increases in Se soil concentrations and potential increase in ponding. These species include the San Joaquin kit fox, American peregrine falcon, bald eagle, Swainson’s hawk, northern harrier, tricolored blackbird, greater and lesser sandhill cranes, least Bell’s vireo, loggerhead shrike, mountain plover and pallid and western red bats. However, these species may be beneficially affected as compared to the No Action Alternative. Effects would be similar to those that would occur under the Proposed Action.

The fish community in Area 1 does not include sensitive species, so no impacts to these species would occur.

IMPACTS WITHIN AREA 2

Predatory birds such as the Swainson’s hawk, American peregrine falcon, bald eagle, burrowing owl, and northern harrier that may forage in Area 2 are likely to receive lower Se exposure under the 2001 Requirements Alternative. Therefore, these species may be beneficially affected under the continuation of the Grassland Bypass Project compared to the No Action Alternative, but there would be no significant change compared to existing conditions. Effects would be similar to those discussed under the Proposed Action.

Lower Se concentrations in the wetlands in Area 2 may also beneficially affect other special-status birds, reptiles, and amphibians that forage in wetlands, including the tricolored blackbird, greater and lesser sandhill crane, least Bell’s vireo, western pond turtle, giant garter snake, pallid and western red bats, American badger and California tiger salamander as compared to the No Action Alternative, but there would be no significant change compared to existing conditions. Effects would be similar to those that would occur under the Proposed Action.

The fish community in Area 2 does not include sensitive species, so no impacts to these species would occur.

IMPACTS WITHIN AREA 3

In Area 3, water quality would not improve over time as it would in the Proposed Action Alternative. Se and salt loads would level off after 2011 (see Figure 2-5), leading to continued water quality impairments and impacts to special-status species that may utilize Mud Slough and the San Joaquin River. In the lower portion of Mud Slough (North), listed species such as San Joaquin kit fox, American peregrine falcon, bald eagle, Swainson's hawk, northern harrier, tricolored blackbird, lesser and greater sandhill cranes, least Bell's vireo, western pond turtle, giant garter snake, pallid and western red bats, American badger, and California tiger salamander would be negatively affected by Se concentrations under the 2001 Requirements Alternative compared to the No Action Alternative, but beneficially impacted compared to existing conditions. Risks would be greater than those that would occur under the Proposed Action.

The effects of the Alternative Action within Area 3 would be similar to those occurring under existing conditions for special-status fish species on the San Joaquin River. The Se concentrations would remain similar to those that currently occur and flows and, thus, habitat quantity would be similar as well. This Alternative would provide less favorable conditions than the No Action Alternative for these species, because of the higher Se levels. This would be considered a negative effect of the Alternative Action under NEPA and a potentially significant adverse impact under CEQA.

The effects of the Alternative Action on hardhead and steelhead in Mud Slough are likely negligible relative to either existing conditions or the No Action Alternative, as the habitat is generally unsuitable for these species and recent surveys indicate they are absent from Mud Slough. Splittail have been documented in Mud Slough in wet years (Beckon et al. 1999), which occur about 1 year in 3. During these wetter conditions, flow reductions would be less and therefore the quantity of habitat is likely to remain relatively high. The Alternative Action would have a less-than-significant impact relative to existing conditions for splittail. The Alternative Action would not, however, provide as much reduction in Se concentrations as the No Action Alternative and would, therefore, result in a potentially negative effect on this species relative to the No Action Alternative. However, because this habitat is used only occasionally by splittail and represents a small proportion of their available habitat throughout the watershed, this effect is minimal.

6.2.2.3.2 Wetlands

Impacts to wetlands in the GDA and Area 2 under this Alternative would be similar to those under the Proposed Action Alternative.

Mud Slough would continue to receive Se and salts from discharge water under the 2001 Requirements Alternative. Discharge levels and associated impacts to wetlands would level off in 2011 (see Figure 2-5), rather than decreasing through 2019 as in the Proposed Project Alternative. Wetlands would not be impacted compared to current existing conditions. However, discharges of water containing elevated Se and salts would adversely affect the wetlands in Mud Slough compared to No Action. Adverse effects would be higher than those that would occur under the Proposed Action.

6.2.2.3.3 Aquatic Habitat

Under the Alternative Action, flows would be the same as those for the Proposed Action through 2014. After 2014, flows would be similar to those in 2014, varying by water-year type. Se concentrations would be similar to those occurring in 2010 for the duration of the project. These concentrations would be similar to those under existing conditions and higher than those under the No Action Alternative.

This Alternative would have the same effects as the Proposed Action until 2014, after which, the Alternative Action would maintain the conditions in 2014, while the Proposed Action would continue to reduce Se concentrations.

This Alternative would result in a less-than-significant impact relative to existing conditions, as flows and Se loadings would be changed only slightly. This Alternative would result in an adverse effect relative to the No Action Alternative because of higher Se concentrations.

In the San Joaquin River near Crows Landing, the Alternative Action would result in slightly lower flows than under existing conditions and slightly improved water quality similar to the Proposed Action. This would provide a slight benefit fish, resulting in a less-than-significant impact relative to existing conditions under CEQA.

Flows at this location would be slightly lower, but water quality would be reduced relative to the No Action Alternative. The effects of this Alternative would be negative relative to the No Action Alternative. This effect would be potentially substantial.

6.2.2.3.4 Bioaccumulation and Food Chain Impacts

The 2001 Requirements Alternative would continue to convey Project Area agricultural subsurface drainwater to Mud Slough via the Drain. The 2001 Requirements Alternative has Se load targets designed to comply with Se WQOs set forth by the 1998 Basin Plan for the San Joaquin River below the Merced River. The 1998 Basin Plan also specifies a schedule for compliance with the Se WQO for Mud Slough (North); the 5 µg/L 4-day average Se WQO applies by October 2010. The 2001 Requirements Alternative would fail to meet this objective more frequently then the Proposed Action.

The 2001 Requirements Alternative has identical Se load limits as the Proposed Action for 2010 through 2014 and maintains the 2011 to 2014 Se load limits for the duration of the project. Modeled Se concentrations in water are the same as the Proposed Action from 2010 to 2014 and modeled Se concentrations from 2015 to 2019 are similar, if not the same, as the 2014 values. These concentrations may be used to estimate effects on fish based on the method outlined in Appendix E2. This estimation procedure applied to Mud Slough below the outfall of the San Luis Drain (Site D) indicates that the 2001 Requirements Alternative would result in average concentrations of Se in fish being maintained during the decade of 2010 to 2019. Highest Se concentrations are expected to occur in above normal rainfall years; the lowest Se concentrations are expected to occur in critically dry years. The average concentration in all samples of fish is expected to remain consistently within the zone of concern for warmwater fish (see Figure 6-5). However, due to variation in Se concentrations among composite fish samples, some samples would exceed the threshold of toxicity while some samples would fall into the no-effect zone (see Figures 6-6 to 6-9).

If flood-swollen drainage water flows exceed the Grassland Bypass Channel capacity of 150 cfs, it may be necessary to release drainwater into wetland supply channels at Agatha Canal and/or Camp 13 Ditch, upstream of the Grassland Bypass, resulting in the contamination of wetland supply channels with subsurface drainwater. Depending on the length and frequency of these events, aquatic and associated terrestrial ecosystems along waterways in the Project Area may be at risk of significant contaminant.

Under the current operation of the Grassland Bypass Project, sediments with high Se concentrations have been accumulating in the Drain. Because the 2001 Requirements Alternative involves continued use of the lower 28 miles of the Drain to convey Project Area agricultural drainwater, continued deposition of sediments is likely. Eventually these sediments will occlude flows in the drain to the extent that they will have to be removed. Depending on the method of removal and disposal of the sediments, the dredging operation and the spoils may put local and downstream ecosystems at significantly increased risk of toxic contamination. See Appendix B, Sediment Management Plan, which outlines how sediments should be removed and disposed.

The 2001 Requirements Alternative would include the same drainage recycling and drainage reuse at the SJRIP In-Valley Treatment/Drainage Reuse Facility that would be implemented under the Proposed Action. The potential environmental effects of these practices are described at the end of Section 6.2.2.2. The 2001 Requirements Alternative would allow for higher Se loads to be discharged from the Drain than the Proposed Action.

The effects from the 2001 Requirements Alternative on waterbirds and terrestrial birds utilizing reuse areas may be significantly adverse relative to existing conditions, but effects would be positive relative to the No Action Alternative. Effects to waterbirds utilizing reuse areas would be similar to those occurring under the Proposed Action, and the same mitigation measures could be used.

6.2.2.4 Mitigation and Minimization Measures

The following Measures 1 through 4 are required to mitigate for significant adverse impacts under CEQA associated with continued operation and expansion of the In-Valley Treatment/Drainage Reuse Facility. Measure 5 is required if Measures 1, 2, and 3 do not sufficiently reduce the exposure to Se. For continued discharge of Se contaminated drainwater to Mud Slough after 2010, the Proposed Action contains a wetland enhancement requirement to mitigate for the additional degradation of this area. The Alternative Action does not contain this mitigation.

MITIGATION 1: AVOIDING BURROWING OWLS

In conformance with federal and state regulations regarding the protection of raptors, a pre-construction survey for burrowing owls will be completed in conformance with CDFG recommendations, no more than 30 days prior to the start of construction. If no burrowing owls are located during these surveys, no additional action would be warranted. However, if breeding or resident owls are located on, or within 250 feet of, the proposed construction site, the following mitigation measures will be implemented:

- A 250-foot buffer, within which no new activity would be permissible, will be maintained between project activities and nesting burrowing owls. This protected area will remain in effect until August 31, or may be terminated earlier at the CDFG's discretion based upon monitoring evidence that indicate that young owls are foraging independently.

Owls may be evicted from the construction area to avoid take of individual owls via construction activities. However, CDFG does not permit the eviction of burrowing owls from burrows during the nesting season (February 1 through August 31). Eviction outside the nesting season may be permitted pending evaluation of eviction plans and receipt of formal written approval from the CDFG authorizing the eviction. If accidental take (disturbance, injury, or death of owls) occurs, the CDFG will be notified immediately.

MITIGATION 2: REDUCE EXPOSURE POTENTIAL BY REDUCING ATTRACTIVENESS OF IRRIGATION DITCHES FOR NESTING

The majority of shorebird nesting on the existing reuse site consists of killdeer and recurvirostrids nesting within, or adjacent to, the irrigation ditches that deliver drainwater to the site. Adults nesting near irrigation ditches feed primarily in these ditches, though this is more typical of recurvirostrids than killdeer. Reducing the attractiveness of the ditches and their immediate surroundings as nesting and foraging habitat is necessary to minimize the level of shorebird exposure to Se.

To date, irrigation ditches have been netted as a short-term measure, and unused ditches have been filled in. Sediment that has collected on the bottom of irrigation ditches will be removed to remove potential nest substrate when water levels are low. Smooth sides and borders will be maintained along irrigation ditches to inhibit the common killdeer and recurvirostrid practice of using rough surfaces such as disked areas to conceal nests.

MITIGATION 3: REDUCE EXPOSURE POTENTIAL BY HAZING BIRDS FROM NESTING NEAR, AND FORAGING IN, IRRIGATION DITCHES

Shorebird use of the existing project site is not homogenous (H.T. Harvey & Associates 2004, 2005). As noted above, shorebird nests at the existing project site are concentrated in the vicinity of irrigation ditches. Additionally, stilts and avocets are semicolonial, often nesting in close vicinity to each other. Hazing will be performed to reduce exposure by reducing the number of nesting birds. Methods of hazing may include firing noise making devices such as cracker shells, 15-mm bird bombs, and bird whistlers from a vehicle to discourage breeding birds from establishing nest sites. In addition, propane-operated cannons will be left operating on a 24-hour basis, if required. Cannon locations will be changed periodically to lessen acclimation.

MITIGATION 4: FLOODED FIELD CONTINGENCY PLAN

In the spring of 2003, a pasture at the existing reuse area site attracted waterfowl when it was inadvertently flooded. This flooded area created ideal ecological conditions for shorebird foraging and nesting and thus, a number of pairs responded opportunistically and bred in the field. Recurvirostrid eggs collected near the pasture had highly elevated Se concentrations compared to other recurvirostrid eggs collected elsewhere on the site. The Panoche Drainage District has since developed a contingency plan for accidental flooding. This plan is presented in Appendix C. The plan includes provisions for immediate removal of unintended drainwater as well as for increased monitoring near flooded sites. The provisions of this plan will be implemented in the event of ponding at the reuse area.

MITIGATION 5: PROVIDE COMPENSATION BREEDING HABITAT

If after employing Mitigation Measures 1, 2, and 3, monitoring (described in Section 15) determines nesting shorebirds are exposed to elevated Se levels as a result of the Proposed Action, compensation habitat for residual impacts will be provided.

COMPENSATION HABITAT PROTOCOL

In 1995, the Service formulated “compensation habitat protocols” for avian impacts from agricultural drainwater evaporation basins with elevated levels of waterborne Se. The motivation for the protocol was to develop a risk-based approach to compensation for impacts that increase accuracy, minimize monitoring costs, and provide incentive to minimize contaminant risk. The foundation of this approach was the observation that both nonlethal and lethal impacts result from avian exposure to elevated levels of Se and that impacts could not be determined by mortality counts alone. Therefore, the Service provided a risk-based approach that relies on egg-Se levels as an easily verified measure of avian exposure to Se and associated impacts.

In addition to the compensation habitat protocol, the Service produced “alternative habitat protocols.” The alternative habitat protocol was formulated to dilute, but not eliminate, avian exposure to contaminants at evaporation basins by providing alternative, freshwater wetlands close to evaporation basins. The In-Valley Treatment /Drainage Reuse project does not include drainwater evaporation basins and, therefore, does not create a situation in which birds would be discouraged from using evaporation basins (via reconfiguration and hazing) in favor of using clean alternative wetland habitats in the functional landscape of the basins. Rather, shorebirds (primarily recurvirostrids and killdeer) are likely exposed to elevated levels of Se while foraging in drainwater conveyance canals and irrigated fields and pastures, which are ephemeral in distribution and extent. Thus, a modified form of the Service’s compensation habitat protocol provides a model (as opposed to the alternative habitat protocol) as a mitigation approach to Se induced impacts at the In-Valley Treatment /Drainage Reuse project. The compensation habitat protocol, as well as the modifications developed by HT Harvey & Associates (2005), to render it suitable for the In-Valley Treatment /Drainage Reuse project, are presented below.

As mentioned above, the compensation habitat protocol is based on measures of Se concentrations in the eggs of recurvirostrids and the number of nesting recurvirostrids exposed to elevated levels of Se at a particular location. Egg levels of Se represent an accurate and repeatable measure of risk exposure in these birds (e.g., Ohlendorf, et al. 1993). A premise of this risk-based approach is that habitats that expose more birds to elevated Se or to higher concentrations of Se require relatively more compensation than habitats with lower Se concentrations or lower numbers of birds.

The Service presented two compensation habitat protocols, an “eggwise” basis and a “henwise” basis. The Service concluded that the henwise protocol is statically “cleaner” and utilizes more detailed exposure-response data actually collected from studies of recurvirostrids nesting at evaporation basins. Thus, the henwise approach is employed here. It is modified slightly to render it suitable for the In-Valley Treatment /Drainage Reuse project situation as opposed to an evaporation basin. The formula for calculating compensation (mitigation) habitat is:

$$\text{Compensation Habitat} = CC \times NN$$

Where,

$$CC = HU \times [(F1 \times L1) + (F2 \times L2) + (F3 \times L3) + (F4 \times L4) + (F5 \times L5)]$$

Where,

CC = compensation coefficient, the multiple of a site's breeding waterbird population that, on average, would be required in predominately shallow wetland acreage to replace lost production,

F1 = the proportion of randomly sampled eggs containing 0 to 5 ppm Se,

F2 = the proportion of randomly sampled eggs containing 5.1 to 20 ppm Se,

F3 = the proportion of randomly sampled eggs containing 21 to 40 ppm Se,

F4 = the proportion of randomly sampled eggs containing 41 to 70 ppm Se,

F5 = the proportion of randomly sampled eggs containing over 70 ppm Se,

L1 = the proportion of production lost when egg Se is from 0 to 5 ppm Se (L1 = 0.0 from premise HP3 in Service 1995)

L2 = the proportion of production lost when egg Se is from 5.1 to 20 ppm Se (L2 = 0.1889 from premise HP3 in Service 1995)

L3 = the proportion of production lost when egg Se is from 21 to 40 ppm Se (L3 = 0.2551 from premise HP3 in Service 1995)

L4 = the proportion of production lost when egg Se is from 41 to 70 ppm Se (L4 = 0.5083 from premise HP3 in Service 1995)

L5 = the proportion of production lost when egg Se is from over 70 ppm Se (L5 = 0.9261 from premise HP3 in Service 1995)

HU = the relative habitat quality for the project site (HU = 1)

Habitat utility (HU) in this equation has been modified from the Service's model (see premises GP-7 and GP-8 in Service 1995). The Service model was developed for evaporation basins in the Tulare Lake Basin and assumes that shallow compensation habitat with islands will exhibit about 2.5 times the habitat utility of evaporation basins without islands. This estimation was based on observations based on the performance of a mitigation site under optimal circumstances in the Tulare Lake Basin where population densities of recurvirostrids are much higher than in the In-Valley Treatment /Drainage Reuse project vicinity (Shuford et al. 1998).

> "NN," or number of nests, replaces "EH," the evaporation basin surface area in the original protocol calculation. In the original protocol, EH is used as a measure of degree of exposure with larger basins providing more habitat for more birds than relatively smaller basins. There are no basins in the In-Valley Treatment /Drainage Reuse project system. Therefore, actual number of nests (NN) is used as a direct measure of the number of birds potentially exposed to drainwater in the system. Values are derived from monitoring data and used to calculate compensation habitat acreage requirements.

At the SJRIP reuse facility, the primary species exposed to elevated levels of Se are recurvirostrids (American avocet and black-necked stilt) and killdeer. Killdeer eggs contain significantly less Se than recurvirostrid eggs at the existing project site (H.T. Harvey & Associates 2002, 2003, 2004, and 2005). Thus, if killdeer egg-Se levels are combined with the recurvirostrid levels, the killdeer results dilute the derived impacts estimates for avocets and stilts. Therefore, compensation acreage for killdeer will be calculated separately from stilts and avocets. Compensation habitat acreages for the two groups will then be combined to determine the total amount of compensation habitat to be provided.

A number of evaporation basin operators have adopted the Service protocol approach, or a similar approach, for determining mitigation habitat acreages. This approach involves an iterative monitoring/mitigation adjustment process in which the amount of compensation habitat provided is based on 3 years of monitoring. That amount of compensation habitat is then provided for the following 3 years. After 3 more years of monitoring, the compensation habitat is then adjusted based the monitoring results for those 3 years and so forth. This iterative process rewards operators for reducing or eliminating impacts by reducing subsequent mitigation requirements. Likewise, if increased numbers of birds are impacted, mitigation requirements increase accordingly. This approach is recommended for the In-Valley Treatment/Drainage Reuse Facility.

Biological monitoring will be required to determine the level of impacts and appropriate mitigation. This monitoring will need to include both:

- Egg sampling for Se analysis sufficient to determine the compensation coefficient (from the above equation) for both recurvirostrids and killdeer, and
- A census effort sufficient to determine the number of nests for both recurvirostrids and killdeer.

Biological monitoring has been conducted at the existing project site since 2001. The existing monitoring design will be modified to meet the above criteria.

Compensation habitat will be designed to maximize use by nesting water birds, specifically black-necked stilts and American avocets. A combination of 4- to 8-inch-deep shallow water foraging areas and large nesting islands are the key features for recurvirostrid nesting habitat. If the compensation habit required is large enough, shallow water depths may be maintained with the use of contour dikes similar to those used in rice farming. To compensate for Se exposure to water birds, the compensation habitat will require freshwater. The water supply to the compensation habitat should not exceed a geometric mean of 2.0-ppb total recoverable Se for any six consecutive monthly samples and 2.7-ppb total recoverable Se for any single monthly sample.

6.2.3 Cumulative Effects

Cumulative impacts are defined as impacts created as a result of the combination of the incremental effects of project evaluated in the environmental document together with other projects causing related impacts. Related regional projects, described in Section 1.5, primarily address water quality concerns in the San Joaquin River and the wetlands and waterways which include those within Area 2 of this project. As described in Section 1.5, under the No Action Alternative, the presence of agricultural drainwater in these waterways would interfere with the delivery of high-quality freshwater to 51,700 acres of state, federal, and private wetlands. This would have significant adverse impacts from Se and salts to wetland and riparian habitats and the special-status species which use them.

The Proposed Action would generally result in cumulatively beneficial effects when combined with the Central Valley Project Improvement Act (CVPIA), Vernalis Adaptive Management Plan (VAMP), San Luis Drainage Feature Re-evaluation Project, and West Side Regional Drainage Plan. The CVPIA and VAMP would increase flows during spring in the San Joaquin River, which would be beneficial for salmonids. The two drainage plans would reduce the concentrations of salts and other constituent elements in the San Joaquin River, which would also be beneficial to salmon. The Alternatives would not be adversely cumulative with the CalFed Bay Delta program and the South Delta Improvement Program. The Action Alternatives would result in decreased Se and salt concentrations in the Delta, and a very slight decrease in flow that is unlikely to adversely affect habitat in the Delta (especially as Vernalis flow standards under D-1641 would continue to be met). The water quality improvements from the Action Alternatives would be beneficial to fish in the Delta.

The Proposed Action would not have cumulative effects with the San Joaquin River Settlement Agreement. One of the objectives of the San Joaquin River Settlement Agreement is to restore Chinook salmon to the San Joaquin River between the Merced River and Friant Dam. This will bring Chinook salmon into close proximity to the Project Area during their upstream and downstream migration, an area this species cannot currently access. This could also increase the frequency with which steelhead utilize the Project Area (they can access the Project Area during portions of the year now, but no suitable habitat for them lies within or upstream of the Project Area, which limits their utilization of the Project Area), as they would be expected to take advantage of the improvements designed for Chinook salmon. This would increase their potential exposure to elevated Se concentrations. The exposure of adults would be very brief, probably a few days to a couple of weeks as these fish move rapidly upstream to their spawning grounds and no spawning habitat lies in the Project Area. These fish would not be feeding, further minimizing their exposure to Se. Outmigrant juvenile Chinook salmon and steelhead could spend several weeks in the Project vicinity, feeding as they work their way down the San Joaquin River to the ocean. These fish could receive significant dosages of Se during this time. However, under the Proposed Action, these concentrations would be less than these fish would experience without the Project under existing conditions, resulting in a cumulatively beneficial effect.

None of the Action Alternatives is likely to result in significant cumulative impacts to special-status species, wetlands, or aquatic habitats. Impacts related to minor ground disturbance, changes in drainflow or water temperature, or Se bioaccumulation do not result in significant cumulative impacts.

6.2.4 Impact and Mitigation Summary

The following sections summarize potential impacts to individual biological resources or ecosystem (special-status species, wetlands and terrestrial habitats, aquatic habitats, and bioaccumulation and food chain) and proposed mitigation measures for each of the Alternatives as required.

Overall, the No Action would lead to increased Se and salinity buildup in Areas 1 and 2, and remove such inputs from Area 3. This Alternative would have significant adverse impacts under CEQA, or negative effects under NEPA, to habitats and species affected by the buildup and overflow of discharge water in Areas 1 and 2. Concurrently, it would result in beneficial impacts/positive affects to habitats and species in Area 3, as discharges of salt and Se inputs are discontinued, reducing the potential for Se bioaccumulation.

The Proposed Action Alternative, in contrast, would have no impacts compared to existing conditions under CEQA and positive or neutral effects compared to the No Action Alternative under NEPA for Area 2 and most of Area 1. Compared to existing conditions, the expanded reuse area may cause significant adverse impacts in Area 1 as crop changes lead to habitat loss or degradation for species in the expansion area, as well as increased Se and higher potential for Se bioaccumulation in that area. By removing drainage water from Area 1, ponding is less likely to occur and less habitat is expected to be degraded than under the No Action Alternative in both Area 2 and Area 1 outside of the reuse area. Area 3 will experience beneficial impacts under CEQA, as discharges of Se and salinity to Mud Slough and the San Joaquin River habitats and species would be lower than under existing conditions. Area 3 would experience negative effects under NEPA, as discharges would be higher than under No Action.

Impacts under the 2001 Requirements Alternative would be similar to those for the Proposed Action Alternative, except that impacts would level off, rather than continually diminish, over the project lifetime.

Table 6-5 summarizes impacts to biological resources for the No Action Alternative and the two Action Alternatives. Impacts are identified for major actions for each Alternative. Impacts are discussed by affected area. The impact terminology in Table 6-5 is consistent with the CEQA/NEPA determinations in Section ES.6. CEQA requires a determination of impact significance or no impact based on existing conditions. The terms “significant adverse impact,” “potentially significant adverse impact,” “beneficial impact,” and “no impact” are used. NEPA requires a comparison of the Action Alternatives with No Action. The NEPA comparisons use the following terms: “negative” for adverse effect, “neutral” for no effect or minimal effect, and “positive” for a beneficial effect. These impacts are discussed below.

Table 6-5 Biological Resource Impacts by Alternative

Action	No Action Compared to Existing Conditions	Proposed Action Compared to No Action	Proposed Action Compared to Existing Condition	Alternative Action Compared to No Action	Alternative Action Compared to Existing Condition
Increase drainwater recycling, close off Drain to GDA drainage water.	*Significant adverse impact* Altered crop use over large areas could lead to decreases in habitat or habitat value for some species in the GDA. Uncontrolled drainage and ponding of high Se water in lowlands could lead to increased Se bioaccumulation in Areas 1 and 2. Wetlands in Area 2 would experience increased salinity and Se loads. *Beneficial impact* Wetlands in Area 3 would experience decreased salinity and Se loads leading to decreased Se bioaccumulation	*Positive* Altered crop use in the expanded reuse area only with lower loss of habitat or habitat value for some species in the GDA than the No Action Alternative. Uncontrolled drainage and ponding is less likely, reducing potential for Se bioaccumulation in Areas 1 and 2. *Negative* Wetlands in Area 3 would experience increased salinity and Se loads, leading to increased bioaccumulation.	*No impact* Action would not occur	*Positive* Altered crop use in the expanded reuse area only with lower loss of habitat or habitat value in the GDA than the No Action Alternative. Uncontrolled drainage and ponding is less likely, reducing potential for Se bioaccumulation in Areas 1 and 2. *Negative* Wetlands in Area 3 would experience increased salinity and Se loads, leading to increased bioaccumulation.	*No impact* Action would not occur
Expand Reuse Area Convert additional 2,900 acres of crops to Reuse Facility	*Potentially Significant Adverse Impact* Altered crop use in expansion area could lead to decreases in habitat or habitat value for some species. Se bioaccumulation could occur over a larger area.	*Positive* Altered crop use in expansion area and ponding would be less than would occur under No Action, resulting in lower increases in Se bioaccumulation.	*Potentially Significant Adverse Impact – Less than Significant with Mitigation* Altered crop use in expansion area could lead to decreases in habitat or habitat value. Se bioaccumulation could occur over a larger area.	*Positive* Altered crop use in expansion area and ponding would be less than would occur under No Action, resulting in lower increases in Se bioaccumulation.	*Potentially Significant Adverse Impact – Less than Significant with Mitigation* Altered crop use in expansion area could lead to decreases in habitat or habitat value. Se bioaccumulation could occur over a larger area.
Install subsurface drainage and collection systems, initial treatment/ salt disposal system	*No impact* Action would not occur.	*Negative* Ground disturbance may affect breeding success of burrowing species.	*Potentially Significant Adverse Impact – Less than Significant with Mitigation* Ground disturbance may affect breeding success of burrowing species.	*Negative* Ground disturbance may affect breeding success of burrowing species.	*Potentially Significant Adverse Impact – Less than Significant with Mitigation* Ground disturbance may affect breeding success of burrowing species.
Construct treatment facility	*No impact* Action would not occur.	*Negative* Ground disturbance may affect breeding success of burrowing species.	*Potentially Significant Adverse Impact – Less than Significant with Mitigation* Ground disturbance may affect breeding success of burrowing species.	*Negative* Ground disturbance may affect breeding success of burrowing species.	*Potentially Significant Adverse Impact – Less than Significant with Mitigation* Ground disturbance may affect breeding success of burrowing species.

Table 6-5 Biological Resource Impacts by Alternative

Action	No Action Compared to Existing Conditions	Proposed Action Compared to No Action	Proposed Action Compared to Existing Condition	Alternative Action Compared to No Action	Alternative Action Compared to Existing Condition
Discharge to Mud Slough	*Beneficial impact* Discharge would not occur. Wetlands and riverine habitat in Area 3 would experience decreased salinity and Se loads leading to decreased bioaccumulation. Significant Adverse Flow in Mud Slough would be substantially reduced under this alternative, resulting in a significant reduction in the quantity of habitat available for splittail in wet years.	*Negative* Wetlands in Mud Slough would experience increased salinity and Se loads, leading to increased bioaccumulation and potential loss of habitat for species sensitive to increased salinity. Habitat quality for splittail would be reduced because of higher Se concentrations. *Positive* Habitats in Areas 1and 2 would experience decreased salinity and Se loads, decreased bioaccumulation and potential loss of habitat for species sensitive to salinity. Neutral Steelhead and hardhead would not be affected as these species have not been observed to use this area in the most recent surveys.	*No impact* Habitats in Areas 1 and 2 would not be adversely impacted by this discharge. *Beneficial Impact* Wetlands in Mud Slough would experience decreased salinity and Se loads leading to lower bioaccumulation This would be beneficial to splittail in wet years.	*Negative* Wetlands in Area 3 would experience increased salinity and Se loads, leading to increased bioaccumulation and potential loss of habitat for species sensitive to increased salinity. Increased Se concentrations could result in adverse effects to splittail in wet years. *Positive* Habitats in Areas 1and 2 would experience decreased salinity and Se loads, decreased bioaccumulation and potential loss of habitat for species sensitive to salinity.	*No impact* Habitats in Areas 1 and 2 would not be adversely impacted by this discharge. *Beneficial Impact* Wetlands in Mud Slough would experience decreased salinity and Se loads leading to lower bioaccumulation No Impact No impact to splittailwould occur in wet years. Se and flow conditions would remain similar to those currently existing.
Discharge to San Joaquin River	*Beneficial impact* Discharge would not occur. Wetlands in Area 3 would experience decreased salinity and Se loads leading to decreased bioaccumulation Se concentraions in the San Joaquin River would be reduced resulting in potential beneficial impacts to Chinook salmon, steelhead, splittail, and hardhead.	*Negative* Riverine habitat would experience increased salinity and Se loads, leading to increased bioaccumulation. This would be potentially significant for Chinook salmon, steelhead, splittail, and hardhead.	*Beneficial Impact* Riverine habitat would experience lower salinity and Se loads leading to decreased Se bioaccumulation. This would be beneficial for Chinook salmon, steelhead, splittail, and hardhead.	*Negative* Riverine habitat would experience increased salinity and Se loads, leading to increased bioaccumulation. This would be potentially significant for Chinook salmon, steelhead, splittail, and hardhead.	*Beneficial Impact* Riverine habitat would experience lower salinity and Se loads leading to decreased Se bioaccumulation to salinity. This impact would not continue to decrease over the life of the project. No Impact No impact would occur to splittail in wet years. Se and flow conditions would remain similar to those currently existing.

6.2.4.1 Special-Status Species

Table 6-6 summarizes the impacts to special-status species of the Alternatives. Impacts are discussed by affected area. The impact terminology in Table 6-6 is consistent with the CEQA/NEPA determinations in Section ES.6. CEQA requires a determination of impact significance or no impact based on existing conditions. NEPA requires a comparison of the Action Alternatives with No Action. The NEPA comparisons use the following terms: “negative” for adverse effect, “neutral” for no effect or minimal effect, and “positive” for a beneficial effect. These impacts are discussed below.

6.2.4.1.1 No Action

Potentially significant adverse impacts, compared to existing conditions, to species foraging in current agricultural land would occur as Se accumulates, land fallows, and ponding occurs. Significant adverse impacts to species utilizing wetland channels from unmanaged flows and seepage would occur as Se and salt loads increase to wetlands that are currently protected from these inputs. Significant beneficial impacts, compared to existing conditions, would occur to wetland and aquatic species in Mud Slough and the impacted section of the San Joaquin River, resulting from reductions in Se concentrations due to no discharges. The loss of aquatic habitat resulting from flow reductions associated with the No Action Alternative may adversely affect fish in Mud Slough, but the resultant loss of habitat in the San Joaquin River at Crows Landing would not be significant.

6.2.4.1.2 Proposed Action

Potential significant adverse impacts, compared to existing conditions, to species foraging in current agricultural land would occur in the expanded reuse area, and significant adverse impacts to ground dwelling species could occur due to ground-breaking activities and construction in the reuse areas. These impacts can be mitigated by measures 1, 2, and 3 (Section 6.2.2.4) to less than significant.

Species utilizing wetlands or waterways in Areas 2 or 3 would experience no impacts compared to existing conditions. Adverse affects could occur to wetland and aquatic species in Mud Slough and the impacted section of the San Joaquin River compared to No Action in the short term, because of higher Se concentrations, but these would decrease over the course of the project. The Proposed Action would not have as great a reduction in habitat in Mud Slough as the No Action Alternative, and this effect would be minimal.

Table 6-6 Summary of Potential Impacts to Special-Status Species

Resource Type	Important Habitat(s)	No Action Compared to Existing Conditions	Proposed Action Compared to No Action	Proposed Action Compared to Existing Conditions	Alternative Action Compared to No Action	Alternative Action Compared to Existing Conditions
Federal and State Listed, Proposed and Candidate Species						
Mammals						
San Joaquin kit fox	GL, SC	Area 1: *Significant Adverse Impact* Se bioaccumulation may increase	Area 1: *Negative* Ground disturbance may reduce breeding success *Positive* Se bioaccumulation may be lower	Area 1: *No impact*	Area 1: *Neutral* *Positive* Se bioaccumulation may be lower	Area 1: *Significant Adverse Impact* Ground disturbance to dens, Se bioaccumulation may increase
		Area 2: *No Impact*	Area 2: *Neutral*	Area 2: *No Impact*	Area 2: *Neutral*	Area 2: *No Impact*
		Area 3: *No Impact*	Area 3: *Neutral*	Area 3: *No Impact*	Area 3: *Neutral*	Area 3: *No Impact*
Birds						
Bald eagle	RF, AH,GL	Area 1: *No impact*	Area 1: *Neutral*	Area 1: *No impact*	Area 1: *Neutral*	Area 1: *No impact*
		Area 2: *Significant Adverse Impact* Se bioaccumulation may increase	Area 2: *Positive* Se bioaccumulation will be reduced	Area 2: *No Impact*	Area 2: *Positive* Se bioaccumulation will be reduced	Area 2: *No Impact*
		Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced
Lesser and greater sandhill crane	AH, CL(rice), MW	Area 1: *Significant Adverse Impact* *Reduced foraging habitat*	Area 1: *Positive* *Less foraging habitat loss*	Area 1: *Significant Adverse Impact* *Se bioaccumulation will be higher*	Area 1: *Positive* *Less foraging habitat loss*	Area 1: *Significant Adverse Impact* *Reduced foraging habitat* *Se bioaccumulation will be higher*
		Area 2: *Significant Adverse Impact* Se bioaccumulation may increase	Area 2: *Positive* Se bioaccumulation will be reduced	Area 2: *No Impact*	Area 2: *Positive* Se bioaccumulation will be reduced	Area 2: *No Impact*
		Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation may increase	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation may increase	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced

Table 6-6 Summary of Potential Impacts to Special-Status Species

Resource Type	Important Habitat(s)	No Action Compared to Existing Conditions	Proposed Action Compared to No Action	Proposed Action Compared to Existing Conditions	Alternative Action Compared to No Action	Alternative Action Compared to Existing Conditions
Birds (continued)						
Peregrine falcon	AH, CL, GL,MW, RF, SC	Area 1: *No Impact*	Area 1: *Neutral*	Area 1: *No Impact*	Area 1: *Neutral*	Area 1: *No Impact*
		Area 2: *Significant Adverse Impact* Se bioaccumulation may increase	Area 2: *Positive* Se bioaccumulation will be reduced	Area 2: *No Impact*	Area 2: *Positive* Se bioaccumulation will be reduced	Area 2: *No Impact*
		Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced
Swainson's hawk	AH, CL(alfalfa), RF	Area 1: *Significant Adverse Impact* Foraging habitat may be altered/reduced and Se bioaccumulation may increase	Area 1: *Positive* Less foraging habitat loss Se bioaccumulation may be lower	Area 1: *Significant Adverse Impact* Foraging habitat may be altered/reduced and Se bioaccumulation may increase	Area 1: *Positive* Less foraging habitat loss Se bioaccumulation may be lower	Area 1: *Significant Adverse Impact* Foraging habitat may be altered/reduced and Se bioaccumulation may increase
		Area 2: *Significant Adverse Impact* Se bioaccumulation may increase	Area 2: *Positive* Se bioaccumulation may be reduced	Area 2: *No Impact*	Area 2: *Positive* Se bioaccumulation may be reduced	Area 2: *No Impact*
		Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation is predicted	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation is predicted	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced
Least Bell's vireo	RF	Area 1: *No Impact*	Area 1: *Neutral*	Area 1: *No Impact*	Area 1: *Neutral*	Area 1: *No Impact*
		Area 2: *Significant Adverse Impact* Se bioaccumulation may increase	Area 2: *Positive* Se bioaccumulation may be reduced	Area 2: *No Impact*	Area 2: *Positive* Se bioaccumulation may be reduced	Area 2: *No Impact*
		Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced
Willow flycatcher	RF	Area 1: *No Impact*	Area 1: *Neutral*	Area 1: *No Impact*	Area 1: *Neutral*	Area 1: *No Impact*
		Area 2: *No Impact*	Area 2: *No Impact*	Area 2: *No Impact*	Area 2: *No Impact*	Area 2: *No Impact*
		Area 3: *No Impact*	Area 3: *No Impact*	Area 3: *No Impact*	Area 3: *No Impact*	Area 3: *No Impact*

Table 6-6 Summary of Potential Impacts to Special-Status Species

Resource Type	Important Habitat(s)	No Action Compared to Existing Conditions	Proposed Action Compared to No Action	Proposed Action Compared to Existing Conditions	Alternative Action Compared to No Action	Alternative Action Compared to Existing Conditions
Reptiles						
Giant garter snake	AH, CL(rice), MW	Area 1: *Significant Adverse Impact* Loss of rice reduces habitat	Area 1: *Positive* No foraging habitat loss	Area 1: *No Impact*	Area 1: *Positive* No foraging habitat loss	Area 1: *No Impact*
		Area 2: *Significant Adverse Impact* Se bioaccumulation may increase	Area 2: *Positive* Se bioaccumulation may be reduced	Area 2: *No Impact*	Area 2: *Positive* Se bioaccumulation may be reduced	Area 2: *No Impact*
		Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced
Amphibians						
California tiger salamander	GL, SC	Area 2: *Significant Adverse Impact* Se bioaccumulation may increase	Area 2: *Positive* Se bioaccumulation will be reduced	Area 2: *No Impact*	Area 2: *Positive* Se bioaccumulation will be reduced	Area 2: *No Impact*
		Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced
Invertebrates						
Conservancy fairy shrimp	VP	*No Impact*	*Neutral*	*No Impact*	*Neutral*	*No Impact*
Longhorn fairy shrimp	VP	*No Impact*	*Neutral*	*No Impact*	*Neutral*	*No Impact*
Vernal pool fairy shrimp	VP	*No Impact*	*Neutral*	*No Impact*	*Neutral*	*No Impact*
Valley elderberry longhorn beetle	GL, RF	*No Impact*	*Neutral*	*No Impact*	*Neutral*	*No Impact*
Vernal pool tadpole shrimp	VP	*No Impact*	*Neutral*	*No Impact*	*Neutral*	*No Impact*
Plants						
Merced button-celery	GL (clay soil)	*No Impact*	*Neutral*	*No Impact*	*Neutral*	*No Impact*
Colusa grass	VP	*No Impact*	*Neutral*	*No Impact*	*Neutral*	*No Impact*

Table 6-6 Summary of Potential Impacts to Special-Status Species

Resource Type	Important Habitat(s)	No Action Compared to Existing Conditions	Proposed Action Compared to No Action	Proposed Action Compared to Existing Conditions	Alternative Action Compared to No Action	Alternative Action Compared to Existing Conditions
Mammals						
Pallid bat	AH,CL,GL, MW,RW,SC	Area 1: *Significant Adverse Impact* Reduced habitat Se bioaccumulation may increase	Area 1: *Positive* Less foraging habitat loss Se bioaccumulation may be lower	Area 1: *Significant Adverse Impact* Se bioaccumulation may increase	Area 1: *Positive* Less foraging habitat loss Se bioaccumulation may be lower	Area 1: *Significant Adverse Impact* Se bioaccumulation may increase
		Area 2: *Significant Adverse Impact* Se bioaccumulation may increase	Area 2: *Positive* Se bioaccumulation will be reduced	Area 2: *No Impact*	Area 2: *Positive* Se bioaccumulation will be reduced	Area 2: *No Impact*
		Area 3: *Beneficial Impact* Se bioaccumulation be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced
Western red bat	AH,CL,GL, MW,RW,SC	Area 1: *Significant Adverse Impact* Reduced habitat Se bioaccumulation may increase	Area 1: *Positive* Less foraging habitat loss	Area 1: *Significant Adverse Impact* Se bioaccumulation may increase	Area 1: *Positive* Less foraging habitat loss	Area 1: *Significant Adverse Impact* Se bioaccumulation may increase
		Area 2: *Significant Adverse Impact* Se bioaccumulation is predicted	Area 2: *Positive* Se bioaccumulation will be reduced	Area 2: *No Impact*	Area 2: *Positive* Se bioaccumulation will be reduced	Area 2: *No Impact*
		Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced
American badger	GL,RF,SC	Area 2: *Significant Adverse Impact* Se bioaccumulation may increase	Area 2: *Positive* Se bioaccumulation will be reduced	Area 2: *No Impact*	Area 2: *Positive* Se bioaccumulation will be reduced	Area 2: *No Impact*
		Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *No Impact*

Table 6-6 Summary of Potential Impacts to Special-Status Species

Resource Type	Important Habitat(s)	No Action Compared to Existing Conditions	Proposed Action Compared to No Action	Proposed Action Compared to Existing Conditions	Alternative Action Compared to No Action	Alternative Action Compared to Existing Conditions
Birds						
Tricolored blackbird	MW,RF,CL	Area 1: *Significant Adverse Impact* Foraging & breeding habitat will be reduced and Se bioaccumulation may increase	Area 1: *Positive* Less foraging habitat loss Se bioaccumulation may be lower	Area 1: *Significant Adverse Impact* Se bioaccumulation may increase	Area 1: *Positive* Less foraging habitat loss Se bioaccumulation may be lower	Area 1: *Significant Adverse Impact* Se bioaccumulation may increase
		Area 2: *Significant Adverse Impact* Se bioaccumulation may increase	Area 2: *Positive* Se bioaccumulation may be reduced	Area 2: *No Impact*	Area 2: *Positive* Se bioaccumulation may be reduced	Area 2: *No Impact*
		Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced
Western burrowing owl	CL,GL,SC	Area 1: *Significant Adverse Impact* Foraging habitat will be reduced and Se bioaccumulation may increase	Area 1: *Positive* Less foraging habitat loss Se bioaccumulation may be lower *Negative* Ground disturbance may reduce breeding success	Area 1: *Significant Adverse Impact* Ground disturbance to burrows, Se bioaccumulation may increase	Area 1: *Positive* Less foraging habitat loss Se bioaccumulation may be lower	Area 1: *Significant Adverse Impact* Ground disturbance to burrows, Se bioaccumulation may increase
		Area 2: *Significant Adverse Impact* Se bioaccumulation may increase	Area 2: *Positive* Se bioaccumulation may be reduced	Area 2: *No Impact*	Area 2: *Positive* Se bioaccumulation may be reduced	Area 2: *No Impact*
Loggerhead shrike	GL,SC	Area 1: *Significant Adverse Impact* Se bioaccumulation may increase	Area 1: *Positive* Less foraging habitat loss Se bioaccumulation may be lower	Area 1: *Significant Adverse Impact* Se bioaccumulation may increase	Area 1: *Positive* Less foraging habitat loss Se bioaccumulation may be lower	Area 1: *Significant Adverse Impact* Se bioaccumulation may increase
Mountain plover	GL,SC	Area 1: *Significant Adverse Impact* Se bioaccumulation may increase	Area 1: *Positive* Less foraging habitat loss Se bioaccumulation may be lower	Area 1: *Significant Adverse Impact* Se bioaccumulation may increase	Area 1: *Positive* Less foraging habitat loss Se bioaccumulation may be lower	Area 1: *Significant Adverse Impact * Se bioaccumulation may increase

Table 6-6 Summary of Potential Impacts to Special-Status Species

Resource Type	Important Habitat(s)	No Action Compared to Existing Conditions	Proposed Action Compared to No Action	Proposed Action Compared to Existing Conditions	Alternative Action Compared to No Action	Alternative Action Compared to Existing Conditions
Birds (continued)						
Northern harrier	AH, CL(alfalfa), RF	Area 1: *Significant Adverse Impact* Foraging habitat loss and Se bioaccumulation may increase	Area 1: *Positive* Less foraging habitat loss Se bioaccumulation may be lower	Area 1: *Significant Adverse Impact* Foraging habitat loss and Se bioaccumulation may increase	Area 1: *Positive* Less foraging habitat loss Se bioaccumulation may be lower	Area 1: *Significant Adverse Impact* Foraging habitat loss and Se bioaccumulation may increase
		Area 2: *Significant Adverse Impact* Se bioaccumulation may increase	Area 2: *Positive* Se bioaccumulation will be reduced	Area 2: *No Impact*	Area 2: *Positive* Se bioaccumulation will be reduced	Area 2: *No Impact*
		Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced
Reptiles						
Silvery legless lizard	MW,RF	*No Impact*	*Neutral*	*No Impact*	*Neutral*	*No Impact*
Western pond turtle	AH,MW,RF	Area 2: *Significant Adverse Impact* Se bioaccumulation may increase	Area 2: *Positive* Se bioaccumulation will be reduced	Area 2: *No Impact*	Area 2: *Positive* Se bioaccumulation will be reduced	Area 2: *No Impact*
		Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced	Area 3: *Negative* Se bioaccumulation will be higher	Area 3: *Beneficial Impact* Se bioaccumulation will be reduced
Amphibians						
Western spadefoot	AH,MW,RF	*No Impact*	*Neutral*	*No Impact*	*Neutral*	*No Impact*
Plants						
Slender-leaved pondweed	AH,MW	Area 2: *Negative* Increased salinity	Area 2: *Positive* Reduced salinity	Area 2: *No Impact*	Area 2: *Positive* Reduced salinity	Area 2: *No Impact*
		Area 3: *Beneficial Impact* Reduced salinity	Area 3: *Negative* Increased salinity	Area 3: *Beneficial Impact* Reduced salinity	Area 3: *Negative* Increased salinity	Area 3: *No Impact*
Sanford's arrowhead	AH,MW	*No Impact*	*Neutral*	*No Impact*	*Neutral*	*No Impact*

Table 6-6 Summary of Potential Impacts to Special-Status Species

Resource Type	Important Habitat(s)	No Action Compared to Existing Conditions	Proposed Action Compared to No Action	Proposed Action Compared to Existing Conditions	Alternative Action Compared to No Action	Alternative Action Compared to Existing Conditions
Fish						
Chinook salmon	AH	Area 3: *Mud Slough: No Impact* *SJR: Beneficial Impact*	Area 3: *Mud Slough: Neutral* *SJR: Negative*	Area 3: *Mud Slough: No Impact* *SJR: Beneficial Impact*	Area 3: *Mud Slough: Neutral* *SJR: Negative*	Area 3: *Mud Slough: No Impact* *SJR: No Impact*
Steelhead	AH	Area 3: *Mud Slough: No Impact* *SJR: Beneficial Impact*	Area 3: *Mud Slough: Neutral* *SJR: Negative*	Area 3: *Mud Slough: No Impact* *SJR: Beneficial Impact*	Area 3: *Mud Slough: Neutral* *SJR: Negative*	Area 3: *Mud Slough: No Impact* *SJR: No Impact*
Splittail	AH	Area 3: *Mud Slough: Adverse in wet years* *SJR: Beneficial Impact*	Area 3: *Mud Slough: Negative in wet years* *SJR: Negative*	Area 3: *Mud Slough: Beneficial Impact in wet years* *SJR: Beneficial Impact*	Area 3: *Mud Slough: Negative in wet years* *SJR: Negative*	Area 3: *Mud Slough: Beneficial impact in wet years* *SJR: :No Impact*
Hardhead	AH	Area 3: *Mud Slough: No Impact* *SJR: Beneficial Impact*	Area 3: *Mud Slough: Neutral* *SJR: Negative*	Area 3: *Mud Slough: No Impact* *SJR: Beneficial Impact*	Area 3: *Mud Slough: Neutral* *SJR: Negative*	Area 3: *Mud Slough: No Impact* *SJR: :No Impact*

Habitat Abbreviations:

AH = Aquatic habitat
MW = Freshwater marsh/wetlands
VP = Vernal pools
RF = Riparian forest
CL = Cropland
GL = Grassland
SC = Scrubland

6.2.4.1.3 Alternative Action

Significant adverse impacts, compared to existing conditions, to some species foraging in current agricultural land would occur in the expanded reuse area. Significant adverse impacts to ground-dwelling species could occur due to ground-breaking activities and construction in the reuse area. These impacts can be mitigated by measures 1, 2, and 3 (Section 6.2.2.4) to less than significant.

Species utilizing wetlands or waterways in Areas 2 or 3 would experience no impacts compared to existing conditions. Adverse effects could occur to wetland and aquatic species in Mud Slough and the affected section of the San Joaquin River compared to No Action in the short term, but these would decrease slightly and then level off. Flow reductions in Mud Slough would be similar to those for the Proposed Action and would result in a less-than-significant loss of habitat in Mud Slough.

6.2.4.2 Wetlands

Changes to water quality, particularly salinity, within wetlands could modify a substantial portion of the vegetation community within the local region, resulting in dominance of salt-tolerant species, including invasive species. This would be a significant adverse impact compared to existing conditions. See Table 6-7.

Table 6-7 Summary of Wetland Impacts

Wildlife Parameter	No Action Alternative Compared To Existing Condition	Proposed Action Compared To No Action	Proposed Action Compared To Existing Condition	Alternative Action Compared To No Action	Alternative Action Compared To Existing Condition
Wetland Habitat	*Area 1 – Adverse, reduced iodine bush scrub habitat* *Area 2 – Adverse, Decrease in Water Quality.* *Area 3 – Beneficial,* Se bioaccumulation may decrease	*Area 1 – Positive, slight, less degradation* *Area 2 – Positive, improved Water Quality* *Area 3 – Negative.* Se bioaccumulation may increase	*Area 1 –No Impact* *Area 2 – No Impact* *Area 3 –Beneficial,* Se bioaccumulation may decrease	*Area 1 – Same as Proposed Action* *Area 2 – Same as Proposed Action* *Area 3 - Negative.* Se bioaccumulation may increase	*Area 1 – No Impact* *Area 2 – No Impact* *Area 3 - Beneficial*

6.2.4.2.1 No Action

This would having significant adverse impacts to wetland water quality in Areas 1 and 2, and significant beneficial impacts to wetlands in Area 3 compared to existing conditions.

6.2.4.2.2 Proposed Action

This would have no impact to wetlands in Areas 1 and 2, and gradually increasing beneficial impacts to wetlands in Area 3 compared to existing conditions.

6.2.4.2.3 Alternative Action

This would have no impact to wetlands in Areas 1 and 2, and temporarily increasing beneficial impacts to wetlands in Area 3 compared to existing conditions.

6.2.4.3 Aquatic Habitats

Table 6-8 summarizes the impacts of the Alternatives on aquatic habitats in comparison to existing condition and No Action.

Table 6-8 Summary of Aquatic Impacts

Wildlife Parameter	No Action Alternative Compared To Existing Condition	Proposed Action Compared To No Action	Proposed Action Compared to Existing Condition	Alternative Action Compared to No Action	Alternative Action Compared to Existing Condition
Sensitive Fish Species in Mud Slough	*Beneficial for splittail in wet years* Decrease in Se bioaccumulation outweighs loss of spatial habitat *No effect for hardhead and steelhead*	*Negative, for splittail in wet years* Se bioaccumulation may increase *Neutral for hardhead and steelhead*	*Beneficial for splittail in wet years* Se bioaccumulation may decrease *No impact for hardhead and steelhead*	*Negative, for splittail in wet years* Se bioaccumulation may increase *Neutral for hardhead and steelhead*	*No impact for splittail, hardhead and steelhead* Se bioaccumulation similar, similar quantity of habitat
Sensitive Fish Species in the San Joaquin River near Crows Landing	*Potentially Beneficial, less than significant* Se bioaccumulation decreased, minimal change in quantity of habitat	*Negative* Se bioaccumulation increased, minimal change in quantity of habitat	*Beneficial, less than significant* Se bioaccumulation decreased, minimal change in quantity of habitat	*Negative* Se bioaccumulation increased, minimal change in quantity of habitat	*No effect, less than significant* Se bioaccumulation similar, minimal change in quantity of habitat

6.2.4.3.1 No Action

The No Action Alternative would have a significant adverse effect on fish habitat due to flow reductions in Mud Slough relative to existing conditions.

The effects of the No Action Alternative on fish habitat in the San Joaquin River near Crows Landing would be beneficial and less than significant compared to existing conditions.

6.2.4.3.2 Proposed Action

In Mud Slough, the Proposed Action would result in a less-than-significant adverse impact relative to existing conditions due to the loss of quantity of habitat, which outweighs reduced Se concentrations. Relative to the No Action Alternative, the Proposed Action, would result in a positive effect on fish habitat because of increased habitat availability, although Se concentrations would be higher.

In the San Joaquin River near Crows Landing, the Proposed Action would result in a less-than-significant (beneficial) impact relative to existing conditions for CEQA due to reduced Se concentrations. Effects on habitat quantity would be less than significant. Compared to No Action, the effect of this Alternative would be potentially negative because of higher Se concentrations.

6.2.4.3.3 Alternative Action

On Mud Slough, the Alternative Action would result in a less-than-significant adverse impact relative to existing conditions. Se concentrations and habitat quantity would remain similar. This Alternative would result in a negative effect relative to the No Action Alternative because of higher Se concentrations.

On the San Joaquin River near Crows Landing, the Alternative Action would result in a less-than-significant adverse impact relative to existing conditions. Se concentrations and habitat quantity would remain similar. No mitigation is required. The effects of this Alternative would be potentially negative relative to the No Action Alternative because of increased Se concentrations.

6.2.4.4 Bioaccumulation and Food Chain Impacts

Table 6-9 summarizes the effects of the Alternatives on Se bioaccumulation.

Table 6-9 Draft Summary of Biological Bioaccumulation Impacts

Wildlife Parameter	No Action Alternative Compared to Existing Condition	Proposed Action Compared to No Action	Proposed Action Compared to Existing Condition	Alternative Action Compared to No Action	Alternative Action Compared to Existing Condition
Bioaccumulation	*Adverse*, Se bioaccumulation may increase in aquatic and associated upland communities upslope of the San Luis Drain terminus. *Beneficial in* Mud Slough and associated upland communities, Se bioaccumulation may decrease	*Negative,* Se bioaccumulation may increase *Positive for* water birds in GDA, Se bioaccumulation may decrease	*Beneficial* to aquatic habitat and associated upland habitats Se bioaccumulation may decrease *No effect* on refuges and wetlands south of San Luis Drain terminus Potentially significant Adverse Impact – With Mitigation less than Significant for water birds in GDA	Similar to Proposed Action, but Se bioaccumulation levels off over time	Similar to Proposed Action, but Se bioaccumulation levels off over time

6.2.4.4.1 No Action

Significant adverse effects on aquatic and associated upland communities would be expected in wildlife refuges and other wetland areas south of the Drain terminus compared to Existing Conditions. Significant adverse affects on migratory birds would be expected as a result of uncontrolled ponding of drainwater along the downslope side of the GDA following winter rains and contamination of wetland supply channels outside the GDA.

Potentially significant beneficial effects on aquatic and associated upland communities would be expected in and near Mud Slough and the San Joaquin River between the Drain terminus and the confluence of the Merced and San Joaquin rivers.

6.2.4.4.2 Proposed Action

No significant ecosystem effects would be expected in wildlife refuges and other wetland areas south of the San Luis Drain terminus.

Compared to existing conditions, potentially significant beneficial effects on aquatic and associated upland communities would be expected in and near Mud Slough and the San Joaquin River between the San Luis Drain terminus and the confluence of the Merced and San Joaquin rivers due to improved water quality. Compared to No Action, negative effects would be expected because Se discharges would be higher than under the No Action Alternative.

Compared to existing conditions, the potential for ponding of drainwater at the In-Valley Treatment Facility to adversely affect birds is less than significant if careful drainage management practices are implemented as described in Section 6.2.2.2. Compared to the No Action Alternative, positive effects would be expected because Se discharges would be higher than the No Action Alternative.

6.2.4.4.3 Alternative Action

Impacts under the Alternative Action would be similar to those for the Proposed Project Alternative, except that impacts would level off, rather than continually diminish, over time.

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SECTION 7
Land Uses

This section describes existing land uses in the Project Area and evaluates the potential impacts of the Proposed and Alternative Actions on these uses. This analysis focuses on three categories of land use/land management: agriculture, wildlife habitat/refuges, and recreation. In addition, land use and other General Plan policies of the affected counties that pertain to these three land use categories and that are relevant to project features and the Project Area are identified. Each of the alternatives is evaluated for consistency with local land use and General Plan policies.

7.1 AFFECTED ENVIRONMENT

The Project Area is primarily located in the northwestern portion of Fresno County and the central section of Merced County. This area consists of the Grassland Drainage Area (GDA) as well as adjacent land to the north through which subsurface drainage has historically flowed. The reuse facility, known as the San Joaquin River Water Quality Improvement Project (SJRIP), is located in the north central section of the GDA on property containing 6,009 acres with planned expansion of up to 6,900 acres. The shape of this property is irregular, conforming to the adjacent canals of the area, with access provided via Russell Avenue, a paved county road. Additional areas potentially affected socioeconomically by the Action Alternatives are contained within and Madera County (along its western border). See Figure 2-4.

Land use within the Project Area consists largely of agriculture (described more fully in Section 7.1.2 below). Crops have been produced in the area for more than 100 years. Irrigation and drainage districts include the Panoche and Charleston drainage districts; Firebaugh Canal, Pacheco, and Widren water districts; and the Camp 13 portion of the Central California Irrigation District.

Though the region is sparsely populated, small urban clusters within the vicinity of the Proposed Action include the cities of Los Banos in Merced County and Firebaugh and Mendota in Fresno County. These communities, all located along State Highway 33, provide services for farms and ranches in the area. The largest of these cities, Los Banos, has been urbanizing over the last 25 years and now serves as a bedroom community for commuters to the Silicon Valley. Hence, while Los Banos relies less on agriculture than in the 1960s, other parts of the area remain highly dependent on farming.

The San Joaquin River flows through the eastern portion of the Project Area, down the center of San Joaquin Valley. In the northern reaches of the Project Area, the river flows through San Luis National Wildlife Refuge, which also contains Mud Slough and Salt Slough, each a tributary to the river. North of the Project Area, the river runs though rural residential and agricultural areas until it enters the Delta near the community of Vernalis, below the confluence with the Stanislaus River. The Merced River flows into the San Joaquin River from the east near the northern tip of the Project Area, at the Stanislaus County/Merced County line, just downstream of the refuge.

7.1.1 County General Plan Goals and Policies

Each county and city in California 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 or 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 relevant to the Proposed Action include agriculture, fish and wildlife habitat, and water resources.

This section summarizes key goals and policies contained in the General Plans for the four counties in the vicinity of the Project Area. Since the Proposed Action does not involve urban development, the key issue is whether the continued use of the San Luis Drain (Drain) to deliver agricultural drainwater from the GDA to the San Joaquin River above its confluence with the Merced River is consistent with county policies for resource conservation and the support of agriculture in Merced and Fresno counties (location of GDA) and in Madera County (agricultural sphere of influence). Compliance monitoring on the San Joaquin River at Crows Landing extends the Project Area to Stanislaus County.

The goals and policies of each county relevant to the Proposed Action including its socioeconomic zone of influence are described in Appendix F and summarized in Table 7-1.

Table 7-1 County General Plan Policy Summary

County	Goals and Objectives
Merced	▪ 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.
Madera	▪ Ensure availability of and maintain high quality water sources. ▪ Protect and enhance the natural quality of the county's streams, creeks, and groundwater. ▪ Encourage continued agricultural use and, where possible, increase agricultural use on lands designated for such use. ▪ Protect, restore, and enhance habitats that support fish and wildlife species. ▪ Preserve and enhance open space lands to maintain the natural resources of the county.
Fresno	▪ Maintain agriculturally designated areas for agriculture use and direct urban growth away from valuable agricultural lands to other areas planned for such development. ▪ Allow by right in areas designated Agriculture activities related to the production of food and fiber and support uses incidental and secondary to the on-site agricultural operation. ▪ Allow in areas designated Agriculture, special agricultural uses and agriculturally related activities. ▪ Consider agricultural land preservation programs that improve the competitive capabilities of farms and ranches, thereby ensuring long-term conservation of viable agricultural operations. ▪ Encourage land improvement programs to increase soil productivity in areas containing lesser quality agricultural soils. ▪ Encourage landowners to participate in programs that reduce soil erosion and increase soil productivity. ▪ Adopt and support policies and programs that seek to protect and enhance surface water and groundwater resources critical to agriculture.
Stanislaus	▪ 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 the county.

7.1.2 Agriculture

The Project Area is located in the San Joaquin portion of California's Central Valley, an important agricultural region for both California and the U.S. California. This area has one of the most diversified economies in the world, producing more than 250 crop and livestock commodities. This section includes material extracted from Appendix G, Economic Impacts Evaluation.

Agriculture is the dominant industry within the GDA. Farmers have raised crops in the area for more than 100 years. Primary crops include cotton, melons, vegetables, alfalfa hay, other field crops, and grains. Virtually all crops are irrigated because average annual rainfall is less than 10 inches per year and most crops require more than 22 acre-inches of water per year (Wichelns and Houston 1996).

Cotton is the dominant crop grown in the GDA and is among the top five crops in each of the counties (Merced and Fresno) comprising most of the Project Area. For the years 2000 through 2005, cotton was grown on an average of 42 percent of GDA cropped land (see Table 7-2). Vegetables (including tomatoes) were grown on an average of 21 percent and melons on 12 percent. Alfalfa is another primary crop, with over 8,900 acres accounting for 11 percent of cropped land. In addition to the acreage in the GDA, in 2007 there were approximately 3,800 acres planted in the SJRIP reuse area, of which 3,280 acres were planted to hay, 420 acres were planted to vegetables (primarily asparagus), and 115 acres were planted to wheat.

Table 7-2 Average Cropping Pattern in the Grassland Drainage Area, 2000-2005

Crop	Acres	Percent of Total Acres
Cotton	33,397	42%
Melons	9,454	12%
Tomatoes	10,616	13%
Alfalfa Hay	8,911	11%
Sugarbeets	3,487	4%
Rice	1,705	2%
Vegetables	6,509	8%
Wheat	3,409	4%
Fallow	2,208	3%
Total	79,696	100%

[1]The data on total acres were based on acreage figures in Appendix C plus the 2,900 acres that will be moved from the GDA to the SRJIP, while the crop mix is based on data from Summers Engineering.

Most crops grown in the GDA are also grown in other parts of the Project Area. However, the proportions of acreages between the GDA and the three counties comprising the vast majority of the Project Area combined (excluding Stanislaus) differ because of many factors, including the unique salinity and selenium conditions in the GDA and crop sensitivities to those conditions. In 2007, for example, cotton was grown on 6 percent of harvested cropland in the three counties while between 2000 and 2005 it was grown on 42 percent of the GDA. Vegetables were grown on 10 percent of land in the three counties and 21 percent of the GDA. The major difference, however, is in land with orchards and vines, which in 2007 accounted for 29 percent of total harvested cropland in the three counties, yet only an average of 2.8 percent of cropland in the GDA between 2000 and 2005.

Poorly drained agricultural lands cover several hundred thousand acres in San Joaquin Valley, including the GDA. High water tables may impede or halt crop growth because of salinity buildup and reduced aeration in the plant root zone. This subject is not new, as agricultural drainage problems have been documented in the San Joaquin Valley for more than 100 years. During that time, irrigators have used a variety of methods to collect and dispose of agricultural drainwater. In central and south San Joaquin Valley (south of the Project Area), neither natural nor artificial outlets exist, and many farmers have used subsurface tile drains and other methods to remove excess water from the crop root zone.

Subsurface saline water management affects the vitality and sustainability of agriculture in the GDA, and is a complex undertaking. For example, the drainwater leaving a particular field may result from both irrigation on that field as well as deep percolation on neighboring fields. Hence, drainwater collected in one drainage system may have been generated by farms in other parts of the area (Wichelns and Weinberg 1990). Limitations on selenium discharges may limit the total amount of drainwater that may be discharged from an area and necessitate recirculation and other drainwater management actions. However, as the water is recirculated, soil and water salinity builds up, and crop yields are impacted.

The general effects of salinity on crop yields have been documented in several sources.[1] The effects, in some cases, have been estimated from field experiments and in others from experiments under laboratory conditions. Salinity clearly is one of many factors that may affect crop yields. Other factors include irrigation water quality, quantity, and timing; fertilizer and pesticide applications; and climate. Consequently, yields may differ among the fields on a farm as well as among farms in a given area.

For this analysis, the GDA and the SJRIP reuse facility were each considered as a single geographic unit. Data did not permit analysis at the individual water or drainage district, farm, or field levels. Therefore, the salinity yield relationships taken from the literature were assumed to apply homogeneously throughout the GDA and the SJRIP reuse area. Differences among fields and farms in the GDA may and likely do exist, but it was not possible to account for these differences in this analysis. Because of these drainage issues, farmers in the GDA use various irrigation methods in attempting to limit the amount of water lost to deep percolation. Selection of the methods used depends on the crop(s) grown and the agronomic and physical compatibility of the method, costs, climate, and other factors.

The additional unplanted but previously cultivated acres to be used for the SJRIP reuse area is in the GDA and is assumed to be cropped according to the same pattern as the rest of the GDA. The SJRIP is planned for up to 6,900 acres for planting with salt-tolerant crops. This property is bisected by the Outside Canal and is bordered by the Delta-Mendota Canal and the Main Canal. These canals are used to convey water through the area. Additionally, the property is improved with a variety of farm canals and ditches that are used to convey irrigation water and drainwater. These farm canals and ditches are owned together with the land. A few deep irrigation wells are found here, together with numerous canal and lift pumps.

Irrigation water is supplied to this property through groundwater pumping and from drainwaters of the neighboring irrigation and drainage districts. In prior years, surface water has been

[1] See, for example, Ayers and Branson 1975, and Donahue, Miller, and Shickluna 1977.

supplied to portions of the property, but these waters have been either sold or transferred to better suited lands or other water users and are not now available to the property. Distribution of this water has been from on-site ditches and canals and flood and/or furrow irrigation methods. The quality of this water varies significantly: well water is generally good to fair, while drainwater varies from fair to very poor. Soils on this property consist largely of various clays, all of which are impacted by wet conditions.

7.1.3 Wildlife Habitat/Refuges

Land uses within the Project Area include a significant area devoted to wildlife habitat. These areas include land that is publicly owned within established wildlife refuges and land that is privately owned and operated for the benefit of private hunting clubs. Most of this land consists of wetlands along the San Joaquin River, Mud Slough, and Salt Slough in Merced County. These areas are remnants of what was once a vast stretch of wetland in the central portion of the San Joaquin Valley.

7.1.3.1 Wildlife Refuges/Management Areas

Many wildlife refuges in California have benefited 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. Wildlife refuges in the Project Area include the San Luis and Merced National Wildlife Refuges, owned and operated by the U.S. Fish and Wildlife Service (Service), and the Los Banos and Volta Wildlife Management Areas, owned and operated by the California Department of Fish and Game (CDFG). In addition, CDFG operates the Grasslands Wildlife Management Area, but the public is not allowed access. The primary objective of the Grasslands Wildlife Management Area is wetland habitat protection, focusing on wintering waterfowl. Figure 7-1 shows the wildlife refuges and management areas in the vicinity of the Project. Table 7-3 summarizes information about the wildlife refuges and management areas in the Project Area.

Table 7-3 Summary of Wildlife Refuges and Management Areas in the Project Area

Name	Size (acres)	Owner Manager	Year Established	Auto Tour	Trails	Hunting
San Luis National Wildlife Refuge	26,600	Service	1966	Yes	Yes	Yes
Merced National Wildlife Refuge	10,262	Service	1951	Yes	No	Yes
Los Banos Wildlife Area	6,217	CDFG	1929	Yes	Yes	Yes
Grasslands Wildlife Management Area	70,000 in Conservation Easements	Private/CDFG	1979	No	No	No
North Grasslands Wildlife Management Area	7,069	CDFG	na	na	Na	Yes

Sources: USFWS 2008, CDFG 2008b, CDFG 2008c.
na = not available

7.1.3.2 Private Hunting Clubs

Approximately 165 private hunting clubs are located in the Project Area. Membership in these clubs ranges from 6 to 80 people. These clubs manage a total of approximately 23,000 acres of habitat for wildlife, primarily waterfowl.

7.1.4 Recreation

Many outdoor recreation activities in the Central Valley are water dependent or water enhanced. Such activities include boating, fishing, swimming, camping, picnicking, hunting, and wildlife observation. Recreational opportunities in the Project Area largely have been shaped by the alteration of major rivers in addition to the opportunities provided at natural waterbodies, streams, and rivers. The focus of this section is on fishing in the Project Area and recreating at wildlife refuges and private hunting clubs.

7.1.4.1 Fishing Opportunities

Fishing is popular along many of the canals in the Project vicinity as well as along the San Joaquin River. Public access is provided on the California Aqueduct and the Delta-Mendota Canal. In addition, fishing is popular at Salt Slough, and although “No Fishing” signs are posted at Mud Slough, fishing occurs there as well. The fish species present in the Project Area are listed in Appendix E1 and discussed in Section 6.1.2.1.5. As many as 25 species have been reported to occur in the Project Area. The most abundant species are bluegill, redear sunfish, largemouth bass, threadfin shad, goldfish, red shiner, common carp, and black bullhead.

7.1.4.1.1 San Joaquin River

No major public recreation features are located along the San Joaquin River in the Project Area, but 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.

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 miles of river and throughout the five counties (the four counties in the Project Area plus San Joaquin County downstream). Based on information from recreation sites on the river, boating and fishing activities on the river are estimated to total 157,000 6-hour recreation visitor days. Most of the use is assumed to come from the local counties (Reclamation 1997a).

7.1.4.1.2 Salt Slough

Within the San Luis National Wildlife Refuge, fishing is permitted during daylight hours in Salt Slough. Access to the area is via the Tule Elk Tour Route and Salt Slough Road. Fishing is by rod and reel only, and the taking of frogs, crayfish, turtles, snakes, and all other wildlife is prohibited. In addition, one fishing area is reserved for disabled persons. Outside the refuge, people fish near the Lander Avenue Bridge. Fish species include bass and catfish.

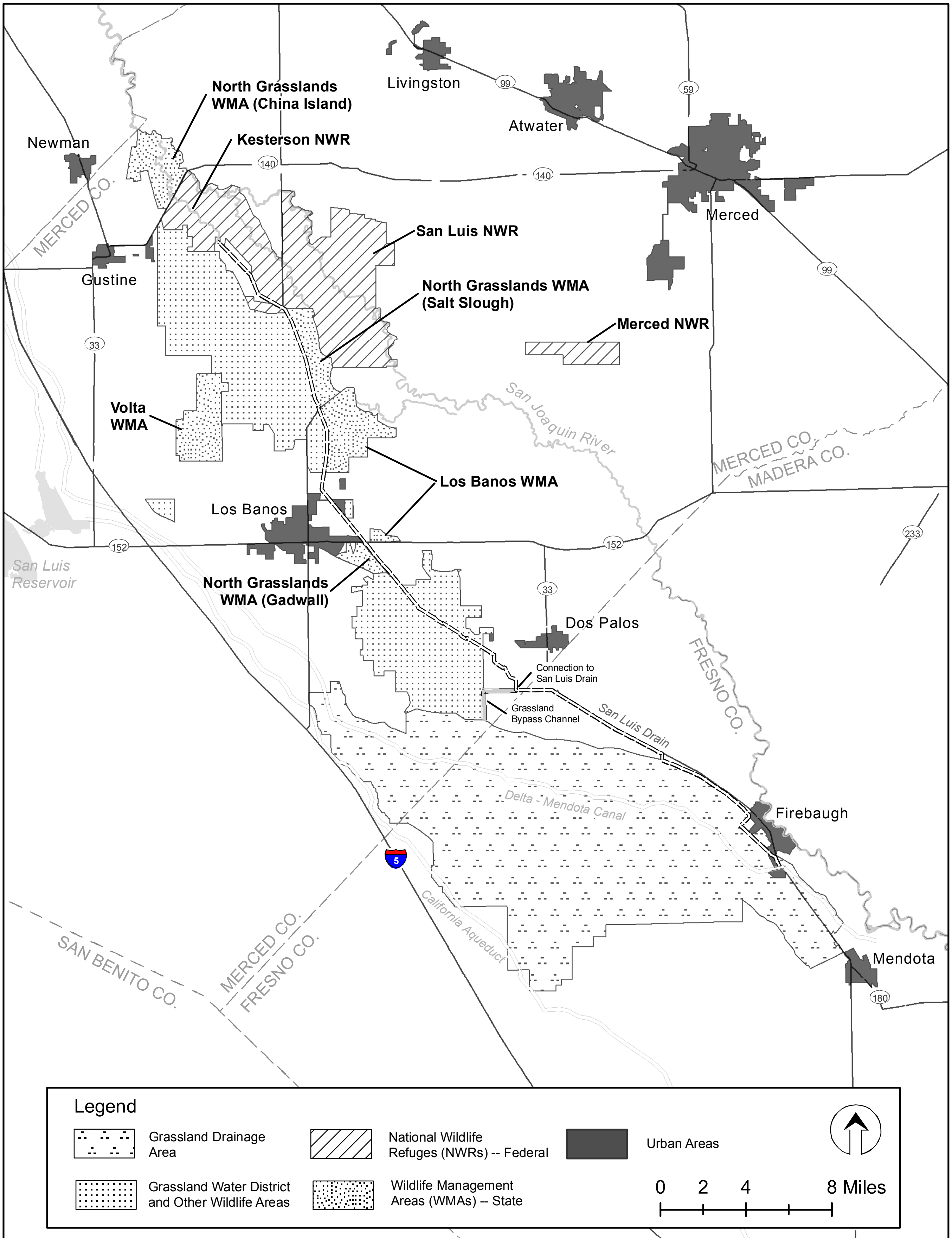

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FIGURE 7-1
WILDLIFE REFUGES AND MANAGEMENT AREAS IN THE PROJECT AREA

7.1.4.1.3 Mud Slough

Fishing is not officially permitted at Mud Slough. With the 1995 Use Agreement, biological toxicity monitoring was implemented in Mud Slough to assess the effects of the Grassland Bypass Project's drainwater on the aquatic community and continues today. Tissue sampling of the biological specimens allows analysis of the potential risk to fish and wildlife resources as well as the public health risks (Reclamation et al. 1996). "No Fishing" signs have been posted at Mud Slough to protect people from ingesting high levels of selenium. The fish species caught at Mud Slough primarily include catfish.

7.1.4.2 Wildlife Refuges/Management Areas

Historically, recreation values associated with the waterfowl present in Project Area wildlife refuges and management areas have focused primarily on hunting, but more recently, bird watching has become increasingly popular as a recreation opportunity. Most recreation activities associated with wildlife refuges and management areas are associated with the presence of waterfowl and upland game. All activities associated with wildlife refuges and management areas are water enhanced. These activities include hunting, hiking, and wildlife observation. The hunting of ducks, geese, and pheasants is permitted between October in January in portions of each refuge and in Los Banos Wildlife Management Area. Fishing is permitted at San Luis National Wildlife Refuge and Los Banos Wildlife Management Area. San Luis and Merced National Wildlife Refuges provide self-guided tours, and camping is permitted at the staging areas during hunting season. Camping is also permitted at Los Banos Wildlife Management Area in the parking lots, and the management area is open to hiking and bike riding all year.

In 1992, combined recreation use at the wildlife refuges and management areas totaled approximately 56,000 five-hour recreation visitor days. The most popular activities have been nonconsumptive uses, such as wildlife viewing. Between 1985 and 1990, nonconsumptive uses accounted for approximately 69 percent of total use, hunting accounted for approximately 22 percent, and fishing accounted for the remaining 9 percent. An estimated 15 percent of the visitors to the refuges originate in the local area (Reclamation 1997a).

Most visitation to the wildlife refuges and management areas occurs during winter when the waterfowl are present. Approximately 45 percent of the total use occurs between October and January, with June through August use at approximately 20 percent of total use. All hunting occurs between October and January, and fishing occurs year-round (Reclamation 1997a).

7.1.4.3 Private Hunting Clubs

Private clubs in the Project Area provide opportunities for members to hunt ducks, geese, and pheasants. Waterfowl hunting activity was estimated at 241,000 hunter days in 1992 (Reclamation 1997a).

7.2 ENVIRONMENTAL CONSEQUENCES

This section evaluates the impact of the No Action Alternative, Proposed Action, and Alternative Action on land uses in the Project Area. Potential impacts on the three primary land uses in the area, agriculture, wildlife habitat and refuges, and recreation, are described individually below. The consistency of each alternative with relevant county General Plan objectives, goals, and policies is evaluated in the context of each of the three primary area land uses listed above. Thus, agricultural policies are evaluated under Section 7.2.1; open space/conservation and wildlife habitat-related policies under Section 7.2.2; and recreation-related policies under Section 7.2.3.

7.2.1 Agriculture

As described in Section 7.1.2, agriculture is the dominant land use within the Project Area. The Proposed Action is designed, in part, to facilitate the continuation of agricultural uses within the GDA by providing a solution to the problem of salt- and selenium-laden agricultural drainwater flowing through wetland habitat areas.

7.2.1.1 Key Impact and Evaluation Criteria

With respect to land use, the primary issue is the extent to which the proposed 2010 Use Agreement for the San Luis Drain would affect agricultural land uses in counties in the Project Area. A related issue is whether the use of the Drain would be in conflict with county General Plan policies pertaining to agriculture within the Project Area.

Evaluation criteria for determining impact thresholds of significance include the following:

- Permanent or long-term reduction in agricultural acreage within the Project Area
- Conflict with General Plan land use designations and/or other policies for agriculture and/or local zoning within the Project Area

7.2.1.2 Environmental Impacts and Mitigation

This analysis is based on reasonably expected outcomes resulting from implementation of each of the alternatives. Conclusions concerning crop yield, soil salinity, and acreage in production are based upon the results of an optimization modeling exercise for the study period 2010-2019 that is fully described in Appendix G. Normal water years and a static supply of Central Valley Project water are built into the modeling assumptions.

7.2.1.2.1 No Use Agreement (No Action)

Under the No Action Alternative, it is anticipated that all of the irrigated acreage within the Project Area would initially continue in agricultural use. It is likely that farmers within the Project Area, in an effort to meet zero discharge in the absence of the ability to use the San Luis Drain as well as to maximize their profits, would plant more salt-tolerant crops and potentially idle acreage. These assumptions are included in the economic model.

Under the No Action Alternative, producers would not discharge beyond the GDA and would either recycle all drainwater from sumps either on farm or within districts or would dispose of drainwater on the SJRIP reuse facility. As a result, the average soil salinity within the GDA is expected to increase from 1.0 millimhos per centimeter (mmhos/cm) in 2008 to 3.2 mmhos/cm by 2019, as shown on Figure 7-2 and explained in Appendix D. Soil salinity within the SJRIP reuse facility is expected to increase from 6.6 mmhos/cm in 2008 to 13.9 mmhos/cm in 2019.

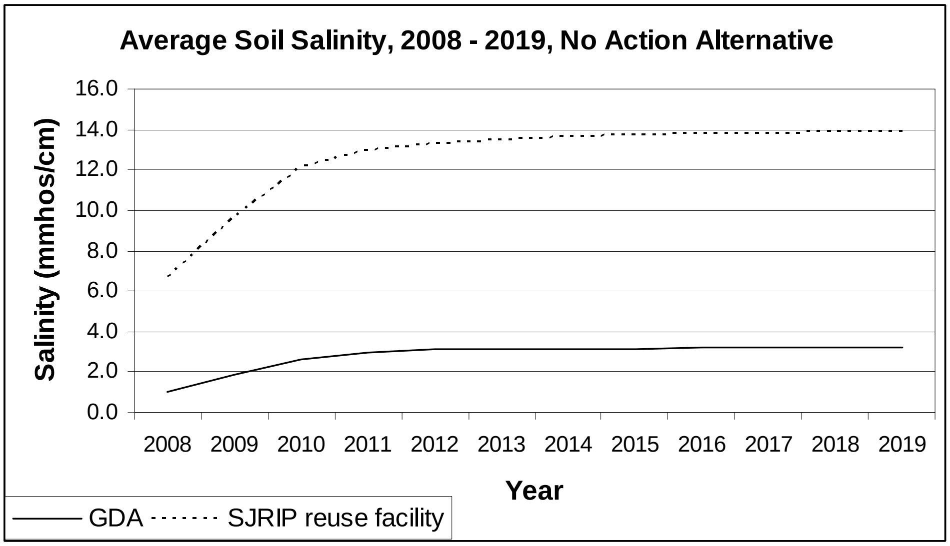

Figure 7-2 Average Salinity of Soil, 2008-2019, No Action Alternative

Under the No Action Alternative, all crop yields except cotton, sugarbeets, and wheat are expected to decline because of the buildup in soil salinity, as shown in Table 7-4. The rate at which yields would decline depends directly on the salt sensitivities of the individual crops. For example, cotton yields would be unaffected because cotton is salt tolerant with a threshold level of 7.0 mmhos/cm. The maximum percentage yield declines are in tomatoes and vegetables, which each decline by six percent. Yield declines in the SJRIP reuse area are higher due to its higher soil salinity.

Table 7-4 GDA Crop Yield per Acre, by Year, No Action Alternative

Year	Cotton (Lbs)	Melons (Ctns)	Tomatoes (Fresh, Tons)	Tomatoes (Processing, Tons)	Alfalfa Hay (Tons)	Sugarbeets (Tons)	Rice (Cwt.)	Vegetables (Tons)	Wheat (Tons)
2010	1760	951	22.8	44.1	8.5	39.3	75.0	16.7	3.2
2011	1760	924	21.9	42.3	8.2	39.3	75.0	16.0	3.2
2012	1760	917	21.6	41.9	8.1	39.3	74.1	15.8	3.2
2013	1760	917	21.6	41.9	8.1	39.3	74.1	15.8	3.2
2014	1760	910	21.4	41.4	8.1	39.3	73.2	15.7	3.2
2015	1760	910	21.4	41.4	8.1	39.3	73.2	15.7	3.2
2016	1760	910	21.4	41.4	8.1	39.3	73.2	15.7	3.2
2017	1760	910	21.4	41.4	8.1	39.3	73.2	15.7	3.2
2018	1760	910	21.4	41.4	8.1	39.3	73.2	15.7	3.2
2019	1760	910	21.4	41.4	8.1	39.3	73.2	15.7	3.2

All other factors unchanged, when the yield for a given crop falls to the point that profit is lower than for an alternative crop, farmers would be expected to opt for the more profitable product. However, because the profit for a given product also depends on the amount of water purchased, the acreage of even relatively salt-tolerant crops, which require large amounts of water, is expected to decline. As shown in Table 7-5, virtually all rice acreage is projected to either be switched to other crops or idled by 2019. Similarly, the acreage of alfalfa hay is expected to decline because of yield impacts, but also because alfalfa requires large amounts of water. In addition to the acreage in Table 7-5, cropped acreage in the SJRIP reuse area is projected to rise from approximately 3,800 acres in 2007 (existing conditions) to approximately 4,800 acres in 2010, with 4,130 acres in hay, 530 acres in vegetables, and 140 acres in wheat.

Table 7-5 GDA Irrigated Crop Acres, by Year, No Action Alternative

Year	Cotton	Melons	Tomatoes (Fresh)	Tomatoes (Processing)	Alfalfa Hay	Sugarbeets	Rice	Vegetables	Wheat	Total
2010	32,465	9,190	2,109	8,210	8,662	3,390	1,657	6,327	3,314	75,325
2011	33,322	9,190	2,109	8,210	8,316	3,525	1,309	6,327	3,016	75,325
2012	34,060	9,190	2,109	8,210	7,983	3,666	1,034	6,327	2,745	75,325
2013	34,744	9,190	2,109	8,210	7,664	3,766	817	6,327	2,498	75,325
2014	35,447	9,190	2,109	8,210	7,357	3,766	645	6,327	2,273	75,325
2015	36,081	9,190	2,109	8,210	7,063	3,766	510	6,327	2,068	75,325
2016	36,657	9,190	2,109	8,210	6,781	3,766	403	6,327	1,882	75,325
2017	37,182	9,190	2,109	8,210	6,509	3,766	318	6,327	1,713	75,325
2018	37,663	9,190	2,109	8,210	6,249	3,766	251	6,327	1,559	75,325
2019	38,106	9,190	2,109	8,210	5,999	3,766	199	6,327	1,418	75,325

The acreages of rice, wheat, and alfalfa hay are projected to decline uniformly throughout the analysis period. The patterns for other crops would be less uniform, however, because the selection of crops is based on relative profitability. In some years, while the yield for a given crop may be very low because of salinity, the crop would be planted nonetheless because it is relatively more profitable than others. For example, while fresh tomato yield in 2009 is projected to be less than the 2010 level, acres of the crop are expected to be held constant throughout the analysis period because of its relative profitability. Furthermore, modeling results indicate no land, other than land removed from production within the GDA and added to the reuse facility, would be removed from production despite the increase in soil salinity. If the analysis period were extended beyond 2019, all other factors unchanged, it is expected that land within the GDA would begin to be abandoned as the SJRIP reuse facility becomes more saline and water logged and additional drainwater is recirculated onto the GDA.

The No Action Alternative is not expected to result in any land use changes inconsistent with Fresno and Merced County General Plan land use designations for the GDA over the 2001–2009 period. However, considering the trend toward declining crop yields shown in Table 7-4, the No Action Alternative is inconsistent with other General Plan policies pertaining to the continued vitality and viability of agriculture (see Appendix F, Fresno County General Plan Goal LU-A). The abandonment of land that is currently in agricultural production would conflict with these stated objectives. The No Action Alternative would either be consistent with or not have any bearing on the other Fresno and Merced County General Plan objectives and policies summarized in Section 7.1.1 and outlined in Appendix F relating to agriculture.

7.2.1.2.2 Grassland Bypass Project 2010–2019 (Proposed Action)

Under the Proposed Action, soil salinity would increase as the amount of salt added through applied water exceeds the amount removed through deep percolation. The rate of increase, however, would be much slower than under the No Action Alternative. Soil salinity projections during each analysis year under the proposed selenium load values were presented in Section 5, Groundwater and Soil Resources, and are shown in Figure 7-3. Soil salinity would increase from the current 1.0 mmhos/cm to a high of 1.9 mmhos/cm in 2015. Soil salinity is expected to remain stable at 1.9 mmhos/cm until 2019. 2019. Soil salinity within the SJRIP reuse facility is expected to increase from 6.6 mmhos/cm in 2008 to 11.2 mmhos/cm in 2019.

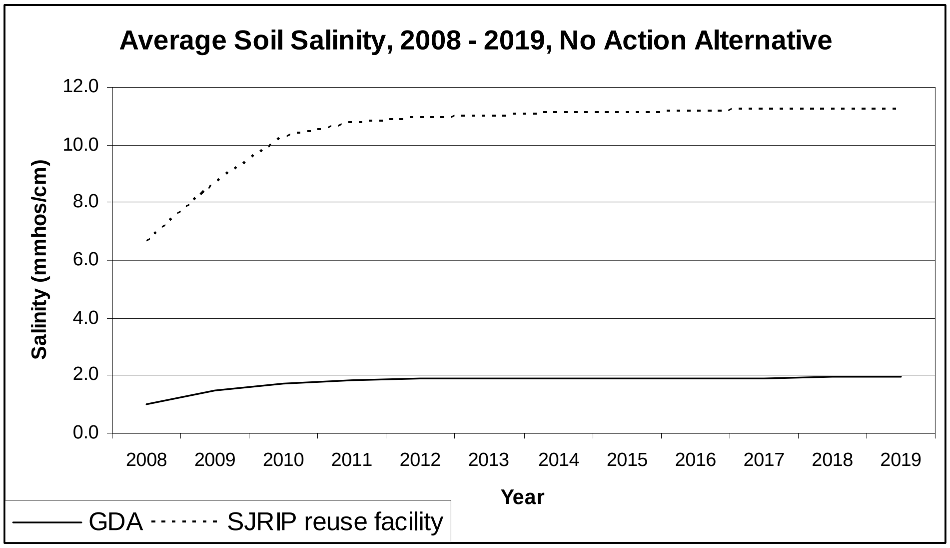

Figure 7-3 Salinity of Soil, 2008–2019, Proposed Action Alternative

The crops included in the analysis would be largely unaffected by the increase in soil salinity expected under the Proposed Action. Melons, the most salt-sensitive crop, is the only crop with expected decreased yields, and its yields are expected to decline by less than two percent. All other crops included in the analysis have salinity thresholds of 2.0 mmhos/cm or greater. Table 7-6 shows annual crop yields for the proposed selenium load values. Yields in the SJRIP reuse facility would decline in the Proposed Action, but by less than in the No Action Alternative.

Table 7-6 GDA Crop Yield per Acre, by Year, Grassland Bypass Project, 2010–2019

Year	Cotton	Melons	Tomatoes (Fresh)	Tomatoes (Processing)	Alfalfa Hay	Sugarbeets	Rice	Vegetables	Wheat
2010	1760	1012	23.0	44.5	8.9	39.3	75.0	17.7	3.2
2011	1760	998	23.0	44.5	8.9	39.3	75.0	17.7	3.2
2012	1760	998	23.0	44.5	8.9	39.3	75.0	17.7	3.2
2013	1760	998	23.0	44.5	8.9	39.3	75.0	17.7	3.2
2014	1760	998	23.0	44.5	8.9	39.3	75.0	17.7	3.2
2015	1760	998	23.0	44.5	8.9	39.3	75.0	17.7	3.2
2016	1760	998	23.0	44.5	8.9	39.3	75.0	17.7	3.2
2017	1760	998	23.0	44.5	8.9	39.3	75.0	17.7	3.2
2018	1760	998	23.0	44.5	8.9	39.3	75.0	17.7	3.2
2019	1760	998	23.0	44.5	8.9	39.3	75.0	17.7	3.2

The optimal acreages of various crops grown over the analysis period under the Proposed Action will reflect changes in crop yields, costs, available inputs, and allowable selenium discharges. Table 7-7 shows expected crop acreages by year. Cotton acreage is projected to increase, while acreage in alfalfa hay, rice, and wheat are projected to decline from existing levels. Although not included in the GDA acreage in Table 7-7, 1,100 acres of agricultural land located adjacent to the GDA would be included in the GDA. No land use changes are expected based on the inclusion of this land into the GDA. Furthermore, in addition to the GDA acreage in Table 7-7, it is expected that 5,520 acres will be cropped and irrigated in the SJRIP drainage area, with the same crop proportions as under No Action. Based on up to 6,900 acres of land in the SJRIP, GDA acreage in production is projected at 74,675 throughout the analysis period. The SJRIP lands would largely remain in agricultural production but would be planted with more salt-tolerant crops. Therefore, the Proposed Action would not be expected to result in any substantial land use changes, nor produce inconsistencies with Fresno or Merced County General Plan land use designations for the GDA.

Table 7-7 GDA Crop Acres, by Year, Grassland Bypass Project

Year	Cotton	Melons	Tomatoes (Fresh)	Tomatoes (Processed)	Alfalfa Hay	Sugarbeets	Rice	Vegetables	Wheat	Total
2010	32,185	9,110	2,091	8,140	8,588	3,360	1,643	6,273	3,286	74,675
2011	33,035	9,110	2,091	8,140	8,244	3,495	1,298	6,273	2,990	74,675
2012	33,766	9,110	2,091	8,140	7,914	3,635	1,025	6,273	2,721	74,675
2013	34,444	9,110	2,091	8,140	7,598	3,734	810	6,273	2,476	74,675
2014	35,141	9,110	2,091	8,140	7,294	3,734	640	6,273	2,253	74,675
2015	35,770	9,110	2,091	8,140	7,002	3,734	506	6,273	2,050	74,675
2016	36,340	9,110	2,091	8,140	6,722	3,734	399	6,273	1,866	74,675
2017	36,861	9,110	2,091	8,140	6,453	3,734	315	6,273	1,698	74,675
2018	37,338	9,110	2,091	8,140	6,195	3,734	249	6,273	1,545	74,675
2019	37,778	9,110	2,091	8,140	5,947	3,734	197	6,273	1,406	74,675

The SJRIP reuse facility would be a conforming use to present zoning on the subject property. Additionally, the Proposed Action would be consistent with other General Plan policies pertaining to the continued vitality and viability of agriculture within both the GDA and the Project Area (see Appendix F, Fresno County General Plan Land Use Goal LU-A, including Policies LU-A.1 through LU-A.3 and LU-A.16 through LU-A.20; Merced County General Plan Land Use Objective 8.A; Merced County General Plan Agriculture Objective 4.A and Policies 2 and 3; The Proposed Action would either be consistent with or not have any bearing on the other County General Plan objectives and policies summarized in Section 7.1.1 and outlined in Appendix F relating to agriculture.

7.2.1.2.3 2001 Requirements Alternative (Alternative Action)

Land uses under this Alternative Action, including production acreage and yields as well as construction of the treatment facility, are expected to be identical to those described under the Proposed Action. Therefore, the Alternative Action would either be consistent with or not have any bearing on the other county General Plan objectives and policies summarized in Section 7.1.1 and outlined in Appendix F relating to agriculture.

7.2.1.3 Cumulative Effects

Cumulative impacts are those that result from the incremental impacts of an action added to other past, present, and reasonably foreseeable future actions (excluding No Action). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. As modeled, the Action Alternatives would not result in declines in cropped acreage during the period 2010 to 2019, but the composition of crops grown would change. The incremental effects would not contribute to a significant cumulative effect on agricultural land management in the region.

7.2.1.4 Impact and Mitigation Summary

Table 7-8 compares the projected 2019 soil and water salinity and irrigated crop acreage for each of the three alternatives as well as the existing conditions. All measures are shown at estimated levels in 2019. The largest soil salinity impacts are in the No Action Alternative. Acreage impacts are similar across alternatives for the period 2010-2019, with fallowed acreage increasing by approximately 1,000 acres due to land being incorporated into the SJRIP facility.

Table 7-8 Comparison of 2019 Values and Impacts Among Alternatives Relative to 2000 Existing Conditions

Measure	Existing Conditions	No Action	Proposed Action	Alternative Action
GDA soil salinity (mmhos/cm)	1.0	3.2	1.9	1.9
Total cropped acreage	81,308	80,126	80,195	80,195

7.2.1.4.1 No Action

Due to trends in declining crop yield set in motion by this alternative, the No Action Alternative would be inconsistent with General Plan policies pertaining to the continued vitality and viability of agriculture. Though it would not be expected to occur until after 2019, the forced retirement of land that is currently in agricultural production would conflict with these stated objectives and would constitute a significant adverse impact over existing conditions.

7.2.1.4.2 Proposed Action

The total amount of cropped acreage within the GDA would be reduced by approximately 2,800 acres (roughly 100 acres of the 2,900 acres to be incorporated into the SJRIP (in addition to the 4,000 acres already planted by 2007) are estimated to be currently fallow), but over half of this acreage is expected to continue to be planted, albeit to other, more salt-tolerant crops. Additionally, 1,100 acres located adjacent to the GDA would be incorporated into the GDA, but no land use changes are expected to result from this action. Therefore, this alternative would not be expected to result in substantial land use changes, nor produce inconsistencies with county General Plan land use designations for the GDA. Additionally, this alternative would be consistent with other General Plan policies pertaining to the continued vitality and viability of agriculture. Therefore, no adverse impacts would be anticipated, and no mitigation is required.

7.2.1.4.3 Alternative Action

Impacts would be expected to be the same as under the Proposed Action.

7.2.2 Wildlife Habitat/Refuges

Impacts pertaining to existing wildlife habitat and wildlife refuge land uses within the Project Area are described in this section. Additionally, the consistency of each alternative with county General Plan policies, goals, and objectives pertaining to wildlife habitat, open space, conservation, and water resources is evaluated. Impacts pertaining to the quality of the habitat itself, and the terrestrial and aquatic species associated with it, are discussed in Section 6, Biological Resources.

7.2.2.1 Key Impact and Evaluation Criteria

With respect to land use, the primary issue is the extent to which implementation of the 2010 Use Agreement for the San Luis Drain would affect wildlife habitat and refuge land uses in counties in the Project Area. A related issue is whether the use of the Drain would be in conflict with county General Plan policies pertaining to wildlife habitat, open space, conservation, and water resources within the Project Area.

Evaluation criteria for determining impact thresholds of significance include the following:

- Permanent or long-term reduction or degradation in wildlife habitat/refuge acreage within the Project Area
- Conflict with General Plan land use designations and/or other policies for wildlife habitat, conservation, open space, or water resources within the Project Area.

7.2.2.2 Environmental Impacts and Mitigation

7.2.2.2.1 No Use Agreement (No Action)

Under the No Action Alternative, no conveyance of agricultural drainage would occur in the Drain. Drainage flows in the GDA would remain substantially within the GDA except when the Drain overflows in high storm events, as described in Section 6.2.2.1.4. However, the possibility of unmanaged drainage and seepage into unlined wetland channels could result in some uncontrolled dissemination of high selenium water onto wildlife habitat areas adjacent to the GDA. Groundwater model results indicate no significant change in subsurface flow northeast towards the wetlands and San Joaquin River (Section 5.2.3.1.1), but some seepage could pond within and adjacent to the GDA. Therefore, wildlife habitat land uses within the Project Area could be adversely affected indirectly; and the impact is potentially significant compared to existing conditions. Reduced flows into Mud Slough due to the complete recycling of drainwater could potentially improve habitat values in Mud Slough.

Given the potential adverse impacts to wildlife habitat and wildlife refuges in the Project Area, the No Action Alternative would not be consistent with General Plan policies pertaining to the preservation and protection of wildlife habitat and open space (see Appendix F, Fresno County General Plan Open Space Element Policies OS-E.1 and OS-E.13; and Merced County General Plan Open Space/Conservation Element Objective 1.A and Policy 9). Given that the No Action Alternative would exacerbate soil and drainwater salinity problems adjacent to the GDA, the alternative would not be consistent with General Plan policies pertaining to water resources/habitat (see Appendix F, Merced County General Plan Open Space/Conservation Element Objective 2.B and Policy 5). The No Action Alternative would either be consistent with or have no bearing on the other Fresno and Merced County General Plan objectives and policies summarized in Section 7.1.1 and outlined in Appendix F relating to wildlife habitat/refuges, open space, conservation, and water resources.

7.2.2.2.2 Grassland Bypass Project, 2010–2019 (Proposed Action)

Under the Proposed Action, drainwater would continue to flow around the wetland habitats and into the San Luis Drain. After 28 miles, the water would enter Mud Slough where it would travel another 6 miles before reaching the San Joaquin River 3 miles upstream of its confluence with the Merced River. Land uses within the Project Area would not be expected to change. The SJRIP facility would be constructed on land that is currently in agricultural use. Habitat in 6 miles of Mud Slough would continue to be affected by drainwater, but the quality of the drainwater would improve as increasingly stringent selenium load limits are applied. In addition, wetland enhancements described in Section 2.2.1.2.1, New Features of Proposed Project, would increase wetland habitat by 31.6 and 76.8 acres for a total of 108.4 acres. As a result, wildlife habitat land uses within the Project Area would not be adversely affected.

Given the lack of significant adverse impacts to wildlife habitat and wildlife refuges in the Project Area, the Proposed Action would be consistent with General Plan policies pertaining to the preservation and protection of wildlife habitat and open space within the Project Area (see Appendix F, Fresno County General Plan Open Space Element Policies OS-E.1 and OS-E.13; Merced County General Plan Open Space/Conservation Element Objective 1.A and Policy 9. Given that the Proposed Action would alleviate soil and drainwater salinity problems adjacent to the GDA, the alternative would also be consistent with General Plan policies pertaining to water resources/habitat (see Appendix F, Merced County General Plan Open Space/Conservation Element Objective 2.B and Policy 5. The Proposed Action would either be consistent with or have no bearing on the other General Plan objectives and policies summarized in Section 7.1.1 and outlined in Appendix F relating to wildlife habitat/refuges, open space, conservation, and water resources.

7.2.2.2.3 2001 Requirements Alternative (Alternative Action)

The 2001 Requirements Alternative is similar to the Proposed Action except the selenium and salt loads discharged to Mud Slough would be limited to those in the 2001 Use Agreement (i.e., less stringent allowances). Also, the Alternative Action does not include the wetland habitat expansion described under the Proposed Action. This alternative does not avoid or substantially lessen any potentially significant impact of the Proposed Action but is technically feasible.

Given the lack of significant adverse impacts to wildlife habitat and wildlife refuges in the Project Area, the Alternative Action would be consistent with General Plan policies pertaining to the preservation and protection of wildlife habitat and open space within the Project Area as explained under the Proposed Action. Given that the Proposed Action would alleviate soil and drainwater salinity problems adjacent to the GDA, the Alternative Action would also be consistent with General Plan policies pertaining to water resources/habitat. The Proposed Action would either be consistent with or have no bearing on the other General Plan objectives and policies summarized in Section 7.1.1 and outlined in Appendix F relating to wildlife habitat/refuges, open space, conservation, and water resources.

7.2.2.3 Cumulative Effects

Cumulative impacts are those that result from the incremental impacts of an action added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. No changes in land use are expected with either of the Action Alternatives. Concerning wildlife habitat land uses, no significant incremental effect occurs that would create an adverse cumulative effect regionally. Under the Proposed Action, wetland habitat would be expanded by 108.4 acres and incrementally contribute to long-term restoration of wetland habitat in the San Joaquin Valley. Also see Section 6.2.3 regarding freshwater deliveries to regional wetlands.

7.2.2.4 Impact and Mitigation Summary

The wildlife habitat land use impacts for the three alternatives are summarized below.

7.2.2.4.1 No Action

- Flows in the GDA would remain substantially within the GDA; however, the potential for unmanaged flow of drainage and seepage containing selenium (from areas outside the GDA) into adjacent areas including wetland channels, would adversely affect adjacent refuges. Wildlife habitat land uses within the Project Area could be adversely affected, and the impact is potentially significant.
- Reduced flows into Mud Slough due to the recycling of drainwater could improve habitat values in that location.
- Given the potential for adverse impacts to wildlife habitat and wildlife refuges in the Project Area, the No Action Alternative would not be consistent with applicable General Plan policies pertaining to the preservation and protection of wildlife habitat and open space within the Project Area. This inconsistency would constitute a significant adverse impact.
- Given that the No Action Alternative would exacerbate soil and drainwater salinity problems adjacent to the GDA, the alternative would not be consistent with General Plan policies pertaining to water resources/habitat.

7.2.2.4.2 Proposed Action

- Land uses within the Project Area would not be expected to change substantially over existing conditions and No Action, resulting in no adverse effect on wildlife habitat land uses within the Project Area. Wetland areas would be expanded. No mitigation is required.
- The Proposed Action would be consistent with General Plan policies pertaining to the preservation and protection of wildlife habitat and open space as well as water resources/habitat within the Project Area. No adverse impacts would be anticipated, and no mitigation required.

7.2.2.4.3 Alternative Action

- Land uses within the Project Area would not be expected to change substantially over existing conditions and No Action, resulting in no adverse effect on wildlife habitat land uses within the Project Area. No mitigation is required.
- The Alternative Action would be consistent with General Plan policies pertaining to the preservation and protection of wildlife habitat and open space as well as water resources/habitat within the Project Area. No adverse impacts would be anticipated, and no mitigation required.

7.2.3 Recreation

The primary recreation activities in the Project Area include water-dependent activities. Fishing occurs directly in the rivers or sloughs, and recreation activities at the wildlife refuges or management areas are based on enjoying wildlife that use the wetland habitat. Impacts pertaining to existing recreational activities and land uses within the Project Area are described in this section. Additionally, the consistency of each alternative with the four General Plan policies, goals, and objectives pertaining to recreation (see Appendix F) is evaluated.

7.2.3.1 Key Impact and Evaluation Criteria

With respect to land use, the primary issue is the extent to which implementation of the 2010 Use Agreement for the San Luis Drain would affect public and private recreational land uses in counties in the Project Area. A related issue is whether the use of the Drain would be in conflict with County General Plan policies pertaining to recreation within the Project Area. Hunting, both on private and public lands, is considered to be a recreation use on lands designated for hunting, but the value (revenue) of hunting is not considered a land use and is not evaluated here.

Evaluation criteria for determining impact thresholds of significance include the following:

- Permanent or long-term reduction in acreage devoted to and/or the opportunity for public and private recreation within the Project Area.
- Conflict with General Plan land use designations and/or other policies pertaining to recreation within the Project Area.

7.2.3.2 Environmental Impacts and Mitigation

7.2.3.2.1 No Use Agreement (No Action)

Under the No Action Alternative, no conveyance of agricultural drainage would occur in the San Luis Drain. Flows in the GDA would remain substantially within the GDA with a potential impact to adjacent public and private recreation areas from uncontrolled seepage and discharges from outside of the GDA to wetland channels. Therefore, recreational land uses within the Project Area could be adversely affected due to constraints on fishing, a potentially significant impact, but fishing would improve in Mud Slough.

The No Action Alternative would either be inconsistent with (significant impact) or have no bearing on the Fresno and Merced County General Plan objectives and policies summarized in Section 7.1.1 and outlined in Appendix F relating to recreation and open space.

7.2.3.2.2 Grassland Bypass Project, 2010–2019 (Proposed Action)

Under the Proposed Action, drainwater would continue to flow around the wetland habitats and into the Drain. After 28 miles, the water would enter Mud Slough where it would travel another 6 miles before reaching the San Joaquin River 3 miles upstream of its confluence with the Merced River. Recreational opportunities would not be expected to either increase or decrease compared to existing conditions. Compared to No Action, fishing opportunities in the wetlands and downstream would increase (beneficial effect) as the water quality of discharges to Mud Slough improves over the period 2010–2019.

The Proposed Action would either be consistent with or have no bearing on the General Plan objectives and policies summarized in Section 7.1.1 and outlined in Appendix F relating to recreation and open space.

7.2.3.2.3 2001 Requirements Alternative (Alternative Action)

The Alternative Action would be similar to the Proposed Action in all aspects except the selenium and salt loads discharged to Mud Slough would be limited to those in the 2001 Use Agreement (i.e., less stringent allowances). Also, this alternative does not include wetland expansion. No adverse impacts relating to existing recreational areas and opportunities would be expected.

The Alternative Action would either be consistent with or have no bearing on the General Plan objectives and policies summarized in Section 7.1.1 and outlined in Appendix F relating to recreation and open space.

7.2.3.3 Cumulative Effects

Cumulative impacts are those that result from the incremental impacts of an action added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. The incremental benefits of enhanced fishing opportunities from water quality improvements could contribute to a cumulative benefit in the region.

7.2.3.4 Impact and Mitigation Summary

The recreational land use impacts for the three alternatives are projected to be minimal.

7.2.3.4.1 No Action

- Compared to existing conditions, recreational land uses within the Project Area could be adversely affected due to constraints on fishing from unmanaged flows potentially reaching the wetlands. This impact is potentially significant. However, the absence of drainwater entering Mud Slough could improve recreation fishing opportunities in the lower portion of Mud Slough, a beneficial effect.
- The No Action Alternative would be inconsistent with or have no bearing on applicable General Plan policies pertaining to recreation within the GDA.

7.2.3.4.2 Proposed Action

- Improvements to drainwater quality and subsequent discharges could improve recreational fishing opportunities in the lower portion of Mud Slough compared to existing conditions (a significant beneficial impact) and throughout the wetlands compared to No Action (positive effect). No mitigation is required.
- Land uses within the GDA and Project Area would not be expected to change substantially compared to existing conditions, resulting in no adverse effect on recreational uses within the Project Area. No mitigation is required. Compared to No Action, there is a positive effect on recreational fishing.
- The Proposed Action would be consistent with General Plan policies pertaining to recreation and open space within the GDA and Project Area. No adverse impacts would be anticipated, and no mitigation required.

7.2.3.4.3 Alternative Action

- Improvements to drainwater quality could improve recreational fishing opportunities in the lower portion of Mud Slough compared to existing conditions and throughout the wetlands compared to No Action. No mitigation is required.
- Land uses within the GDA and Project Area would not be expected to change, resulting in no adverse effect on recreational uses within the Project Area. No mitigation is required.
- The Alternative Action would be consistent with General Plan policies pertaining to recreation and open space within the GDA and Project Area. No adverse impacts would be anticipated, and no mitigation is required.

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SECTION 8

Socioeconomic Resources

INTRODUCTION

This chapter describes the anticipated economic effects of the Proposed and Alternative Actions within the Grassland Drainage Area (GDA) and vicinity. Components of this analysis are population and employment within the Project Area and the importance of agriculture to the local and regional economy. The impact of the Proposed and Alternative Actions on the local and regional economy is evaluated. The chapter is based on the economic evaluation technical report included as Appendix G.

The primary impact variable of interest for the analysis is farm income, in particular net farm income or profit. Profit is affected by many factors such as crop acreages, prices, yields, government programs, water costs, and costs of fertilizers, chemicals, and other inputs. As farm profits decline, so also will both farm investment and consumption. Regional economic activity will also be affected because of the many linkages between production agriculture and myriad other sectors of the economy.

For purposes of this evaluation, it was necessary to utilize county-level economic and agronomic data; few data were available specifically for the GDA. The primary "zone of influence" for the Proposed Action is the three-county area comprised of Fresno, Madera, and Merced counties. While the GDA is not within Madera County, the county is important as both a source of inputs for agricultural production and a location for facilities processing the products produced in the three-county area. While the GDA is the site of the "initial impact" of the alternatives, it is not economically self sufficient. Rather, it has extensive linkages to the larger three-county area through, for example, the locations of supporting industries, shopping patterns, and commuting patterns. The GDA is less densely populated than many other areas in the three-county region.

The economy of the three-county area is largely dependent on agriculture. For the entire San Joaquin Valley, farming and farm-related industries account for 15 percent of all employment and generate 12 percent of the personal income. Within the GDA (and the area immediately adjacent), these figures are likely to be at least as high as for the entire valley. The principal manufacturing industries in the area are engaged in processing agricultural products and in supplying production inputs to agriculture. In the services sector of the economy, the agricultural, forestry, and fisheries service industry has the largest value of output. These industries provide the majority of private sector jobs. Transportation, communication, and retail industries, educational, health, and social services, and three levels of government (local, state, and federal) also contribute to the local economy.

8.1 AFFECTED ENVIRONMENT

8.1.1 Population

For the period from 1990–2007, population in Fresno County grew at a compound annual rate of 1.9 percent; Madera County grew at a 3.2 percent annual rate; and Merced County grew at a 2.1 percent annual rate (see Table 8-1). Among cities within the GDA, Los Banos (Merced County) grew most rapidly, at 5.7 percent per year. Firebaugh and Mendota (both in Fresno County) grew at 2.8 percent and 1.9 percent annual rates, respectively. At January 1, 2007, population in Fresno County was 917,515, Madera County was 148,721, and Merced County was 251,510 (California Department of Finance 2007). Over 78 percent of the Fresno County population was in incorporated areas, while about 44 percent of Madera County's and 61 percent of Merced County's populations were in incorporated areas.

Table 8-1 Population and Population Growth in the Three-County Area

County/City	Jan. 1, 1990 Population	Jan. 1, 2007 Population	Compound Annual Growth, 1990–2007
Fresno	661,400	917,515	1.9%
Firebaugh	4,200	6,692	2.8%
Mendota	6,875	9,426	1.9%
Madera	86,400	148,721	3.2%
Merced	176,300	251,510	2.1%
Dos Palos	4,190	4,899	0.9%
Los Banos	13,750	35,211	5.7%

Source: California Department of Finance, various years, E-1, City/County Population Estimates with Annual Percentage Change; E-2, California County Population Estimates and Components of Change by Year, July 1; and E-4, Population Estimates for Cities, Counties, and the State.

8.1.2 Employment and Income

Total three-county employment in all industries was 471,300 in 2007, an increase of 59,000 jobs between 1998 and 2007 (see Table 8-2). All data relate to activities taking place directly in the study area and exclude linkages to or effects from other counties. The three-county area was selected to emulate a relatively self-sufficient regional economy. The importance of farming is indicated by its share of total industry employment for the three-county area. Farming employment accounted for 15.1 percent of total 2007 employment, down from 19.8 percent in 1998. Farming accounted for only 2.5 percent of total California industry employment in 2007.

Among industry sectors, only the service sector and state and local governments employed more people than farming in the three-county area in 2007. Services, however, have grown rapidly since 1990, and state and local governments have increased their employment by more than 20 percent since 1998. Federal government employment has declined slightly.

Table 8-2 measures "direct employment" by showing the actual industries in which people are employed. As discussed below, many linkages occur among the sectors in a regional economy of the type evaluated here.

Personal income in the three counties is $32.8 billion and represents 2.3 percent of the total for California (see Table 8-3). Fresno County is the largest of the three, followed by Merced, then by Madera. Per capita personal income is $27,080 in Fresno County, and Madera and Merced are similar at $22,580 and $23,180, respectively. Among the 58 counties in California, per capita personal income in Fresno is 43rd, Madera is 58th, and Merced is 52nd. Counties with higher figures are typically in more urbanized areas. Farm income accounted for 2.7 percent of total personal income in Fresno County in 2006, 5.4 percent in Madera County, and 7.2 percent in Merced County. In contrast, farm income accounted for 0.5 percent of total personal income for California in that year.

Table 8-2 Employment and Employment Growth in the Three-County Area

Measure	1998 Employment	2007 Employment	Percent of 2007 Employment in All Industries	Percent Growth, 1998–2007
Total Farm	81,700	71,300	15.1	-12.7
Construction/Mining	16,600	27,000	5.7	62.7
Manufacturing	17,700	40,400	8.6	128.2
Service Providing	272,100	16,500	70.5	22.2
Wholesale Trade	13,700	16,000	3.4	16.8
Retail Trade	40,100	47,800	10.1	19.2
Goods Producing	58,600	67,400	14.3	15.0
Federal Government	11,400	10,900	2.3	-4.4
State/Local Government	66,400	83,700	17.8	26.1
Total Nonfarm	330,600	400,000	84.9	21.0
All Industries	412,300	471,300	100.0	14.3

Source: California Employment Development Department, 2008, Employment by Industry Data, available at http://www.labormarketinfo.edd.ca.gov/.

Note: Separate data are not presented by Fresno, Madera, and Merced counties.

Table 8-3 Total and Per Capita Personal Income in the Three-County Area and California, 2006

Personal Income[1]			
County/State	Total ($1,000s)	Per Capita	Rank Among Counties[2]
Fresno	$23,980,463	$27,081	43
Madera	$3,249,958	$22,580	58
Merced	$5,615,376	$23,182	52
California	$1,436,445,919	$39,626	--

Source: Bureau of Economic Analysis, 2008, Regional Economic Accounts, available at http://www.bea.gov/reigonal.

[1]Rank based on per capita personal income.
[2] Based on 2006 the latest year for which data have been released by the Bureau of Economic Analysis.

8.1.3 Agriculture

As agriculture within the Project Area has changed from land-extensive livestock and grain production to irrigated cotton, field, grain, orchard, and other intensively farmed crops, a comprehensive infrastructure has developed around production farming. These sectors include suppliers of purchased inputs such as feed, fertilizer, irrigation equipment, chemicals, and farm machinery; banks and other financial institutions; cotton gins; food processors; warehousing and storage businesses; and transportation and shipping companies. Because each of these industries purchases from and sells to many other sectors, agriculture has widespread ripple effects throughout the regional economy. For example, vegetables and orchard and vine crops are high-value enterprises that rely heavily on both hired labor and purchased inputs.

The total annual value of crops grown in the GDA and San Joaquin River Water Quality Improvement Project (SJRIP) in 2007 is estimated to be $237.8 million based on farm-level prices (see Table 8-4). Cotton accounted for 41 percent of crop acres in 2007, but 23 percent of total crop value. Conversely, tomatoes and vegetables were cropped on 22 percent of acres, but contributed 46 percent of value. The differences result from variations in value per acre and are particularly noticeable for grains. While rice and wheat accounted for 6 percent of cropland in the GDA in 2007, they accounted for only 2 percent of total crop value. The differences are important because they represent variations in intensity of input use and in overall regional activity affected by agriculture.

Table 8-4 Crop Acres, Value per Acre, and Total Crop Value, Grassland Drainage Area and SJRIP Reuse Facility, 2007[1]

Crop/Group	Acres[1]	Value/Acre	Total Value ($1000s)	Percent of Acres	Percent of Value
Cotton	33,397	$1,662	$55,497,650	41%	23%
Melons	9,454	$5,163	$48,808,390	12%	21%
Tomatoes	10,616	$5,219	$55,406,180	13%	23%
Alfalfa Hay	12,190	$836	$14,083,680	15%	6%
Sugarbeets	3,487	$1,620	$5,648,687	4%	2%
Rice	1,705	$956	$1,630,282	2%	1%
Vegetables	6,928	$7,489	$55,189,160	9%	23%
Wheat	3,524	$435	$1,585,613	4%	1%
Total	81,301		$237,849,642	100%	100%

[1]Acreage estimates are based on data provided by Summers Engineering. (Summer Engineering, pers. comm.., 2008a) Acreage includes currently irrigated lands on the 2,900 acres that will be moved into the SJRIP in the Action Alternatives.

As stated in Section 7.1.1, subsurface saline water management has affected and will continue to affect the vitality and sustainability of agriculture in the GDA. Farm-level benefits and costs are associated with such management. Benefits include the ability to continue farming with the high yields that characterize the area. Costs include those associated with the installation of drainage tiles or other methods of subsurface water collection and disposal and/or treatment of the water. Consequently, irrigators must be sensitive to the quantity and contents of drainwater leaving their fields and collected at points within the GDA. Limitations on selenium (Se) discharges may limit the total amount of drainwater that may be discharged from an area and necessitate on-farm recirculation and other drainwater management actions. However, as the water is recirculated, soil and water salinity build up, and crop yields are impacted.

The effects of salinity on crop yields have been documented for some crops grown in the GDA. Controlled laboratory setting experiments have been conducted to measure yield responses to carefully measured levels of salinity. Some field experimentation has also been conducted (Ayers and Branson 1975). Wichelns and Houston have completed several studies on the economic effects of salinity in the Broadview Water District, which is part of the GDA (see for example Wichelns and Houston, 1995a, 1995b). During periods when a drainage outlet was not available, the District had to recycle all its drainwater, and soil salinity built up significantly. As salt levels built up, growers were forced to replace such salt-sensitive high-value crops as tomatoes and melons with lower-value, salt-tolerant cotton and sugarbeets.

Yield differences were dramatic for the periods. For example, for the 5 years prior to the availability of a drainage outlet in 1983, cotton yields in Broadview averaged 2.3 bales per acre. In the 4 years following, yields averaged 2.6 bales per acre. Similarly, tomato yields increased from 19.3 to 34.8 tons per acre, alfalfa seed increased from 601 to 938 pounds, barley increased from 1.8 to 2.4 tons per acre, and sugarbeets increased from 25.5 to 30.1 tons per acre.

Salinity clearly is only one of many factors that may affect crop yields; the others include irrigation water quality, quantity, and timing; fertilizer and pesticide applications; and climate. Consequently, yields may differ among the fields on a farm as well as among farms in a given area.

Yield data for Broadview since 1986 or for other subareas of the GDA were not available for this study. However, it is reasonable to assume that the yield impacts of salinity are, within some range, symmetric for increases and reductions in salinity levels. This assumption and others are reviewed in Section 8.2.

8.1.4 Other Economic Sectors

Agriculture has been the core industry in the Project Area for many decades. Moreover, agricultural production contributes to significant additional outputs of goods and services in other farm-related businesses throughout the regional economy. Farmers purchase seed, chemicals, fertilizers, and other production inputs, and they and their employees also purchase food, clothing, automobiles, and other household goods and services from businesses in their areas. Farmers also sell to local businesses, including food processors, commodity brokers, feedlots, export dealers, and cotton gins. As a result, changes in agricultural production set off a series of "ripple effects" through the economy, which cause changes in employment, jobs, income, and outputs in many other sectors. The linkages from production agriculture to other sectors are characterized as both "backward" and "forward."

Backward linkages refer to connections between production at the farm level and purchases by farmers of inputs to support production, such as fertilizer, feed, and machinery. If the acreage of a particular crop increases (decreases), the farms producing that crop purchase more (fewer) inputs, hire more (less) labor, pay more (less) taxes, and earn more (less) income. In turn, the increased (decreased) sales by input firms cause those firms to purchase more (fewer) inputs from other sectors, hire more (fewer) workers, and pay more (less) taxes. These cause-effect patterns continue throughout the economy. Hence, changes at the farm level have extensive impacts on many different sectors.

Forward linkages are connections between farms and businesses that handle or process products after they leave the farm, such as cotton gins, dairy processing plants, canning plants, and shippers and brokers. Farm products are inputs for these forward-linked sectors. Hence, an increase (decrease) in the supply of key farm products makes possible an increase (decrease) in the output of products using that input. As production and sales increase (decrease), demands for the inputs used in the products (such as labor, machinery, and supplies) also increase (decrease).[1]

These linkages, each of which can be quantified as "direct," "indirect," and "induced" impacts, are quantified by use of input-output (I-O) analysis. Direct effects are changes in the activity of a

[1] Forward linkages are not quantified in this study. Sufficient data are not available to estimate the flows of products from farms in the GDA to processing plants in the three-county area.

sector and that result from a change in the demands for its output. Indirect effects are changes in the activity of a sector, which result from changes in the demands for outputs from other sectors. Induced effects are the changes in regional spending patterns caused by the changes in income generated from the direct and indirect effects. The measurement of the extent of these linkages begins with farm-level outputs previously shown in Table 8-4. This analysis does not quantify the effects of forward linkages, but rather only quantifies the total economic impact associated with backward linkages.

8.2 ENVIRONMENTAL CONSEQUENCES

Estimation of the economic impacts of the Proposed and Alternative Actions rests on two separate models. The first is a model that simulates farm-level responses to the characteristics and constraints of each alternative. It incorporates crop yield, revenue, cost, and profit information. The second construct is a regional impact analysis model that incorporates key linkages between economic sectors in the three-county area. Details concerning each of these models are provided in Appendix G; they are described briefly below.

8.2.1 Key Impact and Evaluation Criteria

8.2.1.1 Methodology

Two separate models were used to estimate the economic impacts of the Proposed and Alternative Actions on the agricultural sector. The first is an optimization model that simulates farm-level decision making, and was run for each alternative. The model considers the acreage pattern that would maximize profit given the levels of soil salinity and water recycling projected for the GDA under each alternative. The model selects the combination of crops and irrigation technologies that maximizes farm profits in the GDA from 2010 to 2019. The model includes a variety of constraints, such as yield-salinity relationships on crops grown in the area and maximum percentages by which crop acreages may change between years. Outputs from the model for each alternative include the acreage, production, gross revenues, costs, and profits expected for each crop.

The second model used is an I-O framework developed for the three-county area. For each year and each alternative, changes in gross revenues were taken from the optimization model. The changes were converted to categories matching the arrangement of industry sectors within the IMPLAN database. The nine crops included in the optimization model were converted to six pertinent IMPLAN sectors: cotton, food grains (wheat, rice), hay (alfalfa hay), vegetables (melons, fresh and processing tomatoes, and vegetables), and sugar (sugarbeets). These converted figures were then input directly into the I-O model as changes in final demands for the respective crop sectors.

For the specified changes in final demands, the I-O model provides estimated production levels required from every other industry in the region to meet those changes. The inputs and outputs can then be traced via the I-O accounts to determine the overall impacts on the various industries making up the regional economy.

The estimation of regional impacts was based on the 2006 IMPLAN database as the existing condition; more recent data were not currently available. It was implicitly assumed that the economic structure of the three-county economy and the technical relationships and production processes in the I-O model would remain unchanged between 2006 and 2019.

8.2.1.2 Determination of Impact Significance

In the subsequent analysis, an assessment is made of changes in different variables. No convenient yardsticks were available to assess the significance of the changes noted in any of the variables or issues analyzed. It was not possible to perform statistical tests of significance on such variables as percentages of acres in various crops, since information on individual landholdings was not available. It was therefore decided on the basis of professional judgment that any change of 5 percent or greater in the annualized present value of net farm income or regional variables would constitute a significant impact. Furthermore, these socioeconomic changes have the potential to result in physical changes in the environment (e.g., cropping patterns and soils), so a significance determination under California Environmental Quality Act (CEQA) is appropriate.

The key farm-level variable used for measurement of impact significance was farm profit because it summarizes the effects of an alternative on the long-run viability of farming in the three-county area. Impacts were measured relative to estimated 2007 existing conditions. The best approximation for profits is one that includes actual cropping patterns, yields, prices, and costs. Because those data were not available, estimated figures outlined in Section 8.1 were used. Profit estimates in this section reflect profits from cropped farmland, as well as the water treatment costs at the planned SJRIP and fees for Se discharge associated with the Proposed Action and the 2001 Requirements Alternatives. Profit estimates for the No Action Alternative exclude these costs. Consequently, profits for the two Action Alternatives and the No Action Alternative differ. Profit in 2010 for the No Action Alternative is $55.3 million. Profits for the Proposed Action and 2001 Requirements Alternatives vary slightly in some years because of a different fee structure for Se discharge. Profits in 2010 for the Proposed Action are estimated at $58.7 million and at $58.5 million for the 2001 Requirements Alternative. To measure the significance of each alternative's impact on farming, profits in each alternative were compared to the profit under 2007 existing conditions. The Proposed Action is also compared to the No Action Alternative to estimate the effect of this alternative under National Environmental Policy Act (NEPA).

The key regional variables used for measurement of impact significance are total personal income and total industry output. Both are for the entire three-county impact area, i.e., Fresno, Madera, and Merced counties.

8.2.2 Environmental Impacts and Mitigation

This section describes the economic consequences for each alternative for each year of the projection period, 2010 to 2019. The alternatives analyzed are No Action, Proposed Action, and 2001 Requirements Alternative. A "Normal" water year is assumed throughout the projection period for each alternative. The agricultural production revenues and profits projected for each year are based on changes in crop acreage patterns that would be expected to occur solely due to changes in soil salinity and drainwater discharge constraints; all other factors (including water supply, crop prices, weather, etc.) are assumed to remain the same as in 2007 existing conditions.

The assumptions underlying the alternatives will affect production, consumption, and investment decisions in agriculture. As a result, agricultural output will change. The changes in agricultural output are utilized to compute direct impacts, measured as changes in output, employment, and income in the agricultural sector. In addition, changes in final demands will produce indirect and induced impacts in agriculture and many other sectors of the regional economy because of the linkages and interdependencies among industries. Because no substantial effects on recreation in the Project Area and vicinity would occur from any of the alternatives[2], recreation-related economic impacts were not evaluated and are assumed to not occur (i.e., no impact).

8.2.2.1 No Use Agreement (No Action)

The optimization model selected the crop acreages and irrigation technologies that provide maximum profit for the irrigators under specific constraints. The constraints for the No Action Alternative reflect that all drainwater from sumps must be recycled, and that soil salinity rises throughout the GDA as well as in the reuse area. As expected, the results suggest that farmers seeking to maximize profits under these conditions plant more salt-tolerant crops. Acreage remains in high-value salt-sensitive crops until yields fall to the point where profits are reduced below profit from alternative crops.

Projections concerning soil and applied water salinity under this alternative are presented on Figure 7-2 in the previous chapter on land uses. Projections concerning crop yields and crop acreage under this alternative are presented in Tables 7-4 and 7-5, respectively.

The projected changes in crop yields and acreages would result in changes in farm revenues within the GDA and the SJRIP reuse facility. Table 8-5 shows total revenues by crop and year from 2010 to 2019 under No Action. These revenues are compared to existing 2007 revenues of $237.8 million. Total revenue under No Action is expected to drop by 2010, both because yields are expected to decline throughout the Project Area between 2007 and 2010 due to rising salinity levels, and because over 2,000 acres of land are changed from irrigated crop production in the GDA to salt-tolerant plant production the reuse facility. Total revenue in 2010 under No Action is estimated at $224.6 million, but falls to $218.0 in 2014 before rising slightly to $219.8 by 2019 (as farmers switch to more salt-tolerant crops). Revenues for cotton increase steadily as that crop is substituted for less salt-tolerant crops. However, the increase in cotton revenues would offset only part of the declines in other crops. Revenues from melons, alfalfa hay, rice, tomatoes, vegetables, and wheat all would drop between 2010 and 2019.

[2] Limitations on recreational fishing associated with No Action are not quantifiable.

Table 8-5 Revenue by Crop Type and Year under No Action (Grassland Drainage Area and Reuse Area, Millions $)

Year	Cotton	Melons	Tomatoes	Alfalfa Hay	Sugarbeets	Rice	Vegetables	Wheat	Total
2010	56.60	42.59	53.33	12.63	5.94	0.99	51.24	1.27	224.58
2011	57.74	41.37	51.19	11.76	6.10	0.78	49.23	1.16	219.33
2012	58.90	41.07	50.66	11.33	6.10	0.61	48.74	1.05	218.46
2013	59.96	41.07	50.66	11.00	6.10	0.48	48.73	0.96	218.96
2014	60.91	40.77	50.13	10.62	6.10	0.38	48.24	0.88	218.02
2015	61.79	40.77	50.13	10.32	6.10	0.30	48.23	0.80	218.43
2016	62.59	40.77	50.13	10.04	6.10	0.24	48.23	0.73	218.82
2017	63.32	40.77	50.13	9.78	6.10	0.19	48.23	0.67	219.18
2018	64.00	40.77	50.13	9.51	6.10	0.15	48.23	0.61	219.49
2019	64.63	40.77	50.13	9.27	6.10	0.12	48.23	0.56	219.80

Compared to existing 2007 farm profits of $61.4 million, projected farm profits under the No Action Alternative would decline. Farm profits in 2010 under No Action are estimated at $55.3 million, but would drop in the next several years as yields decline due to salts building up in the soil. As farmers begin adjusting from the initial crop mix to increased acreage of more salt-tolerant crops, profits begin to recover and remain at approximately $52 million until 2019 (see Figure 8-1). The net present value of estimated annual profits for 2010 through 2019 is $433.7 million, using a 3 percent discount rate. This value is a 15 percent reduction from the net present value of farm profits that would be expected if existing profits of $61.4 million were to be realized each year from 2010 to 2019.

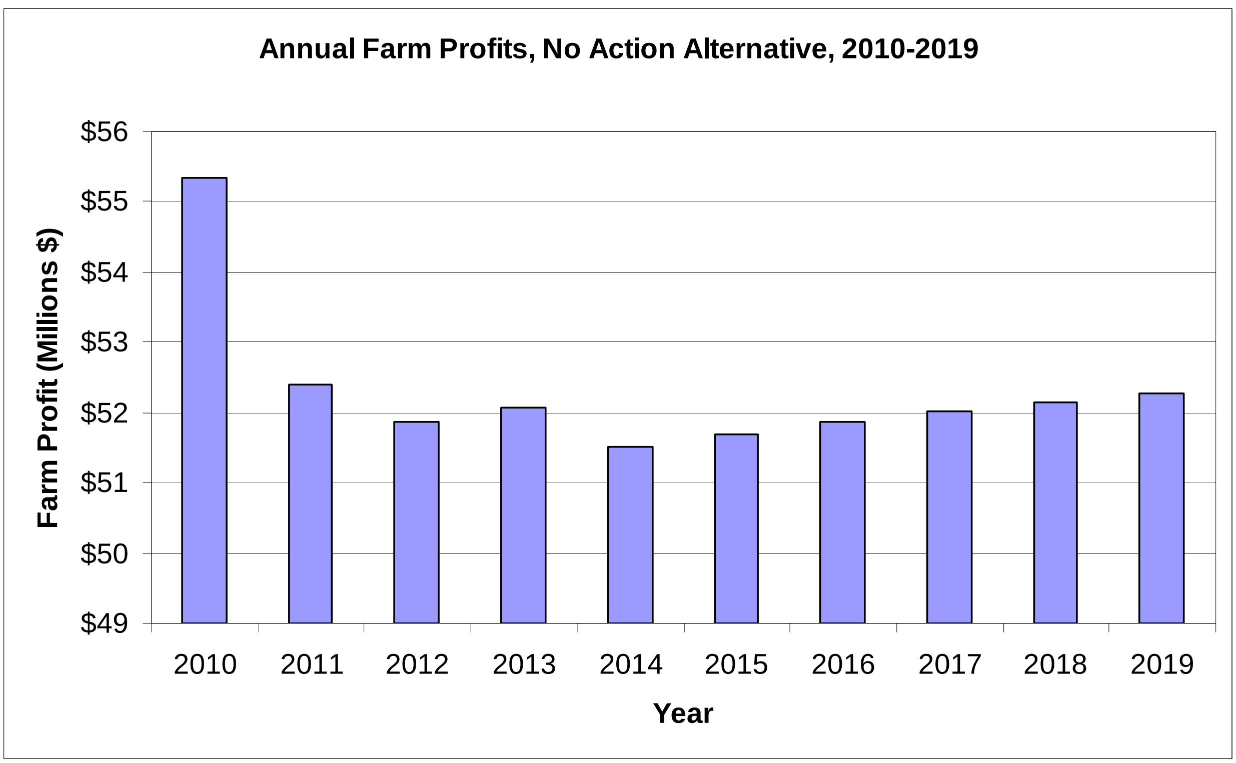

Figure 8-1 Annual Farm Profits, 2010–2019, No Action Alternative

Although the time period for this analysis is 2010 to 2019, it is important to note that reductions in farm profits and revenue impacts of the No Action Alternative would likely increase substantially in later years (after 2019). As noted in Section 2, over time the reuse capacity of the SJRIP would diminish as salt accumulates within the root zone and the ability of the SJRIP to support salt-tolerant crops declines. This would impact the profitability of farmlands throughout the GDA as fields in the lower portion of the region would become waterlogged and unfarmable and would be abandoned. Additionally, once the reuse facility became inoperative, individual districts and farmers would have to recycle drainwater "on farm and within districts," resulting in increased salinity levels and associated crop yield and revenue declines throughout the GDA.

Under the No Action Alternative, soil and water salinity would increase, crop yields and revenues would decline, acreages would shift among crops, but total cropped acreage would remain very similar between 2010 and 2019. Due to the 2,230 acres that are being moved from the irrigated agriculture GDA into the SRJIP, the total irrigated acreage is expected to drop by approximately 1,000 acres, or a decline of approximately 1.5 percent.

The gross revenue change for each year is found by subtracting existing 2007 revenue from the value for each project year. For example, the direct output effect for 2010 is estimated at $13.3 million, and is the difference between the existing 2007 total crop revenues of $237.8 million and the 2010 total crop revenue of $224.6 million shown in Table 8-5. Those differences were used as input in the I-O model to determine the regional economic impacts.

Table 8-6 shows the impacts of the No Action Alternative, by year. Both direct and total impacts are shown for output, personal income, and employment. Direct impacts are the effects of the alternative on the agricultural sector, while total impacts reflect the effects of the direct impacts on all sectors of the economy. In the year 2010, the direct output in agriculture is reduced by $13.3 million. The total output impact in 2010, taking into account the effects of agricultural output on economic activity in other sectors and of associated increased employment and consumer income, is a reduction of $19.7 million.

Table 8-6 Regional Output, Personal Income, and Employment Impacts, No Action Alternative compared to Existing Conditions

Year	Output ($Million)		Income ($ Million)		Employment (Jobs)	
	Direct	Total	Direct	Total	Direct	Total
2010	-$13.3	-$19.7	-$8.9	-$12.6	-60	-127
2011	-$18.5	-$27.4	-$12.5	-$17.7	-82	-173
2012	-$19.4	-$28.5	-$13.3	-$18.5	-88	-180
2013	-$18.9	-$27.6	-$13.1	-$18.1	-89	-174
2014	-$19.8	-$28.8	-$13.9	-$19.1	-95	-181
2015	-$19.4	-$28.1	-$13.7	-$18.7	-95	-175
2016	-$19.0	-$27.3	-$13.6	-$18.4	-94	-170
2017	-$18.7	-$26.7	-$13.5	-$18.1	-94	-165
2018	-$18.4	-$26.1	-$13.4	-$17.8	-93	-160
2019	-$18.1	-$25.5	-$13.3	-$17.6	-93	-155

Under No Action, output impacts are expected to be negative in all years compared to existing conditions. It is projected that the largest impact would be felt in 2014, with roughly $28.8 million reduction in total output, $19.1 million reduction in total income, and reduction of approximately 180 full and part-time jobs. As growers begin responding to rising salinity levels by changing their cropping pattern, the expected total output impact is reduced by 11 percent and the total income impact is reduced by 8 percent between 2014 and 2019.

8.2.2.2 Grassland Bypass Project, 2010–2019 (Proposed Action)

Under this alternative, it is assumed that the 2001 Use Agreement will be revised and extended through 2019 (Proposed 2010 Use Agreement). The GDA could continue to use the Drain to discharge drainwater collected from irrigators and upslope drainers. The Se load in the discharge is constrained to be less than or equal to the Se load values listed in Table 8-7. Based on the annual Se load figures proposed in the 2010 Use Agreement's (see Figure 2.21). The values for the 2010 Use Agreement presented in Table 8-7 are an average of the "Below Normal" and "Above Normal" water year type load limits.

Table 8-7 Annual Selenium Load Restrictions, 2010–2019 Grassland Bypass Project

Pounds Discharged	
Year	Proposed Action 2010 Use Agreement
2010	3,513
2011	3,329
2012	3,329
2013	3,329
2014	3,329
2015	2,590
2016	1,852
2017	1,114
2018	375
2019	375

Source: Appendix A, Draft Use Agreement

The Grassland Bypass Project would include the construction of a new treatment facility at the SJRIP reuse facility. Costs to process water at the facility were estimated at $1,500 per acre-foot[3] (Summers Engineering, pers. comm., 2008a). Total treatment costs were assessed based on the volume of water sent to the facility in each year, as presented in Appendix C. An average of the Above Normal and Below Normal/Dry expected annual volume was used in this analysis to calculate treatment costs. It is anticipated that the treatment facility would be operational in 2015 and would treat approximately 5,750 acre-feet per year of water at a cost of $8.6 million. Treatment costs are expected to rise to $9.8 million in 2019 as volume treated rises to 6,500 acre-feet. The total present value of expected treatment costs between 2015 and 2019, using a 3 percent discount rate, is $35.2 million.

Under the Proposed Action Alternative, soil salinity would increase, but at a much slower rate than under the No Action Alternative. Crop yields would remain at or near their maximum respective values. Water would be recycled, but the optimal amount of recycling as well as crop acreages and irrigation methods would be determined based on the allowable Se load (from Table 8-7). Results presented in Section 4 indicate that the volume of water recirculated on the

[3] It is expected that this estimate is on the high end of what treatment costs may be, thereby providing a conservative estimates of benefits of the Proposed Action as appropriate for an EIR/EIS.

GDA would be similar under No Action and the Proposed Action, but the volume of drainwater used at the SJRIP would decline under the Proposed Action.

Projections concerning soil and drainwater salinity under this alternative are presented on Figure 7-3 in Section 7. Projections concerning crop yields and crop acreage in the GDA under this alternative are presented in Tables 7-5 and 7-5, respectively.

Although an additional 670 acres are expected to change from irrigated production in the GDA to the SJRIP compared to the No Action Alternative, yields, revenues, profits, and regional impacts increase compared to No Action. The Proposed Action would also result in 1,100 acres located adjacent to the GDA being included in the GDA, but no change in acreage or crop revenue is expected to result from this action so revenue from this acreage is not included in this analysis.

Table 8-8 shows total projected revenues by crop and year under the proposed 2010 Use Agreement Se load values. Total revenue is estimated at $230.9 million in 2010, an increase of $6.3 million over 2010 revenues in No Action. Revenues rise to a peak of $233.8 million in 2019. Although yields of salt sensitive crops decline slightly during this time period, it is anticipated that farmers will switch to higher valued crops, which outweighs the revenue impacts of the slightly higher salinity levels. In general, the revenues in each crop type remain level throughout the 10 year period, with the exception that increased acreage in cotton is expected, with corresponding declines in grain acreage. Over the course of the 10-year Use Agreement, the present value of revenues in the Proposed Action is expected to exceed the present value of crop revenue in No Action by $107.7 million, or 6 percent.

Table 8-8 Revenue by Crop Type and Year under Proposed Action (Grassland Drainage Area and Reuse Area, Millions $)

Year	Cotton	Melons	Tomatoes	Alfalfa Hay	Sugarbeets	Rice	Vegetables	Wheat	Total	Increase from No Action
2010	56.1	44.9	53.4	14.0	5.9	1.0	54.4	1.3	230.9	6.3
2011	57.2	44.3	53.4	13.5	6.0	0.8	54.3	1.2	230.8	11.5
2012	58.4	44.3	53.4	13.1	6.0	0.6	54.3	1.1	231.3	12.8
2013	59.4	44.3	53.4	12.8	6.0	0.5	54.3	1.0	231.7	12.8
2014	60.4	44.3	53.4	12.4	6.0	0.4	54.3	0.9	232.1	14.1
2015	61.3	44.3	53.4	12.1	6.0	0.3	54.3	0.8	232.5	14.1
2016	62.0	44.3	53.4	11.8	6.0	0.2	54.3	0.7	232.9	14.0
2017	62.8	44.3	53.4	11.5	6.0	0.2	54.3	0.7	233.2	14.0
2018	63.5	44.3	53.4	11.2	6.0	0.1	54.3	0.6	233.5	14.0
2019	64.1	44.3	53.4	11.0	6.0	0.1	54.3	0.6	233.8	14.0

It is expected that farm profits from crop production under the Proposed Action Alternative are higher than under the No Action Alternative in each year from 2010 to 2019. Total Proposed Action farm profits in 2010 are $58.7 million and rise slowly to approximately $60.0 million by 2019. The net present value of annual profits for 2010 through 2019 is $505.5 million, which compares to $433.7 million under the No Action Alternative, an increase of 17 percent.

However, once treatment costs and fees for Se discharge are included, farm profits are only higher for the first five years. In 2015, when treatment of drainwater is expected to start, the estimated treatment costs of approximately $9 million annually cause profits under the Proposed

Action to fall slightly below profits from No Action for the same period. These costs are based on estimated per acre-foot treatment costs of $1,500 [4] (Summers Engineering, pers. comm., 2008a). Using these figures, total Proposed Action farm profits in 2010 are $58.7 million and rise slowly to $59.0 million in 2014 before falling to approximately $50 million in years 2015 to 2019 due to drainwater treatment costs. The net present value of annual profits for 2010 through 2019 is $455.7 million, which compares to $433.6 million under the No Action Alternative, an increase of 5 percent.

Under the Proposed Action, soil and water salinity would increase, but at a slower rate than under the No Action Alternative. As a result, yields for most crops would not decline, while those for others would fall by a smaller amount. Total cropped acreage would not decline, but the composition of the crops grown would slightly change, particularly for the additional 670 acres incorporated into the reuse facility. The gross revenue under the No Action compared to the corresponding year under the Proposed Action was used as the basis for estimating regional economic impacts. For example, in 2010, the No Action project revenue was $224.6 million and the Proposed Action revenue was $230.9 million. The difference between these, $7.3 million, is the basis for estimating the regional economic impact of the Proposed Action in 2010. The differences were used as input in the I-O model to determine the regional impacts for each of the Se load values considered.

Table 8-9 shows the regional economic impacts of crop production under the Proposed Action compared to No Action by Project year. Impacts are expressed as direct and total for output, personal income, and employment. Direct impacts are the effects on the agricultural sector of the alternative. Total impacts reflect the effects of the direct impacts on all sectors of the economy. So, for example, in 2010 the total output impacts of the $7.3 direct output increase is $11.1 million, after taking into account the effects of higher agricultural outputs on demands from other sectors and of higher employment and consumer income. Corresponding total increases in income are $6.8 million and in employment are approximately 70 full and part-time jobs.

Table 8-9 Regional Economic Output, Personal Income, and Employment Impacts, Grassland Bypass Project 2010–2019 Compared to No Action (Millions $)

Year	Output		Income		Employment	
	Direct	Total	Direct	Total	Direct	Total
2010	$7.3	$11.1	$4.6	$6.8	30	70
2011	$12.5	$18.8	$8.0	$11.7	51	119
2012	$13.8	$20.9	$8.9	$13.0	57	133
2013	$13.8	$20.8	$8.9	$13.0	56	132
2014	$15.2	$22.9	$9.8	$14.3	62	145
2015	$15.2	$22.9	$9.8	$14.3	62	146
2016	$15.1	$22.8	$9.8	$14.2	62	145
2017	$15.1	$22.8	$9.8	$14.2	62	145
2018	$15.1	$22.8	$9.8	$14.2	62	145
2019	$15.1	$22.8	$9.8	$14.2	62	145

Economic impacts from crop production relative to No Action are projected to be positive for all years, with the smallest increase occurring in 2010 and rising in each year until leveling off in

4 It is expected that this estimate is on the high end of what treatment costs may be, thereby providing a conservative estimates of benefits of the Proposed Action as appropriate for an EIR/EIS.

years 2014 to 2019. The total regional gain in output between 2014 and 2019 is approximately $22.8 million annually, while the gain in person income is approximately $14.2 million and the gain in employment is approximately 145 full and part-time jobs. Netting out the decrease in personal income due to increased incentive fees and drainwater treatment, the direct increase in personal income from 2015 to 2019 drops from $9.8 million to an average of zero, while the average total increase in personal income drops from $14.2 million to approximately $4.0 million.

8.2.2.3 2001 Requirements Alternative (Alternative Action)

The 2001 Requirements Alternative is nearly identical to the continuation of the Grassland Bypass Project, but constrains the limits of Se and salt loads discharged to Mud Slough to those in the 2001 Use Agreement (i.e., less stringent allowances).

The values for the 2001 Requirements Alternative are an average of the Wet and Dry year load limits for 2009.

Table 8-10 Annual Selenium Load Restrictions, 2010–2019, 2001 Requirements Alternative

Pounds Discharged	
Year	2001 Requirements Alternative
2010	2,755
2011	2,755
2012	2,755
2013	2,755
2014	2,755
2015	2,755
2016	2,755
2017	2,755
2018	2,755
2019	2,755

Source: Appendix A, 2010 Use Agreement

It is anticipated that soil salinity levels throughout the GDA would be the same as under Proposed Action, so there are no anticipated differences in crop acreage, revenues, or profits. Additionally, it is anticipated that the Phase 3 treatment facility would be constructed under this alternative, resulting in the same costs being incurred as under the Proposed Action. The only expected economic difference between the Proposed Action and the 2001 Requirements Alternative Action is that there would be a slight decrease in the value of the fees that would be paid by the GDA for discharge of Se. Based on the Se load discharges projected (average of Above Normal and Below Normal/Dry years) in the 2010 Use Agreement, it is anticipated that under the Alternative Action the present value of incentive fees paid by GDA farmers would be $991,000. This compares to expected mitigation and incentive fee payments of $2.3 million under the Proposed Action.

In summary, the farm revenue and regional economic impacts of the Alternative Action would not differ from the Proposed Action, but would result in increased present value of farm profit of $1.3 million over the 10-year project period in comparison to 2007 existing conditions.

8.2.3 Cumulative Effects

Cumulative impacts are those that result from the incremental impacts of an action added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

To the extent that other subareas in the Westside Plan, in addition to the Grassland Subarea, are successful in implementing source control, drainage reuse, and evaporation system methods (to manage drainage for salts and Se in valley that would result in an increase in soil salinity), effects on personal income and industry output may be individually insignificant to the Grassland Subarea but significant when combined with the other subareas. Mitigation for these valley-wide effects could include measures to remove salt from the soils, minimize drainage reuse, or subsidize costs of treatment facilities to improve farm profits. Some of these measures are likely to require additional NEPA/CEQA evaluation prior to their implementation.

8.3 IMPACT AND MITIGATION SUMMARY

Table 8-11 compares the projected farm revenue and profits, as well as regional output, personal income, and employment impacts for each of the three alternatives from 2010 to 2019. Impacts are presented in both average annual value and present value for that period in current dollars. All are measured relative to the year 2007 values (which represent the existing condition). All Alternatives result in negative economic impacts due to the incorporation of acreage from the GDA (irrigated crops) to the reuse facility (salt-tolerant crops with an emphasis on consumptive use of drainwater). Over the 10 years, the No Action Alternative has the largest adverse impacts because of the additional effects of reduced crop yields. Under No Action, average annual farm revenues would decline from existing conditions by $18.3 million and average annual farm profits would decline by $9.1 million. The total present values of farm revenue and profit declines over the 10 years are $151.4 million and $74.9 million, respectively.

Table 8-11 Comparison of 2010-2019 Present Value and Average Annual Impacts Among Alternatives Relative to 2007 Existing Conditions

Economic Measure	No Action	Proposed Action	Alternative Action
Average Annual			
Farm Revenue ($ Millions)	-18.3	-5.6	-5.6
Farm Profit ($ Millions)	-9.1	-7.0	-6.8
Regional Output ($ Millions)	-26.6	-5.7	-5.7
Regional income ($Millions)	-17.7	-9.6	-9.5
Regional employment (jobs)	-165.9	-33.4	-33.4
Present Value ($ Millions)			
Total farm revenue ($ Millions)	-151.4	-46.9	-46.9
Total farm profit ($ Millions)	-74.9	-55.2	-54.0
Total regional output ($ Millions)	-226.2	-50.2	-50.2
Total regional income (jobs)	-150.0	-77.9	-76.7

The impacts projected under the two Action Alternatives are equal over the 10 years, other than farm profit and regional income, which are slightly higher under the Alternative Action because of lower discharge fees. Impacts of the two Action Alternatives are negative compared to existing conditions, but the adverse effects are fewer than those under the No Action Alternative.

From 2010 to 2019 under the Proposed Action, annual farm revenues and profits would decline from existing conditions by an average of $5.6 million and annual farm profits would decline by an average of $7.0 million. The present values of these declines are $46.9 million and $55.2, respectively. The decline in farm profits compared to existing conditions is primarily because of the costs to treat drainwater from 2015 through 2019.

Nearly 99 percent of land in the GDA is projected to remain in production during the project period, although the cropping mix will likely change as farmers attempt to maximize profit and as land is tatken out of irrigated agriculture in the GDA and placed into reuse at the SJRIP. Farm-level revenues and profits would decline under the No Action Alternative because of the increased soil salinity associated with not allowing any Se load discharge. Farm-level revenues and profits would decline under the Action Alternatives because of both acreage changes at the SJRIP and the cost of treating drainwater, but these declines are fewer than the projected declines under No Action.

In addition to the regional economic benefits of increased crop production under both Action Alternatives, construction of the treatment component of the SJRIP facility would result in additional economic activity. As noted above, the costs of the facility reduce farm profitability, but costs would be at least partially offset by the construction activity that would spur job creation and increase local income. As the costs of the Phase 3 treatment facility are not known (Summer Engineering, pers. comm., 2008), these positive regional economic impacts are not estimated.

Uncertainty is associated with implementing feasible mitigation for these impacts which are, therefore, unavoidable. To the extent that treatment costs can be implemented for less than $1,500 per acre-foot of drainwater, the impact to farm profits and revenues and regional income and employment would be reduced. Also, the water produced from treatment would have value and offset some of the treatment costs. Furthermore, the GAF would apply for grants, but uncertainty is associated with obtaining these funds.

8.3.1.1 No Action

- Under the No Action Alternative, annual farm profit would fall 15 percent from $61.4 million under existing 2007 conditions to an average of $52.3 million over the 10-year period The total present value of farm profits over the 10 years is also expected to fall by 15 percent compared to existing conditions. This adverse impact is significant based on the criterion discussed in Section 8.2.1, a change of at least 5 percent.
- The regional impacts of the No Action Alternative would be insignificant. The existing personal income of the three-county area is $33.5 billion and the existing total industry output of the area is $70.8 billion. Under the No Action Alternative, total annual income from 2010 to 2019 would average $17.7 million below the existing level, a decline of less than 0.1 percent. Total annual industry output would average $26.6 million below the existing level, also a decline of less than 0.1 percent.

8.3.1.2 Proposed Action

- Under the Proposed Action and proposed Se load values, annual farm profit would decline by 11 percent from $61.4 million in 2007 to an average of $54.4 million from 2010 to 2019. The total present value of farm profits over the 10-year period is also expected to decline by 11 percent compared to existing conditions. This adverse impact is significant and unavoidable based on the criterion discussed in Section 8.2.1, a change of at least 5 percent, and the uncertainty associated with potential mitigation measures.
- The regional impacts of the Proposed Action would be adverse but not significant. Under this alternative, total annual personal income from 2010 to 2019 would decrease by an average of $9.6 million and annual regional output would decline by $5.7 million compared to existing conditions. Both would be within 0.1 percent of their existing levels.
- Compared to No Action, under the Proposed Action it is projected that annual farm profit over the 10-year period would be greater by an average of $2.1 million, or 4 percent. This beneficial impact is not significant. Similarly, the regional impacts of the Grassland Bypass Project relative to No Action would be fewer, a positive effect.

8.3.1.3 Alternative Action

- Under the 2001 Requirements Alternative, farm profit would decline by 11 percent from $61.4 million in 2007 to an average of $54.6 million from 2010 to 2019. The total present value of farm profits over the 10-year period are also expected to decline by 11 percent compared to existing conditions. This adverse impact is significant and unavoidable based on the criterion discussed in Section 8.2.1, a change of at least 5 percent and the uncertainty associated with potential mitigation measures.
- The regional impacts of the Alternative Action would be adverse but not significant. Under this alternative, total annual personal income from 2010 to 2019 would decrease on average by $9.5 million and regional output would decline by $5.7 million compared to existing conditions. Both would be within 0.1 percent of the existing level.
- Compared to No Action, it is projected that annual farm profit over the 10-year period would be greater by an average of $2.3 million, or 4 percent. This beneficial impact is not significant. Similarly, the regional impacts of the Alternative Action relative to No Action would be fewer, a positive effect.

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SECTION 9
Cultural Resources

The purpose of this section is to describe the prehistoric and historic cultural resources that may exist in the region affected by the Grassland Bypass Project. The possible environmental consequences of each alternative on cultural resources are then discussed, and strategies for mitigation are listed. The Action Alternatives do not entail any activities that have the potential to cause effects to historical properties, assuming historical properties are present; therefore, no formal efforts to identify or evaluate historical properties was conducted for the purposes of this section. Consequently, no specific impacts can be determined at this time. Future “undertakings” or “projects” related to the implementation of the Proposed Action (the continuation of the Grassland Bypass Project, 2010–2019), or the 2001 Requirements Alternative may require separate environmental review and, hence, independent cultural resource investigations.

The Project Area, as part of the greater Central Valley, has been heavily modified for agriculture and has been subject to extensive erosion and deposition throughout the last 10,000 years (the Holocene). These processes have either deeply buried elements of the archaeological record or they have been deleterious to this record. The natural drainage pattern of surface waterways within the vicinity of the Project Area has been highly modified by the installation of extensive agricultural drainage systems and levees. This has severely altered the watercourses in a way that would likely also impact intact archaeological deposits, if extant on the landscape. However, in undeveloped upland areas of the Kesterson Unit of the San Luis National Wildlife Refuge and the China Island Unit of the North Grasslands Wildlife Management Area, many significant archeological and historical resources may still exist. In addition, unknown cultural resources can still exist in areas that are considered of lower sensitivity.

The three alternatives discussed below (and in Chapter 2) involve either continuing the existing activities and management of subsurface agricultural drainage from the Grassland Drainage Area (GDA) as part of existing San Luis Drain Use Agreement or not implementing the continuation of the Use Agreement. Therefore, the No Action Alternative, Proposed Action (Grassland Bypass Project), and the 2001 Requirements Alternative will not affect any historic properties because none of the actions associated with these alternatives require any activities that have the potential to cause effects to historical properties, assuming such properties exist within the Project Area.

9.1 AFFECTED ENVIRONMENT

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 or other ethnic groups. For the purposes of the present document, the term “historic properties” are those resources eligible for listing in the National Register of Historic Places (NRHP)(36 Code of Federal Regulations [CFR] 60.4). Any property eligible for listing in the NRHP is by default considered eligible for the California Register of Historical Resources

(Public Resources Code, Section 5024.1). Archeological and historic architectural properties provide scientifically important information about California's history and cultural heritage.

9.1.1 Prehistoric Resources

Prehistoric resources that occur in the region of the Grassland Bypass Project include village sites, temporary camp sites, milling sites, lithic scatters, and isolated burials. Such sites are most commonly found along the San Joaquin River and its associated sloughs. Seasonal flooding has buried many sites under sediments. Substantial agricultural development in the valley has disturbed or destroyed many prehistoric sites.

Prehistoric sites are most likely to exist in areas not fully developed or farmed, like the wildlife refuges; however, artifacts or other features may remain below plow zones in agricultural lands.

The prehistoric period in the Project Area is generally agreed upon to begin with the Clovis Period, about 11,000 years before present. These populations consisted of nomadic hunters who used distinctive fluted spear points, called Clovis Points. The spear points have been found in San Joaquin Valley on the surface with bones of extinct animals, such as mammoth, sloths, and camels.

Approximately 8,000 years before present, the native populations switched from hunting to seed gathering. Archeological evidence includes food grinding implements such as mortars and pestles. Well-made artifacts, such as charm stones and beads, indicate that this period demonstrated social stratification and craft specialization (Reclamation 1997b).

Table 9-1 shows the chronology of perceived prehistoric cultures derived from an excavation site near the 2001 Grassland Bypass Project.

Table 9-1 Prehistoric Resource Chronology of the Middle San Joaquin Valley Region, West Side (San Luis Reservoir, Merced County)

Period	Dates	Characteristics
Positas Complex	3300 to 2600 B.C.	Small shaped mortars, cylindrical pestles, milling stones, perforated flat cobbles, and spire-lopped olive snail (Olivella spp.) beads
Pacheco Complex	2600 B.C. to A.D. 300	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
Gonzaga Complex	A.D. 300 to 1000	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
Panoche Complex	A.D. 1500 to 1850	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

Source: Reclamation 1997b.

9.1.2 Native Americans

San Joaquin Valley once supported a large population of Native Americans. The river provided water and fish, and the adjacent riparian areas offered shelter, wood for building and fire, and a huge variety of waterfowl and animals for hunting. The main cultural groups in the area during the ethnographic period were the Yokuts and Miwok.

In general, the Yokuts were seasonally mobile hunter-gatherers with semi permanent villages found throughout San Joaquin Valley and along the San Joaquin River and its tributaries. They traveled among the foothills of the Sierra Nevada, Delta, and Pacific Ocean to collect a variety of food including deer, salmon and other fish, waterfowl, tule roots, seeds, mussels, turtles, shellfish, and rabbits.

The Miwok culture extended from the Delta to the foothill and mountain areas of the upper Merced and Chowchilla rivers. The Miwok were also seasonally mobile hunter-gatherers with semi permanent villages. Acorns were the staple food. Other food sources included buckeye, seeds, bulbs, pine nuts, deer, elk, rabbits, squirrels, fowl, salmon and other fish, bear, and insects.

Prior to Euro-American contact, it is believed that San Joaquin Valley and the Sierra Nevada foothills were among the most heavily populated areas in California. It has been estimated that up to six individuals per square mile may have inhabited this area. In the early 1800s, Spanish soldiers forced the Yokuts from the banks of the San Joaquin River to their missions. In 1832, malaria and cholera decimated most of the population (San Joaquin River Riparian Habitat Restoration Program 1998). It is estimated that by 1910 only 6 to 9 percent survived (Reclamation 1997b).

Human remains are a sensitive and important issue to many surviving Native American groups.

9.1.3 Euro-American Resources

Initial Euro-American 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. After 1836, 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.

Agricultural development of the valley has occurred since the Gold Rush era, leading to the establishment of numerous rural communities. These communities may contain sites and structures of historical significance.

As settlements grew, agricultural enterprises became more common. Dry-farming practices predominated during the early years until the 1880s when large-scale diversions of water from the San Joaquin River and its tributaries began. By the turn of the century, more than 350,000 acres were being irrigated across San Joaquin Valley. New pump technology in the 1920s allowed more groundwater to be used. Valuable crops, such as vegetables, fruits, and nuts, were grown.

The construction of the Central Valley Project in the mid-1900s drastically changed the hydrology of the San Joaquin River by diverting most of the river's flows at Friant Dam.

Potential historic resources in the region of the Grassland Bypass Project are largely related to agriculture, including farmsteads, labor camps, yards for distributing agricultural produce, feedlots, 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.

Due to the long history of agricultural use, it is unlikely that intact surface or shallow subsurface artifacts 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.

9.2 ENVIRONMENTAL CONSEQUENCES

The National Historic Preservation Act (NHPA) of 1966 (as amended) established the federal government's policy on historic preservation and the programs, including the NRHP, through which that policy is implemented. Under the NHPA, historic properties include "…any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places" (16 United States Code 470w (5)). The NHPA of 1966 (as amended) and its implementing regulations (16 United States Code 470 et seq., 36 CFR Part 800, 36 CFR Part 60, and 36 CFR Part 63) require the agency(ies) to consider the effect of the undertaking on historic properties and to afford the Advisory Council on Historic Preservation and the State Historic Preservation Officer a reasonable opportunity to comment on any undertaking that could adversely affect cultural properties listed or eligible for listing on the NRHP.

The historic significance of cultural resources is evaluated in terms of eligibility for listing on the NRHP. NRHP significance criteria applied to evaluate the cultural resources in this study are defined in 36 CFR 60.4 as follows:

> The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and
>
> (a) that are associated with events that have made a significant contribution to the broad patterns of our history; or
>
> (b) that are associated with the lives of persons significant in our past; or

(c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

(d) that have yielded, or may be likely to yield, information important in prehistory or history.

9.2.1 Determination of Impact Significance

An analysis of potential impacts to cultural resources employs the Criteria of Adverse Effect described in regulations implementing NHPA Section 106 (36 CFR 800.5). Under these regulations, an undertaking has an effect on a historic property when the undertaking may alter characteristics of the property that may qualify the property for inclusion in the NRHP (36 CFR 800.5[a]). An effect is considered adverse when the effect on a historic property may diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Adverse effects include the physical destruction of all or part of the property. Adverse effects on historic properties include, but are not limited to:

- Isolation of the property from or alteration of the property's setting when that character contributes to the property's qualifications for listing on the NRHP;
- Introduction of visual, audible, or atmospheric elements that are out of character with the property or that alter its setting;
- Neglect of a property resulting in its deterioration or destruction; or
- Transfer, lease, or sale of the property (36 CFR 800.5).

9.2.2 Environmental Impacts and Mitigation

9.2.2.1 No Use Agreement (No Action)

No impacts to historic properties are anticipated from this alternative because it does not propose actions that may cause effects to historical properties. Because this alternative represents the possible consequences of not approving the 2010 Use Agreement for the San Luis Drain, no specific material alteration of built environment or ground disturbance is currently proposed. However, the ramifications of this alternative may lead to future projects not currently planned that could cause effects to historical properties, which would require separate environmental review.

9.2.2.2 Grassland Bypass Project, 2010–2019 (Proposed Action)

No impacts to historic properties are anticipated by the Proposed Action because it does not propose actions that may cause effects to historical properties. All actions are proposed to occur within the GDA and, in essence, continue similar operations to those conducted under the existing Use Agreement on lands previously disturbed by agricultural production. Future expansion of drainage water treatment facilities or management facilities at the San Joaquin

River Water Quality Improvement Project (SJRIP) reuse facility that result from the implementation of this alternative would have no potential to affect historical properties.

9.2.2.3 2001 Requirements Alternative (Alternative Action)

The 2001 Requirements Alternative would include the same components as the Grassland Bypass Project, 2010–2019 (the Proposed Action) Alternative except that the selenium and salt loads discharged to Mud Slough would be limited to the less stringent allowances described in the 2001 Use Agreement. Consequently, and as with the Proposed Action Alternative, the 2001 Requirements Alternative would not include actions at this time or with future actions at the SJRIP reuse facility that would cause effects to historical properties.

9.2.2.4 Cumulative Effects

No cumulative effects to cultural resources are anticipated with No Action Alternative and the Proposed Project (Grassland Bypass Project, 2010–2019) because the alternatives do not propose actions that could cause incremental effects to historical properties and contribute to a cumulative loss of resources within the Project Area.

9.2.3 Mitigation Strategies

In general, projects that include ground-disturbing activities such as grading and excavation have the potential to impact historic and prehistoric archaeological resources and may impact historic architectural resources if buildings would be demolished, moved, or altered—or if the setting of an historic resource would be substantially changed. Projects that entail minor surface disturbance or construction would likely result in negligible impacts to cultural resources, but not in every case. On the other hand, large-scale impacts can result from projects that require large degrees of ground disturbance. In essence, as the intensity of construction impacts increases, the potential to impact cultural resources increases. The identification of specific impacts and mitigation measures that are appropriate for a specific project will depend on both the nature of the cultural resources that are present and on the nature of the project. In some instances, mitigation measures must be developed in consultation with multiple agencies and other interested parties. In some circumstances, impacts to historical resources or properties cannot be mitigated to less-than-significant levels. The possible procedures for first identifying and evaluating known and unknown historical resources and then mitigating any potential impacts to those resources caused by Project actions are listed below:

- Conduct cultural resource inventories and evaluations of significance for resources identified per NHPA Section 106 (36 CFR Part 800) and/or CEQA Guidelines Section 15064.5.
- Conduct consultation with local Native Americans.
- Avoid potentially significant sites through project redesign.
- If potential historical properties are identified that cannot be avoided, perform site evaluations.
  - Develop mitigations for eliminating, reducing, rectifying, or compensating for the impacts anticipated.

- Perform data recovery or HABS/HARE[1] documentation if impacts to significant historical properties cannot be avoided or mitigated.
- Consult with the State Historic Preservation Officer, Indian Tribes, Consulting Parties, and Advisory Council on Historic Preservation, as appropriate through the federal lead agency.

9.2.4 Impact and Mitigation Summary

9.2.4.1 No Action

No impacts to historical cultural resources, compared to existing conditions.

9.2.4.2 Proposed Action

No impacts to historical cultural resources, compared to existing conditions and No Action.

9.2.4.3 Alternative Action

No impacts to historical cultural resources, compared to existing conditions and No Action.

[1] Historic American Building Survey/ Historic American Engineering Record

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SECTION 10
Energy Resources

Section 10 describes existing energy resource consumption associated with current conditions within the Grassland Drainage Area (GDA) and describes the impact of each alternative on energy consumption in the Project Area and vicinity.

10.1 AFFECTED ENVIRONMENT

Energy resources within the Project Area are provided by Pacific Gas and Electric (PG&E) through a mix of hydroelectric, nuclear, and coal-fired power generation. Hydroelectric power generation plants provide approximately 24 percent of California's electrical generation capacity, and are generally the first source of power utilized within the overall grid. The Central Valley Project (CVP) hydropower system provides a significant portion of the available energy to San Joaquin Valley. The CVP system consists of 11 power plants with 38 generators (Reclamation and Service 1999).

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 Western Area Power Administration (Western) operates, maintains, and upgrades the transmission grid that was constructed by the CVP. Western also markets surplus power to preference power customers and other utilities. These preference power customers include municipalities, Federal and state-owned installations, public utility districts, and local water and irrigation districts. The generation of CVP hydroelectric power plants is delivered to PG&E along with Western power purchases. PG&E utilizes its transmission facilities to deliver the power to CVP plants and preference customers, including several within the GDA.

Within the Project Area and vicinity, the major storage reservoir that supplies water for hydroelectric power generation is the San Luis Reservoir. The San Luis Unit began operating in 1967 and includes both the San Luis and O'Neill reversible pump/generation facilities. O'Neill can either lift water from the Delta-Mendota Canal to O'Neill Forebay or release water from the forebay to the canal. Water from the forebay can either be pumped into San Luis Reservoir or released to the San Luis Canal. Water from San Luis Reservoir is released to meet water user needs through the San Luis Generating Plant to O'Neill Forebay, where it is either released to the Delta-Mendota Canal through O'Neill Power Plant or to the San Luis Canal (Reclamation 1997a).

The installed generation capabilities of San Luis and O'Neill generating facilities are 424,000 and 25,200 kilowatts (kW), respectively. However, due to operating limitations, the generating capability of the San Luis Generating Plant is limited to 414,000 kW. The San Luis Generating Plant is shared with the California State Water Project. The CVP share of San Luis generation is 197,000 kW (based on the generating capability). Due to limitations on turbine operation, the total generation capacity at O'Neill Power Plant is 14,400 kW (Reclamation 1997a).

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 on the economics of the energy market). Downstream water needs are in turn dependent on irrigation needs, water rights agreements, and other water supply contracts. Power from other sources of generation, which are typically more expensive (at least incrementally so), is purchased to supplement the hydroelectric portion of the grid at any given time. During peak demand periods, hydropower constitutes a smaller percentage of the overall power supply in the grid than during periods of low energy demand.

Electric power is currently consumed within the GDA for the operation of sumps and the recirculation of irrigation water, as shown in Table 10-1. Total annual energy consumption in the GDA averages 1,680,250 kilowatt hours (kWh) which is equivalent to approximately 257 brake horsepower (BHP) continuously.

Table 10-1 Existing Annual Energy Consumption of Grassland Drainage Area

District and Purpose	Discharge Volume (acre-feet/year)	Lift Head (feet)	Pumping Efficiency (percent)	Average Power (BHP)	Power Consumption (kWh/year)
Broadview Sumps	0	0	65%	0.0	0
Broadview Recirculation	0	0	65%	0.0	0
Camp 13 Sumps	1,420	10	65%	3.4	22,360
Charleston Sumps	1,930	10	65%	4.7	30,400
Charleston Recirculation	450	114	65%	12.4	80,790
Firebaugh Canal Sumps	1,800	10	65%	4.3	28,350
Firebaugh Canal Recirculation	2,060	10	65%	5.0	32,440
Pacheco Sumps	3,820	10	65%	9.2	60,160
Pacheco Recirculation	640	10	65%	1.5	10,080
Panoche Sumps	9,900	10	65%	23.9	155,920
Panoche Recirculation	1,980	256	70%	113.5	741,280
SJRIP 1 (4,000 acres)	16,460	20	65%	79	518,470
Totals	40,460			257	1,680,250

Source: Summers Engineering 2008b

10.2 ENVIRONMENTAL CONSEQUENCES

This section describes how the Proposed Action and alternatives would change existing electric power consumption patterns within the Project Area and the GDA.

10.2.1 Key Impact and Evaluation Criteria

The key issues are the energy requirements of the Proposed Action and Alternatives and how these requirements might affect local and regional energy supplies, particularly during peak energy demand periods. An additional consideration is the presence or absence of energy conserving features in the design and operation of the Proposed and Alternative Actions.

10.2.2 Environmental Impacts and Mitigation

This analysis is based on reasonably expected outcomes resulting from implementation of each of the alternatives. The Proposed Action and Alternative Action would each increase energy consumption within the Project Area due to construction and operation of the San Joaquin River Water Quality Improvement Project (SJRIP). The power requirements associated with this facility would incrementally add to electricity consumption within the Project Area.

10.2.2.1 No Use Agreement (No Action)

Under the No Action Alternative, irrigators within the GDA would not use the San Luis Drain (Drain) to convey agricultural drainwater to Mud Slough. To meet selenium load limits for the San Joaquin River, irrigators would be required to recycle all drainwater. This requirement would be expected to result in marginally increased power consumption patterns within the GDA as additional energy is used for the operation of sumps and the recirculation of drainwater. This incremental change would not be expected to exert a significant strain on electrical power supplies in the region.

10.2.2.2 Grassland Bypass Project, 2010–2019 (Proposed Action)

Under the Proposed Action, irrigators within the GDA would continue to use the Drain to convey agricultural drainwater to Mud Slough. However, beginning in 2006, the SJRIP would be available for use by irrigators to remove salts and selenium, among other constituents, from drainwater.

Electric power consumption under this alternative would be expected to increase over existing conditions, with the addition of two elements shown in Table 10-2 beginning in 2006. Therefore, implementation of the Proposed Action would increase average annual power consumption within the GDA by approximately 21,735,630 kWh, resulting in a total power consumption for the GDA of approximately 23,415,880 kWh per year. Some additional power requirements during the construction period for the treatment facility are also anticipated, though these would be expected to be very small when compared to the power needs associated with facility operation.

Table 10-2 Future Additional Energy Consumption for Grassland Bypass and Mud Slough Bypass Alternative

Reuse and Treatment	Discharge Volume (acre-feet/year)	Lift Head (feet)	Pumping Efficiency (percent)	Average Power (BHP)	Power Consumption (kWh/year)
SJRIP 2 (2,000 acres)	8,500	27	70%	51	335,630
Treatment Plant (assumed)	5,000	n/a	n/a	3,276	21,400,000
Totals	13,500			3,327	21,735,630

Source: Summers Engineering 2008b

The additional power expected to be consumed under the Proposed Action would incrementally add to requirements for electricity usage within the Project Area. This incremental change would not be expected to exert a significant strain on electrical power supplies in the region. However, it is anticipated that the SJRIP would be operated at its peak capacity during the summer months when crop irrigation needs are at their greatest. This coincides with the period of peak power demand throughout the region. To ensure that power consumption associated with the Proposed Action is minimized, energy conservation should be considered in both the design and eventual operation of the treatment facility to the maximum extent feasible.

10.2.2.3 2001 Requirements Alternative (Alternative Action)

Under the 2001 Requirements Alternative Action, irrigators within the GDA would continue to use the San Luis Drain to convey agricultural drainwater under the requirements of the 2001 Use Agreement. As with the Proposed Action, beginning in 2006, the SJRIP would be available for use by irrigators to remove salts and selenium, among other constituents from drainwater.

Electric power consumption under this alternative would be expected to increase over as under existing conditions, with the addition of three elements shown in Table 10-2 beginning in 2006. The Alternative Action would not change expected future power consumption levels within the Project Area other than temporarily during the construction period. Therefore, implementation of the Alternative Action would be expected to result in the same average annual power consumption as the Proposed Action.

The additional power expected to be consumed under the Alternative Action would incrementally add to requirements for electricity usage within the Project Area. This incremental change would not be expected to exert a significant strain on electrical power supplies in the region. As under the Proposed Action, in order to ensure that power consumption associated with the Alternative Action is minimized, energy conservation should be considered in both the design and eventual operation of the SJRIP to the maximum extent feasible.

10.2.3 Cumulative Effects

Cumulative impacts are those that result from the incremental impacts of an action added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. The increase in demand for power associated with the Proposed Action and Alternative Action would occur in a larger region that is experiencing municipal and industrial growth. Operation of the SJRIP, when combined with other anticipated growth in energy demand within San Joaquin Valley, would not result in a significant cumulative adverse effect. This growth in energy demand is “planned for” by energy providers in the region. New energy facilities would be provided to accommodate growth, not to limit it.

10.2.4 Impact and Mitigation Summary

Impacts associated with the No Action, Proposed Action, and Alternative Action are expected to be incremental in nature, as described below.

10.2.4.1 No Action Alternative

- Increased recycling will not affect sump operation. The sumps will produce about the same volumes regardless of where the water is sent. Increased power consumption will result from increased use of the recirculation systems.

- Additional power consumption would incrementally add to requirements for electricity usage within the Project Area, but would not be expected to exert a significant strain on electrical power supplies in the region.

10.2.4.2 Proposed Action

- Beginning in 2006, average annual power consumption within the GDA would be increased by approximately 21,735,630 kWh, resulting in a total power consumption for the GDA of approximately 23,415,880 kWh per year.
- Some additional power would be consumed during the construction period for the treatment facility, although this amount would be small when compared to the power needs associated with facility operation.
- Additional power consumption would incrementally add to requirements for electricity usage within the Project Area, but would not be expected to exert a significant strain on electrical power supplies in the region.
- Since it is likely that the SJRIP would be operated at its peak capacity during the summer months when power demand is at its greatest, energy conservation should be considered in both the design and eventual operation of the treatment facility to the maximum extent feasible.
- No significant adverse impacts are anticipated, and no mitigation is required.

10.2.4.3 Alternative Action

Impacts under this alternative are identical to the Proposed Action (listed above).

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SECTION 11

Indian Trust Assets

The purpose of this section is to describe Indian Trust Assets (ITAs) that may exist in the region potentially affected by the proposed continuation of the Grassland Bypass Project, 2010–2019. The possible environmental consequences of each alternative on ITAs are discussed, and strategies for mitigation are listed.

ITAs are legal interests in property held in trust by the U.S. for federally recognized Indian tribes or individual Indians. An Indian trust has three components: (1) the trustee, (2) the beneficiary, and (3) the trust asset. ITAs can include land, minerals, federally reserved hunting and fishing rights, federally reserved water rights, and in-stream flows associated with trust land. Beneficiaries of the Indian trust relationship are federally recognized Indian tribes with trust land; the U.S. is the trustee. By definition, ITAs cannot be sold, leased, or otherwise encumbered without approval of the U.S. The characterization and application of the U.S. trust relationship have been defined by case law that interprets Congressional acts, executive orders, and historic treaty provisions (Rivera, pers. comm., 2008a).

Consistent with President William J. Clinton's 1994 memorandum, "Government-to-Government Relations with Native American Tribal Governments," the Bureau of Reclamation (Reclamation) assesses the effect of its programs on tribal trust resources and federally recognized tribal governments. Reclamation is tasked to actively engage federally recognized tribal governments and consult with such tribes on a government-to-government level (59 Federal Register 1994) when its actions affect ITAs. The U.S. Department of the Interior Departmental Manual Part 512.2 ascribes the responsibility for ensuring protection of ITAs to the heads of bureaus and offices. Part 512, Chapter 2 of the Departmental Manual states that it is the policy of the Department of the Interior to recognize and fulfill its legal obligations to identify, protect, and conserve the trust resources of federally recognized Indian tribes and tribal members. All bureaus are responsible for, among other things, identifying any impact of their plans, projects, programs, or activities on ITAs; ensuring that potential impacts are explicitly addressed in planning, decision, and operational documents; and consulting with recognized tribes who may be affected by proposed activities. Consistent with this policy, Reclamation's Indian trust policy states that Reclamation will carry out its activities in a manner that protects ITAs and avoids adverse impacts when possible, or provides appropriate mitigation or compensation when it is not. To carry out this policy, Reclamation incorporated procedures into its National Environmental Policy Act compliance procedures to require evaluation of the potential effects of its proposed actions on trust assets (Reclamation 2000b). Reclamation is responsible for assessing whether the Sacramento River Water Reliability Study – SRWRS Elverta Diversion Alternative has the potential to affect ITAs. Reclamation will comply with procedures contained in Departmental Manual Part 512.2, guidelines, which protect ITAs. (Rivera, pers. comm., 2008a)

Public Domain Allotments are small parcels of land usually held by individual Indians.

Continued drainwater reuse and completion of the San Joaquin River Water Quality Improvement Project treatment facility is unlikely to harm ITAs. Future projects, such as the specific treatment facility designed under Phase 3, may have adverse impacts to ITAs that will require separate environmental review.

11.1 AFFECTED ENVIRONMENT

The Project Area potentially affected by the continuation of the Grassland Bypass Project, 2010–2019 includes portions of Fresno, Merced, and Stanislaus counties.

Although no concise legal definition of ITAs exists, the courts have traditionally interpreted them as being tied to real property. ITAs are property interests held in trust by the U.S. for the benefit of Indian tribes or individuals. Indian reservations, rancherias, and Public Domain Allotments are common ITAs. The natural resources within the boundaries, such as trees, water, minerals, oil, and gas, are also considered ITAs.

An examination of records held by the Bureau of Indian Affairs and Reclamation was conducted by the Regional ITA Coordinator. No reservations or rancherias are located within the Project Area. No known ITAs are found within the Project Area. The nearest ITA is a Public Domain Allotment, which is approximately 58 miles northeast of the Project location (Rivera, pers. comm., 2008b).

11.2 ENVIRONMENTAL CONSEQUENCES

11.2.1 Key Impact and Evaluation Criteria

The types of actions that may affect ITAs include interference with the exercise of a reserved water right, degradation of water quality where a water right exists, impacts to fish and wildlife where a hunting or fishing right exists, or noise near a land asset where it adversely impacts uses of the reserved land (Rivera, pers. comm.., 2008b).

11.2.2 Environmental Impacts and Mitigation

No reservations or rancherias are located in the area potentially affected by the continuation of the Grassland Bypass Project. No Public Domain Allotments are located within the affected area. Therefore, no impacts would occur to ITAs caused by the No Action Alternative, the Proposed Action (Grassland Bypass Project, 2010–2019), or the Alternative Action (2001 Requirements Alternative).

11.2.3 Cumulative Effects

None of the alternatives, in combination with other known projects or policies, would harm ITAs in the Project Area.

- **Growth-Inducing Impacts.** None of the alternatives would foster urban growth or further agricultural development of natural habitats within the Project Area. The Proposed Action would enhance area wetlands.

- **Short- and Long-Term Relationships.** None of the alternatives would directly affect ITAs.
- **Irreversible and Irretrievable Commitments.** No ITAs are located in the Project Area, and no long-term commitments will be necessary to implement any of the alternatives.

11.2.4 Mitigation Strategies

No ITAs are located in the Project Area, and no mitigation will be necessary to implement any of the alternatives.

11.2.5 Impact and Mitigation Summary

No ITAs are located in the Project Area or vicinity. No impacts would occur to ITAs, and no mitigation will be necessary to implement any of the alternatives.

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SECTION 12
Greenhouse Gases

The continuation of the Grassland Bypass Project, 2010–2019, would indirectly cause greenhouse gas (GHG) emissions from generation of electric power used to run pumps and operate the treatment plant. In the following sections, Proposed Action GHG emissions are identified and evaluated including the potential cumulative effect to climate change.

12.1 AFFECTED ENVIRONMENT

The affected environment is comprised of the regulatory requirements in California and the larger physical environment, which goes beyond the immediate Project Area. GHGs and climate change occur at a global level.

12.1.1 Regulatory Background

AB 32

The Global Warming Solutions Act of 2006 (AB 32) codifies California's goal of reducing statewide emissions of GHG to 1990 levels by 2020. This reduction will be accomplished through an enforceable statewide cap on global warming emissions that will be phased in starting in 2012 in order to achieve maximum technologically feasible and cost-effective GHG emission reductions. In order to effectively implement the cap, AB 32 directs the Air Resources Board (ARB) to develop appropriate regulations and establish a mandatory reporting system to track and monitor global warming emissions levels.

Pursuant to AB 32, the California Environmental Quality Act of 1970 (CEQA) now requires quantitative assessment of GHG emissions directly or indirectly caused by projects. As part of this new requirement, the state Attorney General's office reviews Environmental Impact Reports (EIRs) and determines whether an EIR is adequate, in part, based on the assessment of GHG emissions and proposed mitigation measures. Present Attorney General policy maintains that from a cumulative perspective, every net increase could be considered significant. To reduce the potential of having this CEQA document challenged, the following sections contain a determination of GHG that the Proposed Action will cause to be emitted, an evaluation of significance from a cumulative perspective, and provisions for mitigation measures.

At present, no enforceable rules or regulations have been promulgated by the ARB or other state agency, which defines a significant source of GHG emissions. In addition, there are no applicable facility-specific emission limitations or caps for GHG emissions, either statewide or at the local Air Pollution Control District or Air Quality Management District level. Thus, there is no present state or local regulatory or guidance mechanism for determining whether a project advances or hinders California's GHG reduction goals, and no standards of significance for GHG impacts have been established under CEQA. (CAPCOA 2008)

In anticipation of the need for regulatory agencies to promulgate GHG significance thresholds, the California Air Pollution Control Officers Association (CAPCOA) has analyzed the basis and implications of not setting a GHG emissions threshold, setting a zero threshold, and two primary approaches for agencies considering a nonzero threshold. The first approach is grounded in statute (AB 32) and Executive Order (EO) S-3-05 and explores four possible nonzero options. The options under this approach are variations of ways to achieve the 2020 goals of AB 32 from new development, which is estimated to yield about a 30 percent reduction from current business practices. The second approach explores a tiered threshold option with seven variations. The tiered concept offers both quantitative and qualitative approaches to setting thresholds as well as different metrics by which tier cut points can be set. (CAPCOA 2008)

SB 1368

California Senate Bill 1368 (SB 1368) adds Sections 8340 and 8341 to the Public Utilities Code (effective January 1, 2007) with the intent "to prevent long-term investments in power plants with GHG emissions in excess of those produced by a combined-cycle natural gas power plant" with the aim of "reducing emissions of GHGs from the state's electricity consumption, not just the state's electricity production." SB 1368 provides a mechanism for reducing the GHG emissions of electricity providers, both in-state and out-of-state, thereby assisting the ARB in meeting its mandate under AB 32.

SB 1368 prohibits California utilities (i.e., load serving entities [LSEs]) from entering into long-term (5 years or longer) power contracts with generators unless base load generation (i.e., 60 percent annual capacity factor or greater) complies with stringent GHG emission standards. In 2007, the California Public Utilities Commission (PUC) established an output-based Emission Performance Standard (EPS) for investor-owned utilities' base load generation. The EPS requires that base load generation GHG emission rates in units of pounds per net megawatt-hour (lb/net MW-hr CO_2 equivalent) cannot exceed that of a new base load combined-cycle natural gas-fired plant. The 2007 interim EPS is 1,100 lb/net MW-hr of CO_2 (PUC Decision No. 07-01-039).

SB 97

Senate Bill 97 (SB 97) directs the Office of Planning and Research (OPR) to prepare, develop, and transmit to the Resources Agency guidelines for the feasible mitigation of GHG emissions or their effects by July 1, 2009. The Resources Agency is required to certify or adopt those guidelines by January 1, 2010. SB 97 also protects, for a short time, certain projects funded by the Highway Safety, Traffic Reduction, Air Quality and Port Security Bond Act of 2006, or the Disaster Preparedness and Flood Protection Bond Act of 2006 (Proposition 1B or 1E) from claims of inadequate analysis of GHG as a legitimate cause of action. This latter provision will be repealed on January 1, 2010.

12.1.2 Overview of Climate Change

Climate change refers to long-term fluctuations in temperature, precipitation, wind, and other elements of the Earth's climate system. Natural processes such as solar-irradiance variations, variations in the Earth's orbital parameters, and volcanic activity can produce variations in climate. The climate system can also be influenced by changes in the concentration of various gases in the atmosphere, which affect the Earth's absorption of radiation.

The Earth naturally absorbs and reflects incoming solar radiation and emits longer wavelength terrestrial (thermal) radiation back into space. On average, the absorbed solar radiation is balanced by the outgoing terrestrial radiation emitted to space. A portion of this terrestrial radiation, though, is itself absorbed by gases in the atmosphere. The energy from this absorbed terrestrial radiation warms the Earth's surface and atmosphere, creating what is known as the "natural greenhouse effect." According to the Intergovernmental Panel on Climate Change (IPCC), without the natural heat-trapping properties of these atmospheric gases, the average surface temperature of the Earth would be about 33°C (59°F), which would cause a permanent ice age in the higher latitudes. (USEPA 2008a)

Under the United Nations Framework Convention on Climate Change (UNFCCC), the definition of climate change is "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." Given that definition, in the IPICC's *Second Assessment Report* (SAR) (1996) of the science of climate change, the IPCC, concluded that "human activities are changing the atmospheric concentrations and distributions of GHGs and aerosols. These changes can produce a radiative forcing by changing either the reflection or absorption of solar radiation, or the emission and absorption of terrestrial radiation." Building on this conclusion, the more recent IPCC, *Third Assessment Report* (TAR) (2001) asserts that "concentrations of atmospheric greenhouse gases and their radiative forcing have continued to increase as a result of human activities." (USEPA 2008a)

The IPCC reports that the global average surface temperature of the Earth has increased by between 0.6 ± 0.2°C (1.1 ± 0.4°F) over the 20th century. This value is about 0.15°C (0.27°F) larger than that estimated by the SAR, which reported for the period up to 1994, "owing to the relatively high temperatures of the additional years (1995 to 2000) and improved methods of processing the data." (USEPA 2008a)

While the SAR concluded, "the balance of evidence suggests that there is a discernible human influence on global climate," the TAR states the influence of human activities on climate in even starker terms. It concludes that, "In light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely to have been due to the increase in GHG concentrations." (USEPA 2008a)

12.1.3 Properties of the Earth's Atmosphere

The air we breathe is mixture of constituent gases and its composition varies slightly with location and altitude. For 20th century scientific and engineering purposes, it became necessary to define a standard composition known as the U. S. Standard Atmosphere. In addition to the common gases (nitrogen, oxygen, carbon dioxide, methane, hydrogen, nitrous oxide), the Standard Atmosphere contains noble or inert gases (helium, neon, argon, krypton, xenon). Radon (Rn) is also present in low concentrations near ground level in limited geographic areas where it is naturally emitted from certain types of rock and soil. Table 12-1 shows the typical composition of dry standard air (UIG 2008, USEPA 2008a). The apparent molecular weight of dry standard air is 27.966. (Jennings 1970, duPont 1971)

Table 12-1 Standard Composition of Dry Air

Principal Gas	Chemical Symbol	MW (g/mole)	Concentration (ppmv)	Mole (fraction)	Fraction (percent)	MW (g/mole)
Nitrogen	N_2	28.014	780,805.00	0.78080500	78.080500	21.873471
Oxygen	O_2	31.998	209,450.00	0.20945000	20.945000	6.701981
Argon	Ar	39.948	9,340.00	0.00934000	0.934000	0.373114
Carbon Dioxide	CO_2	44.009	377.76	0.00037776	0.037776	0.016625
Neon	Ne	20.183	18.21	0.00001821	0.001821	0.000368
Helium	He	4.003	5.24	0.00000524	0.000524	0.000021
Methane	CH_4	16.043	1.75	0.00000175	0.000175	0.000028
Krypton	Kr	83.800	1.14	0.00000114	0.000114	0.000096
Hydrogen	H_2	2.016	0.50	0.00000050	0.000050	0.000001
Nitrous Oxide	NO_2	44.013	0.31	0.00000031	0.000031	0.000014
Xenon	Xe	31.30	0.09	0.00000009	0.000009	0.000003
Totals			1,000,000.00	1.00000000	100.000000	28.965721

Sources:
Universal Industrial Gases, Inc., http://www.uigi.com/air.html, 2008
USEPA 2008a
Condensed Laboratory Handbook, E.I. du Pont de Nemours & Co., Inc., Wilmington, DE, 1971
Environmental Engineering – Analysis and Practice, B. H. Jennings, International Textbook Company, 1970
Carbon dioxide varies with uptake by removal mechanisms, 365 (IPCC) to 380 ppmv (UIG)

Notes:
MW = molecular weight, g/mole
ppmv = parts per million by volume (10-6)

12.1.4 Properties of Greenhouse Gases

As shown in Table 12-1, over 99 percent of the Earth's atmosphere consists of nitrogen and oxygen. However, neither plays a significant role in enhancing the greenhouse effect because both are essentially transparent to terrestrial radiation. The greenhouse effect is primarily a function of the concentration of water vapor, carbon dioxide, and other trace gases in the atmosphere that absorb the terrestrial radiation leaving the surface of the Earth (USEPA 2008a). Changes in the atmospheric concentrations of these GHG can alter the balance of energy transfers between the atmosphere, space, land, and the oceans. A gauge of these changes is called radiative forcing, which is a simple measure of changes in the energy available to the Earth-atmosphere system (USEPA 2008a). Holding everything else constant, increases in GHG concentrations in the atmosphere will produce positive radiative forcing (i.e., a net increase in the absorption of energy by the Earth). Climate change can be driven by changes in the atmospheric concentrations of a number of radiatively active gases and aerosols. There is clear scientific evidence that human activities have affected concentrations, distributions, and life cycles of these gases (USEPA 2008a).

Naturally occurring GHG include water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (NO_2), and ozone (O_3). Several classes of halogenated substances that contain fluorine, chlorine, or bromine are also GHG, but they are, for the most part, solely a product of industrial activities. Chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) are halocarbons that contain chlorine, while halocarbons that contain bromine are referred to as bromofluorocarbons (i.e., halons). Because CFCs, HCFCs, and halons are stratospheric ozone depleting substances, they are covered under the Montreal Protocol on Substances that Deplete the Ozone Layer. The UNFCCC defers to this earlier international treaty; consequently, these gases are not included in national GHG inventories. Some other fluorine containing halogenated substances—hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)—do not deplete stratospheric ozone but are potent GHGs. These latter substances are addressed by the UNFCCC and accounted for in national GHG inventories. (USEPA 2008a)

There are also several gases that, although they do not have a commonly agreed upon direct radiative forcing effect, do influence the global radiation budget. These tropospheric gases—referred to as ambient air pollutants—include carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and tropospheric (ground level) ozone (O_3). Tropospheric ozone is formed photochemically by two precursor pollutants, volatile organic compounds (VOCs) and nitrogen oxides (NO_X) in the presence of ultraviolet light (sunlight). Aerosols—extremely small particles or liquid droplets—often composed of sulfur compounds, carbonaceous combustion products, crustal materials and other human induced pollutants—can affect the absorptive characteristics of the atmosphere. However, the level of scientific understanding of aerosols and their effects is limited. (USEPA 2008a)

Carbon dioxide, CH_4, and NO_2 are continuously emitted to and removed from the atmosphere by natural processes on Earth. Anthropogenic activities, however, can cause additional quantities of these and other GHG to be emitted or sequestered, thereby changing their global average atmospheric concentrations. Natural activities such as respiration by plants or animals and seasonal cycles of plant growth and decay are examples of processes that only cycle carbon or nitrogen between the atmosphere and organic biomass. Such processes—except when directly or indirectly perturbed out of equilibrium by anthropogenic activities—generally do not alter average atmospheric GHG concentrations over decadal timeframes. Climatic changes resulting from anthropogenic activities, however, could have positive or negative feedback effects on these natural systems. Atmospheric concentrations of these gases, along with their rates of growth and atmospheric lifetimes, are presented in Table 12-2. (USEPA 2008a)

Table 12-2 Global Concentrations and Rates of Change

Atmospheric Variable	CO_2 (ppmv)	CH_4 (ppmv)	NO_2 (ppmv)	SF_6 (pptv)	CF_4 (pptv)
Pre-industrial atmospheric concentration (1750)	278	0.70	0.270	0	40
Atmospheric concentration in 1998	365	1.75	0.314	4.20	80
Percent increase from pre-industrial to 1998	31%	150%	16%	n/a	100%
Rate of concentration change (units/decade)	1.5	0.007	0.0008	0.24	1
Estimated atmospheric concentration in 2008	366.5	1.757	0.3108	4.44	81
Percent increase from 1998 to 2008	0.41%	0.40%	0.26%	5.71%	1.25%
Atmospheric Lifetime (years)	50-200	12	114	3200	>50,000

Sources: USEPA 2008a

Notes:
ppmv = parts per million by volume (10^{-6})
pptv = parts per trillion by volume (10^{-12})
Rate of change for decade 1990 to 1999
Carbon dioxide varies with uptake by removal mechanisms, 365 (IPCC) to 380 ppmv (UIG)

A brief description of each GHG, its sources, and its role in the atmosphere is given below. The following section then explains the concept of Global Warming Potential (GWP), which are assigned to individual gases as a measure of their relative average global radiative forcing effect.

WATER VAPOR (H_2O)

Overall, the most abundant and dominant GHG in the atmosphere is water vapor. Water vapor is neither long-lived nor well mixed in the atmosphere, varying spatially from 0 to 2 percent (USEPA 2008a). In addition, atmospheric water can exist in several physical states including gaseous, liquid, and solid. Human activities are not believed to directly affect the average global concentration of water vapor; however, the radiative forcing produced by the increased concentrations of other GHGs may indirectly affect the hydrologic cycle. A warmer atmosphere has an increased water holding capacity; yet, increased concentrations of water vapor affects the formation of clouds, which can both absorb and reflect solar and terrestrial radiation. Aircraft contrails, which consist of water vapor and other aircraft emittents, are similar to clouds in their radiative forcing effects (USEPA 2008a).

CARBON DIOXIDE (CO_2)

In nature, carbon is cycled between various atmospheric, oceanic, land biotic, marine biotic, and mineral reservoirs. The largest fluxes occur between the atmosphere and terrestrial biota, and between the atmosphere and surface water of the oceans. In the atmosphere, carbon predominantly exists in its oxidized form as CO_2. Atmospheric CO_2 is part of this global carbon cycle, and therefore its fate is a complex function of geochemical and biological processes. Carbon dioxide concentrations in the atmosphere increased from 278 parts per million by volume (ppmv) in pre-industrial times to 365 ppmv in 1998, a 31 percent increase (USEPA 2008a). The IPCC, notes that "this concentration has not been exceeded during the past 420,000 years, and likely not during the past 20 million years. The rate of increase over the past century is unprecedented, at least during the past 20,000 years." The IPCC definitively states that "the present atmospheric CO_2 increase is caused by anthropogenic emissions of CO_2" (USEPA 2008a). Forest clearing, other biomass burning, and some nonenergy production processes (e.g., cement production) also emit notable quantities of CO_2. In the SAR, the IPCC, also stated that "[t]he increased amount of CO_2 [in the atmosphere] is leading to climate change and will produce, on average, a global warming of the Earth's surface because of its enhanced greenhouse effect—although the magnitude and significance of the effects are not fully resolved" (USEPA 2008a).

METHANE (CH_4)

Methane is primarily produced through anaerobic decomposition of organic matter in biological systems. Agricultural processes such as wetland rice cultivation, enteric fermentation in animals, and the decomposition of animal wastes emit methane, as does the decomposition of municipal solid wastes. Methane is also emitted during the production and distribution of natural gas and petroleum, and is released as a by-product of coal mining and incomplete fossil fuel combustion. Atmospheric concentrations of CH_4 have increased by about 150 percent since pre-industrial times, although the rate of increase has been declining. The IPCC has estimated that slightly more than half of the current CH_4 flux to the atmosphere is anthropogenic, from human activities such as agriculture, fossil fuel use, and waste disposal (USEPA 2008a). Methane is removed from the atmosphere by reacting with the hydroxyl radical (OH) and is ultimately converted to CO_2. Minor removal processes also include reaction with chloride in the marine boundary layer, a soil sink, and stratospheric reactions. Increasing emissions of CH_4 reduces the concentration of hydroxyl, a feedback that may increase CH_4's atmospheric lifetime (USEPA 2008a).

NITROUS OXIDE (NO_2)

Anthropogenic sources of NO_2 emissions include agricultural soils, especially the use of synthetic and manure fertilizers; fossil fuel combustion, especially from mobile combustion; adipic (nylon) and nitric acid production; wastewater treatment and waste combustion; and biomass burning. The atmospheric concentration of NO_2 has increased by 16 percent since 1750, from a pre-industrial value of about 270 ppb to 314 ppb in 1998, a concentration that has not been exceeded during the last thousand years. Nitrous oxide is primarily removed from the atmosphere by the photolytic action of sunlight in the stratosphere. (USEPA 2008a)

OZONE (O_3)

Ozone is present in both the upper stratosphere, where it shields the Earth from harmful levels of ultraviolet radiation, and at lower concentrations in the troposphere, where it is the main component of anthropogenic photochemical "smog." During the last two decades, emissions of anthropogenic chlorine and bromine-containing halocarbons, such as CFCs, have depleted stratospheric O_3 concentrations. This loss of O_3 in the stratosphere has resulted in negative radiative forcing, representing an indirect effect of anthropogenic emissions of chlorine and bromine compounds (USEPA 2008a). The depletion of stratospheric O_3 and its radiative forcing was expected to reach a maximum in about the year 2000 before starting to recover, with detection of such recovery not expected to occur much before 2010 (USEPA 2008a). The past increase in tropospheric O_3, which is also a GHG, is estimated to provide the third largest increase in direct radiative forcing since the pre-industrial era, behind CO_2 and CH_4. Tropospheric O_3 is produced from complex chemical reactions of volatile organic compounds mixing with NO_X in the presence of sunlight. Ozone, CO, SO_2, NO_2, and particulate matter (PM) are included in the category referred to as "criteria pollutants" in the United States under the Clean Air Act and its subsequent amendments. The tropospheric concentrations of O_3 and these other pollutants are short-lived and, therefore, spatially variable (USEPA 2008a).

HALOCARBONS, PERFLUOROCARBONS, AND SULFUR HEXAFLUORIDE (SF_6)

Halocarbons are, for the most part, human-made chemicals that have both direct and indirect radiative forcing effects. Halocarbons that contain chlorine—CFCs, HCFCs, methyl chloroform, and carbon tetrachloride—and bromine—halons, methyl bromide, and hydrobromofluorocarbons (HBFCs)—result in stratospheric ozone depletion and are therefore controlled under the Montreal Protocol on Substances that Deplete the Ozone Layer. Although CFCs and HCFCs include potent global warming gases, their net radiative forcing effect on the atmosphere is reduced because they cause stratospheric ozone depletion, which is itself an important GHG in addition to shielding the Earth from harmful levels of ultraviolet radiation. Under the Montreal Protocol, the United States phased out the production and importation of halons by 1994 and of CFCs by 1996. Under the Copenhagen Amendments to the Protocol, a cap was placed on the production and importation of HCFCs by non-Article 5 countries beginning in 1996, and then followed by a complete phase-out by the year 2030. The O_3 depleting gases covered under the Montreal Protocol and its Amendments are not covered by the UNFCCC. HFCs, PFCs, and SF_6 are not O_3 depleting substances, and therefore are not covered under the Montreal Protocol. They are, however, powerful GHGs. HFCs—primarily used as replacements for ozone depleting substances but also emitted as a by-product of the HCFC-22 manufacturing process—currently have a small aggregate radiative forcing impact; however, it is anticipated that their contribution to overall radiative forcing will increase (USEPA 2008a). PFCs and SF_6 are predominantly emitted from various industrial processes including aluminum smelting, semiconductor manufacturing, electric power transmission and distribution, and magnesium casting. Currently, the radiative forcing impact of PFCs and SF_6 is also small; however, they have a significant growth rate, extremely long atmospheric lifetimes, and are strong absorbers of infrared radiation, and therefore have the potential to influence climate far into the future. (USEPA 2008a)

CARBON MONOXIDE (CO)

Carbon monoxide has an indirect radiative forcing effect by elevating concentrations of methane and tropospheric O_3 through chemical reactions with other atmospheric constituents (e.g., the hydroxyl radical, OH) that would otherwise assist in destroying methane and tropospheric O_3. Carbon monoxide is created when carbon containing fuels are burned incompletely. Through natural processes in the atmosphere, it is eventually oxidized to CO_2. Carbon monoxide concentrations are both short-lived in the atmosphere and spatially variable. (USEPA 2008a)

NITROGEN OXIDES (NO_X)

The primary climate change effects of NO_X (i.e., NO and NO_2) are indirect and result from their role in promoting the formation of O_3 in the troposphere and, to a lesser degree, lower stratosphere, where it has positive radiative forcing effects. Additionally, NO_X emissions from aircraft are also likely to decrease methane concentrations, thus having a negative radiative forcing effect (USEPA 2008a). Nitrogen oxides are created from lightning, soil microbial activity, biomass burning – both natural and anthropogenic fires – fuel combustion, and, in the stratosphere, from the photo-degradation of NO_2. Concentrations of NO_X are both relatively short-lived in the atmosphere and spatially variable (USEPA 2008a).

NONMETHANE VOLATILE ORGANIC COMPOUNDS (NMVOC)

Nonmethane VOCs (NMVOCs) include compounds such as ethane (C_2H_4), propane (C_3H_8), butane (C_4H_{10}), and pentane (C_5H_{12}). These compounds participate, along with NO_X, in the formation of tropospheric O_3 and other photochemical oxidants. NMVOCs are emitted primarily from transportation and industrial processes, as well as biomass burning and nonindustrial consumption of organic solvents. Concentrations of NMVOCs tend to be both short-lived in the atmosphere and spatially variable (USEPA 2008a).

AEROSOLS

Aerosols are extremely small particles or liquid droplets found in the atmosphere. They can be produced by natural events such as dust storms and volcanic activity, or by anthropogenic processes such as fuel combustion and biomass burning. They affect radiative forcing in both direct and indirect ways: directly by scattering and absorbing solar and thermal infrared radiation; and indirectly by increasing droplet counts that modify the formation, precipitation efficiency, and radiative properties of clouds. Aerosols are removed from the atmosphere relatively rapidly by precipitation. Because aerosols generally have short atmospheric lifetimes, and have concentrations and compositions that vary regionally, spatially, and temporally, their contributions to radiative forcing are difficult to quantify. (USEPA 2008a)

The indirect radiative forcing from aerosols is typically divided into two effects. The first effect involves decreased droplet size and increased droplet concentration resulting from an increase in airborne aerosols. The second effect involves an increase in the water content and lifetime of clouds due to the effect of reduced droplet size on precipitation efficiency (USEPA 2008a).

Recent research has placed a greater focus on the second indirect radiative forcing effect of aerosols.

Various categories of aerosols exist, including naturally produced aerosols such as soil dust, sea salt, biogenic aerosols, sulfates, and volcanic aerosols, and anthropogenically manufactured aerosols such as industrial dust and carbonaceous aerosols (e.g., black carbon, organic carbon) from transportation, coal combustion, cement manufacturing, waste incineration, and biomass burning. The net effect of aerosols is believed to produce a negative radiative forcing effect (i.e., net cooling effect on the climate), although because they are short-lived in the atmosphere—lasting days to weeks—their concentrations respond rapidly to changes in emissions. Locally, the negative radiative forcing effects of aerosols can offset the positive forcing of GHGs. “However, the aerosol effects do not cancel the global-scale effects of the much longer-lived GHGs, and significant climate changes can still result” (USEPA 2008a).

The IPCC’s TAR notes that “the indirect radiative effect of aerosols is now understood to also encompass effects on ice and mixed-phase clouds, but the magnitude of any such indirect effect is not known, although it is likely to be positive” (USEPA 2008a). Additionally, current research suggests that another constituent of aerosols, elemental carbon, may have a positive radiative forcing. The primary anthropogenic emission sources of elemental carbon include diesel exhaust, coal combustion, and biomass burning.

12.1.5 Global Warming Potential

GWP is intended as a quantified measure of the globally averaged relative radiative forcing impacts of a particular GHG. It is defined as the cumulative radiative forcing both direct and indirect effects integrated over a period of time from the emission of a unit mass of gas relative to some reference gas (USEPA 2008a). CO_2 is the reference gas. Direct effects occur when the gas itself is a GHG. Indirect radiative forcing occurs when chemical transformations involving the original gas produce a gas or gases that are GHG, or when a gas influences other radiatively important processes such as the atmospheric lifetimes of other gases. The GWP coefficient is a dimensionless scaler (i.e., correction factor) which is used to express emissions of various GHGs as CO_2 equivalents. By multiplying emission of a GHG times its respective GWP, equivalent emissions of CO_2 are obtained.

The GWP values shown in Tables 12-3 and 12-4 allow policy makers to compare the impacts of emissions and reductions of different gases. According to the IPCC, GWPs typically have an uncertainty of roughly ±35 percent, though some GWPs have larger uncertainty than others, especially those in which lifetimes have not yet been ascertained. In the following decision, the parties to the UNFCCC have agreed to use consistent GWPs from the IPCC SAR, based upon a 100-year time horizon, although other time horizon values are available.

Table 12-3 100-Year Global Warming Potentials of Greenhouse Gases

Greenhouse Gas	Lifetime Years	GWP 100-Year
Carbon Dioxide (CO_2)	50-200	1
Methane (CH_4)	9-15	21
Nitrous Oxide (NO_2)	120	310
HFC-23	264	11,700
HFC-125	33	2,800
HFC-134a	15	1,300
HFC-143a	48	3,800
HFC-152a	2	140
HFC-227ea	37	2,900
HFC-236fa	209	6,300
HFC-4310mee	17	1,300
Fluoromethane (CF_4)	50,000	6,500
Fluoroethane (C_2F_6)	10,000	9,200
Fluorobutane (C_4F_{10})	2,600	7,000
Fluorohexane (C_6F_{14})	3,200	7,400
Sulfur Hexafluoride (SF_6)	3,200	23,900

Sources: USEPA 2008a

Table 12-4 100-Year Global Warming Potentials of Ozone Depleters

Ozone Depleter	Direct 100-year	Net Effect	
		min	max
CFC-11	4,600	(600)	3,600
CFC-12	10,600	7,300	9,900
CFC-113	6,000	2,200	5,200
HCFC-22	1,700	1,400	1,700
HCFC-123	120	20	100
HCFC-124	620	480	590
HCFC-141b	700	(5)	570
HCFC-142b	2,400	1,900	2,300
Trichloromethane ($CHCl_3$)	140	(560)	0
Carbon Tetrachloride (CCl_4)	1,800	(3,900)	660
Methyl Bromide (CH_3Br)	5	(2,600)	(500)
Halon-1211	1,300	(24,000)	(3,600)
Halon-1301	6,900	(76,000)	(9,300)

Sources: USEPA 2008a

GHGs with relatively long atmospheric lifetimes (e.g., CO_2, CH_4, NO_2, HFCs, PFCs, and SF_6) tend to be evenly distributed throughout the atmosphere, and consequently global average concentrations can be determined. The short-lived gases such as water vapor, CO, tropospheric O_3, other ambient air pollutants (e.g., NO_X, and NMVOCs), and tropospheric aerosols (e.g., SO_2 products and black carbon), however, vary spatially, and consequently it is difficult to quantify their global radiative forcing impacts. GWP values are generally not attributed to these gases that are short-lived and spatially inhomogeneous in the atmosphere. (USEPA 2008a)

12.2 ENVIRONMENTAL CONSEQUENCES

This section describes how the existing infrastructure and Proposed Action and Action Alternative result in emissions of GHGs (statewide) from existing and potential electric power consumption within the Grassland Drainage Area (GDA) and the Project Area.

12.2.1 Carbon Dioxide Emissions from Electric Power Generation

GHG emissions from fossil-fueled generation of electricity consist mainly of water vapor, CO_2, CH_4, and NO_2, along with relatively small amounts (compared to CO_2) of CO, NO_X, and NMVOC. In California, due to stringent air pollution control rules and regulations, natural gas is the only fossil fuel used to fire steam turbine, gas turbine, or combined cycle power plants. Imported power can include coal-fired generation from out-of-state, which emits significantly more CO_2 than natural gas. However, as summarized below, California Senate Bill 1368 places significant constraints on the importation of coal-fired electric power into the state.

The GHG of most concern is CO_2 since it is generated in extremely large quantities by the burning of fossil fuels, can last in the atmosphere for two centuries, and forces climate change more than any other GHG. In 2006, CO_2 accounted for 85 percent of the GHG emissions produced in the United States, and electrical generation accounted for 39 percent of all CO_2 emissions. Thus, 33 percent of all GHG emissions in the United States is CO_2 emitted from power generation. In 2006, 2,328.2 million metric tonnes (teragrams [Tg]) of CO_2 were emitted in the United States from electrical generation (USEPA 2008a). In California, CO_2 is the major component of power plant GHG emissions, about 99.995 percent. Methane and nitrous oxide are very minor components, about 0.004 and 0.001 percent, respectively (CR 2008).

The ARB has estimated that in 2004, the state emitted 528.6 million metric tonnes of CO_2 equivalent GHG emissions (ARB 2008). Of this, 123.2 million metric tonnes (23.3 percent) were emitted from electric power generation (including combined heat and power facilities). This was about 5.3 percent of the 2004 national total (2314.9 Tg).

Table 12-5 compares typical generation CO_2 emission rates between fossil fuel generating technologies. The 2007 interim EPS is 1,100 lb/net MW-hr of CO_2 (PUC Decision No. 07-01-039).

Table 12-5 Carbon Dioxide Emission Rates for Fossil Fuel Generation

Operating Parameter	Units	Combined Cycle Gas/Steam Turbine	Simple Cycle Gas Turbine	Gas Fired Steam Turbine	Coal Fired Steam Turbine
Typical Heat Rate	BTU/kw-hr	7,300	9,800	11,200	9,800
Thermal Efficiency	percent	47%	35%	30%	35%
Fuel	type	gas	gas	gas (sm/md)	coal (lg)
Load Characteristic	type	Base	Peaking	Cyclic/Base	Base
CO_2 Emission Factor	lb/mmBTU	115	115	115	230
CO_2 Emission Rate	lb/MW-hr	840	1,130	1,290	2,250

Sources:
Compilation of Air Pollution Emission Factors (AP-42)
Air Pollution Engineering Manual (AP-40)

Nonfossil generating resources include eligible renewables (i.e., biomass, geothermal, small hydroelectric, solar, wind), large hydroelectric, and nuclear. Except for biomass (e.g., combusting agricultural waste), these generation resources do not emit GHGs since they do not involve combustion.

Use of electric power contributes to climate change indirectly through the combustion of fossil fuels in power plants, along with generating resources, which do not emit GHGs. The power mix approach is used to determine the weighted average GHG emission rate for all generating resources combined. This requires obtaining average power mix data from an electric utility which defines what percentages of its power come from eligible renewables (i.e., wind, solar, geothermal, biomass, hydroelectric), coal, oil, natural gas, and nuclear generating resources. For each of these generating resources, GHG emission rates can be calculated from U.S. Environmental Protection Agency (USEPA) or other certified (quality assured) emission factors in units of pounds per megawatt-hour (lb/mw-hr) based on the fuel type and typical heat rate (thermal efficiency). Table 12-6 shows typical power mixes for large California utilities in 2006, the most recent year for which complete data are readily available.

Table 12-6 California Large Utility Power Mixes for 2006

Generating Resources	SCE	PG&E
Eligible Renewables (total)	16%	12%
Biomass & Waste	2%	4%
Geothermal	9%	2%
Small Hydroelectric	1%	4%
Solar	1%	1%
Wind	3%	1%
Coal	11%	1%
Large Hydroelectric	8%	22%
Natural Gas	48%	40%
Nuclear	17%	24%
Other	0%	1%
Total	100%	100%

Sources:
Southern California Edison (SCE) 2006
Pacific Gas & Electric (PG&E) 2006

The combustion of fossil fuels, principally natural gas, in power plants emits GHGs consisting mainly of CO_2, along with small amounts of CH_4 and NO_2. For electric power consumed in California, indirect GHG emissions are based on the Climate Registry General Reporting Protocol, Version 1.0, Chapter 14, March 2008 for Grid 2006 Subregion CAMX (Climate Register 2008). The following emission factors apply:

- Carbon Dioxide, CO_2 = 878.71 lb/mw-hr (GWP = 1)
- Methane, CH_4 = 0.036 lb/mw-hr (GWP = 21)
- Nitrous Oxide, NO_2 = 0.008 lb/mw-hr (GWP = 310)

These factors take into account power mix but do not include emissions from transmission and distribution losses. As recommended in the protocol, CO_2 equivalents are also calculated (Climate Register 2008).

12.2.2 Other Greenhouse Gases from Electric Utility Operations

Sulfur hexafluoride (SF_6) is used by the electric utility industry as a gaseous dielectric medium for high-voltage circuit breakers and switchgear. Gaseous SF_6 equipment is used to replace oil-filled equipment that can contain carcinogenic polychlorinated biphenyl (PCBs). Gaseous SF_6 under pressure is used as an insulator in high-voltage equipment because it has a much higher dielectric strength than air or nitrogen. Although most SF_6 decomposition products caused by arcing tend to quickly reform to SF_6, excessive arcing or corona can produce disulfur decafluoride (S_2F_{10}), a highly toxic gas, with toxicity similar to phosgene. Leakage or release of SF_6 from pressurized electrical equipment is a source of GHG emissions associated with the electric utility industry. In 2006, losses of SF_6 from the electrical transmission and distribution was 13.2 million metric tonnes. (USEPA 2008a)

Generally, various HFCs and PFCs are used by the electric utility industry as refrigerants in air conditioning systems to cool critical equipment (i.e., controls) and to maintain building comfort. Except for unintentional leaks and losses, refrigerants are required to be captured and reclaimed during equipment servicing or replacement in the same manner as commercial air conditioning enterprises. Therefore, GHG emissions of HFCs and PFCs are minimized. Older refrigeration equipment may contain quantities of CFCs and HCFCs, however, the replacement of old equipment with new equipment over time will result in the phase-out of these sources of O_3 depleter GHG emissions (used refrigerants are captured). Halons are used in fire extinguishing systems where critical and costly electrical equipment is present (e.g., controls and computers) to prevent collateral equipment damage which would be caused by water or dry chemical fire extinguishants.

12.2.3 Key Impact and Evaluation Criteria

The key issues are the indirect emissions of GHGs driven by the energy requirements of the Proposed and Alternative Actions and how these emissions cumulatively affect climate change. An additional consideration is the presence or absence of energy conserving features, hence emission minimization, in the design and operation of the Proposed and Alternative Actions.

12.2.4 Environmental Impacts and Mitigation

This analysis is based on reasonably expected outcomes resulting from implementation of each of the alternatives. The Proposed Action and Alternative Action would each increase indirect GHG emissions due to generation of electric power, in part, using fossil fuels. The additional electric power requirements associated with the alternatives would cumulatively contribute to climate change.

12.2.4.1 No Use Agreement (No Action)

Under the No Action Alternative, districts and farmers within the GDA would not use the San Luis Drain (Drain) to convey their agricultural drainwater to Mud Slough after December 2009. Drainwater would be applied to the San Joaquin River Water Quality Improvement Project (SJRIP) reuse areas until these go out of production. Then, to meet selenium load limits for the San Joaquin River, irrigators would be required to recycle all drainwater on farm, without discharge. This requirement would be expected to marginally increase power consumption within the GDA as additional energy is used for the operation of sumps and the recirculation of drainwater. This would incrementally increase indirect GHG emissions, which would cumulatively contribute to climate change.

12.2.4.2 Grassland Bypass Project, 2010–2019 (Proposed Action)

Under the Proposed Action, irrigators within the GDA would continue to use the Drain to convey agricultural drainwater to Mud Slough until 2019. However, from 2006 forward, the SJRIP would be available for use by irrigators to remove salts and selenium, among other constituents, from drainwater (see Figure 2-2). Operation of the treatment facility using electric power would result in increased indirect GHG emissions that are neither substantial nor significant (compared to No Action and existing conditions) which would cumulatively contribute to climate change.

Indirect GHG emissions under the Proposed Action would be expected to remain the same as under existing conditions shown in Table 12-7, with the addition of three elements shown in Table 12-8 beginning in 2006. In order to ensure that power consumption and indirect GHG emissions associated with the Proposed Action is minimized, energy conservation would be considered in both the design and eventual operation of the full treatment facility to the maximum extent feasible.

Table 12-7 Existing Annual Indirect Greenhouse Gas Emissions for Grassland Drainage Area

District and Purpose	Power Consumption (MW-hr/yr)	Carbon Dioxide (tonnes/yr)	Methane (tonnes/yr)	Nitrous Oxide (tonnes/yr)	CO_2 Equivalents (tonnes/yr)
Broadview Sumps	0.0	0.0	0.0000	0.0000	0
Broadview Recirculation	0.0	0.0	0.0000	0.0000	0
Camp 13 Sumps	22.4	8.9	0.0004	0.0001	9
Charleston Sumps	30.4	12.1	0.0005	0.0001	12
Charleston Recirculation	80.8	32.2	0.0013	0.0003	32
Firebaugh Canal Sumps	28.4	11.3	0.0005	0.0001	11
Firebaugh Canal Recirculation	32.4	12.9	0.0005	0.0001	13
Pacheco Sumps	60.2	24.0	0.0010	0.0002	24
Pacheco Recirculation	10.1	4.0	0.0002	0.0000	4
Panoche Sumps	155.9	62.1	0.0025	0.0006	62
Panoche Recirculation	741.3	295.5	0.0121	0.0027	297
SJRIP 1 (4,000 acres)	518	206.7	0.0085	0.0019	207
Totals	1,680	670	0.027	0.006	672

Source: The Climate Registry General Reporting Protocol 2008

Table 12-8 Future Additional Indirect Greenhouse Gas Emissions for Grassland Drainage Area

Reuse and Treatment	Power Consumption (MW-hr/yr)	Carbon Dioxide (tonnes/yr)	Methane (tonnes/yr)	Nitrous Oxide (tonnes/yr)	CO_2 Equivalents (tonnes/yr)
SJRIP 2 (2,000 acres)	336	133.8	0.0055	0.0012	134
Treatment Plant (assumed)	21,400	8,529.5	0.3494	0.0777	8,561
Totals	21,736	8,663	0.355	0.079	8,695

Source: The Climate Registry General Reporting Protocol 2008

12.2.4.3 2001 Requirements Alternative (Alternative Action)

Under the 2001 Requirements Alternative Action, irrigators within the GDA would continue to use the Drain to convey agricultural drainwater following volume reductions at the SJRIP reuse facility. As with the Proposed Action, beginning in 2006, the SJRIP would be available for use by irrigators to remove salts and selenium from drainwater. The additional power expected to be consumed under the Alternative Action would incrementally add to requirements for electricity usage within the Project Area. This would result in increased indirect GHG emissions, which would cumulatively contribute to climate change.

Indirect GHG emissions under this alternative would be expected to remain the same as under existing conditions shown in Table 12-7, with the addition of three elements shown in Table 12-8 beginning in 2006. Therefore, implementation of the Alternative Action would be expected to result in approximately the same indirect GHG emissions as the Proposed Action. As under the Proposed Action, in order to ensure that power consumption and indirect GHG emissions associated with the Alternative Action is minimized, energy conservation would be considered in both the design and eventual operation of the SJRIP treatment facility to the maximum extent feasible.

12.2.5 Cumulative Effects

Cumulative impacts are those that result from the incremental impacts of an action added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

As shown in Tables 12-7 and 12-8, either the Proposed Action or Alternative Action would cause approximately 8,695 metric tonnes of additional CO_2 equivalents to be emitted annually due to increased electric power consumption. This represents about 0.0016 percent of overall statewide CO_2 equivalent emissions (528.6 Tg), and about 0.0071 percent of in-state power generation CO_2 equivalent emissions (123.2 Tg). (ARB 2008)

Due to the lack of promulgated significance thresholds for GHG emissions (CAPCOA 2008), it is not possible to draw quantitative conclusions about the significance of the Proposed Action or Alternative Action on climate change. Therefore, there can be no conclusion about whether these GHG impacts are quantitatively significant or substantial, nor can the need for, or extent of, GHG mitigation measures be addressed. However, the effects of GHG emissions have been cumulatively determined to lead to climate change on a global scale (USEPA 2008a), which is a significant cumulative impact. A project participates in this impact by its incremental contribution combined with the cumulative increase of all other sources of GHGs. While relatively small in scale, the Proposed or Alternative Actions would incrementally contribute this significant cumulative impact. Therefore, the Proposed or Alternative Actions, which would indirectly cause incremental emissions of GHGs that are less than significant, would be cumulatively considerable and thus qualitatively, if not quantitatively, significant.

12.2.6 Impact and Mitigation Summary

Impacts associated with the No Action, Proposed Action, and Alternative Action are expected to be incremental in nature, as described below.

NO ACTION ALTERNATIVE

- Increased recycling of drainwater within the GDA would result in marginally increased power consumption for the operation of sumps, therefore, marginally increased indirect emissions of GHGs, a minimal effect or less-than-significant impact.
- Additional indirect GHG emissions would incrementally add to GHG emissions within the state; however, the marginal amount is too small to be quantified and therefore not quantitatively significant.

PROPOSED ACTION

- Beginning in 2006, average annual power consumption within the GDA would be increased by approximately 21,735,630 KW-hrs, resulting in a total power consumption for the GDA of approximately 23,415,880 KW-hrs per year. This increase translates to additional GHG emissions of 8,695 tonnes per year (CO_2 equivalents), or about 0.0016 percent of the California state total.
- Greenhouse gases would be emitted during construction of the new treatment facility, primarily from diesel-powered construction equipment, although this amount would be small when compared to indirect GHG emissions caused by long-term facility operation.
- Since it is likely that the SJRIP facility would be operated at its peak capacity during the summer months when power demand is at its greatest, energy conservation, thus GHG emissions minimization would be considered in both the design and eventual operation of the treatment facility to the maximum extent feasible.
- Since no quantitative GHG emission significance thresholds presently exist in law, and the Proposed Action effects are minimal or less than significant, mitigation measures are not required.
- Additional indirect GHG emissions would incrementally add to the cumulative contributions and effects of all other sources of GHG emissions, both in the state and world-wide that are qualitatively considerable.

ALTERNATIVE ACTION

- Impacts under this alternative are similar to the Proposed Action described above, either minimal or less than significant.

S E C T I O N 1 3

Environmental Justice

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 and low-income populations of the United States. U.S. Environmental Protection Agency'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."* (U.S. Environmental Protection Agency 2008b)

This section provides baseline demographic information used in and an analysis of environmental justice impacts.

13.1 AFFECTED ENVIRONMENT

13.1.1 Race and Ethnicity

The minority population in the Project Area and vicinity is based on an analysis of race and ethnicity from the U.S. Census Bureau 2006 American Community Survey (ACS) population data for three counties that approximate the area of potential impact from the Proposed Action and Alternative Action (see Section 8.1). Population data are summarized by four racial categories: White (and other), Black, American Indian/Eskimo/Aleut, and Asian and Pacific Islander (Table 13-1). These categories as used in the 2006 ACS 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.

Table 13-1 Population By Race and Ethnicity, 2006

County	Total Persons, April 1, 2006	Race (percent)				
		White/ Other	Black	Amer. Indian, Eskimo, Aleut	Asian/Pacific Islander	Percent Hispanic
Fresno	891,756	85.0	4.9	1.1	8.9	47.6
Madera	146,345	93.2	3.6	1.2	2.0	49.2
Merced	245,658	88.3	3.5	0.8	7.3	52.2
Project Area*	1,283,759	88.8	4.5	1.1	7.8	41.4
State	35,246,104	80.4	6.2	0.7	12.7	35.9

Source: U.S. Census Bureau, 2006 American Community Survey (ACS)

*Calculated from county percent distributions.

In comparison to the California state demographics, the Project Area is proportionately higher in Hispanic population (41.4 percent) than is the state (35.9 percent). Racially, the area contains greater percentages of whites and persons of other races (88.8 percent) and Native Americans (1.1 percent) than does the state (80.4 percent and 0.7 percent, respectively).

13.1.2 Low Income

Low income populations in the three-county Project Area are identified by several socioeconomic characteristics of the population residing in the area. As categorized by the 2006 ACS, 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 13-2).

Table 13-2 Income and Poverty, 2006

County	Money Income (2006 , Inflation Adjusted)		Percent Below Poverty Level All Persons
	Per Capita	Median Household	
Fresno	18,791	42,732	20.9
Madera	16,745	39..68	22.3
Merced	16,641	40,447	21.5
Project Area	NA	NA	NA
State	26,974	56,645	13.1

Source: U.S. Census Bureau, 2006 American Community Survey (ACS)

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

Income and poverty, based on the 2006 ACS, illustrates that the Project Area counties' per capita and median household incomes are all lower than the averages for the state (Table 13-2). Merced County had the lowest per capita income, only $16,641 (2006 dollars). Similar results are found for the percentages of persons 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 2006 weighted average poverty threshold for one person under age 65 was $10,488; for a family of four persons it was $20,614; and for a family of eight persons it was $34,774 (U.S. Census Bureau 2006).

Other measures of low income, such as substandard housing and unemployment, also characterize demographic data in relation to environmental justice (Table 13-3). Substandard housing units are occupied units that are overcrowded (1.01 persons or more per room) or lack complete plumbing facilities. The Project Area counties of Fresno and Merced have higher percentages of substandard housing, 9.1 percent and 9.3 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 Project Area's unemployment rate in 2006 was 10.1 percent, significantly higher than the state unemployment rate of 6.6 percent. The highest unemployment rate was in Merced County (10.9 percent).

Table 13-3 Housing, Labor Force, and Employment, 2006

	Housing Units 2006		Civilian Labor Force 2006	
County	Total	Percent Substandard	Total	Unemployment Rate (percent)
Fresno	277,256	9.1	406,053	9.7
Madera	41,052	12.3	57,533	11.8
Merced	72,180	9.3	108,670	10.9
Project Area*	390,488	9.5	572,256	10.1
State	12,151,227	8.2	17,926,638	6.6

Source: U.S. Census Bureau, 2006 American Community Survey (ACS)

*Calculated from county percentage distributions.

13.2 ENVIRONMENTAL CONSEQUENCES

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 Executive Order 12898; CEQA has no corresponding requirement.

13.2.1 Key Impact and Evaluation Criteria

To address environmental justice concerns, the following issues are evaluated to determine potential impacts and their level of significance:

- Are affected resources used by a minority or low-income community?
- Are minority or low-income communities disproportionately subject to environmental or human health or economic impacts?
- Do the resources used for the project support subsistence living?

13.2.2 Environmental Impacts and Mitigation

The three-county Project 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. The importance of agriculture to the local economy has been described in Section 8.2.2. Consequently, the potential exists for low-income and minority groups to be disproportionately affected. Environmental justice issues are focused on environmental impacts on natural resources (and associated human health impacts) and potential socioeconomic impacts. Impacts to employment would occur from the No Action and the Proposed or Alternative Actions (see Section 8.2.2), so the potential exists for a socioeconomic impact on minority or low-income groups. Environmental resources used by low-income and Hispanic groups in the Project Area are primarily the aquatic/recreation resources. Existing minority and low income groups in the Project Area use the area sloughs and rivers for recreation. This use is expected to continue over the 2010 to 2019 period. It is not known whether these groups use these resources disproportionately to the overall population, however.

13.2.2.1 No Use Agreement (No Action)

ECONOMIC RESOURCES

The projected reductions in crop yields lead to reductions in farm revenues. While the economic impacts to the regional income and employment are insignificant, low income and minority groups would likely be disproportionately affected. Households relying on jobs and income in the agricultural sector would be most affected. These effects would produce an adverse effect to environmental justice, especially to the Hispanic community both regionally and locally. This population group is disproportionately located in the Project Area.

AQUATIC/RECREATION RESOURCES

Existing minority and low income groups use local sloughs and rivers 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 renewable natural resources is common among Native Americans, but these sloughs and rivers are not expected to support subsistence level fishing to a significant level. However, fishing to supplement normal food sources is expected to continue. Potentially beneficial effects on aquatic and associated upland communities would be expected in and near Mud Slough and the San Joaquin River between the San Luis Drain terminus and the confluence of the Merced and San Joaquin rivers (Section 6.2.4.4 Bioaccumulation and Food Chain Impacts) from water quality improvements that would benefit fishing opportunities, but other wetland areas used for fishing could be degraded by unmanaged drain water flows. This would have no effect over 2007 existing use on environmental justice, because the use would be recreational rather than subsistence and not disproportionately affect Hispanics.

13.2.2.2 Grassland Bypass Project, 2010–2019 (Proposed Action)

ECONOMIC RESOURCES

Compared to the No Action, the impact to local farm profits and income is slightly negative due to increased water treatment costs but not substantial. Although beneficial compared to No Action, the impacts to regional employment and income are not substantial. Local jobs could be most affected (a small increase), including jobs held by Hispanics. Therefore, the beneficial effect to environmental justice is less than substantial.

AQUATIC/RECREATION RESOURCES

Compared to No Action, there could be potentially negative effects on aquatic communities in Mud Slough (North) due to lower water quality that could harm recreational fishing. However, the effects from the Proposed Action on waterbirds utilizing wetland enhancements areas would be beneficial relative to the No Action Alternative. Neither of these effects is expected to disproportionately affect low-income and minority population groups, since each would equally affect all anglers and bird hunters.

13.2.2.3 2001 Requirements Alternative (Alternative Action)

ECONOMIC RESOURCES

Similar to the Proposed Action, the impact to environmental justice is likely positive but not substantial.

AQUATIC/RECREATION RESOURCES

Similar to the Proposed Action, no expected adverse effect on environmental justice would occur.

13.2.3 Cumulative Effects

See Section 8.2.3 for cumulative economic effects. For both the Proposed and Alternative Actions, the economic impacts to Hispanics employed in agriculture have been identified as negative but not substantial.

13.2.4 Impact and Mitigation Summary

For each of the alternatives, the following sections summarize potential effects to “environmental justice.”

13.2.4.1 Economic Resources

NO ACTION

Potentially substantial and adverse effect on the Hispanic community due to the disproportional effect on the Hispanic community from income and employment losses.

PROPOSED ACTION

Compared to No Action, the impact to the regional Hispanic community is likely positive but not substantial.

ALTERNATIVE ACTION

Compared to the No Action, the impact to the regional Hispanic community is likely positive but not substantial.

13.2.4.2 Aquatic Resources

NO ACTION

Beneficial impacts to recreational fishing in Mud Slough would not affect environmental justice.

PROPOSED ACTION

Potential impacts would not affect environmental justice.

ALTERNATIVE ACTION

Potential impacts would not affect environmental justice.

S E C T I O N 1 4

Other Effects

This chapter addresses other potential effects as required by CEQA and/or NEPA: relationship between short-term uses and maintenance of long-term productivity, irreversible or irretrievable commitment of natural resources, unavoidable adverse impacts, and growth-inducing effects.

14.1 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 (Grassland Bypass Project, 2010–2019) and the Alternative Action (2001 Requirements Alternative), 2001–2009. At issue is whether short-term effects are counterbalanced by long-term effects. Short-term construction impacts are associated with the continued implementation of the In-Valley Treatment/Drainage Reuse Facility. However, the short- and long-term benefits of improved water quality of the San Joaquin River ecosystem and reliability in drainage management outweigh short-term adverse effects on individual resources. Both alternatives are addressed in the discussion below by resource category.

14.1.1 Surface Water

Near-field areas are defined as areas within the Grassland Drainage Area and receiving water environment upstream of the Merced River (Mud Slough [North] and the San Joaquin River between the confluence of Mud Slough and the Merced River). Far-field areas include the San Joaquin River downstream of the confluence with the Merced River.

14.1.1.1 Near-Field Impacts

Water quality in the near-field receiving water environment would improve relative to existing conditions for selenium, boron, molybdenum, and salinity, a beneficial effect, and is most beneficial for the Proposed Action. However, the 4-day average selenium WQO for Mud Slough would not be met in the first year of Project implementation for all Water Year types and for the San Joaquin River upstream of Merced River. However, selenium concentrations decrease after treatment becomes available, consistent with the selenium load allocation for the Drain. . Temporary short-term impacts occur during high flow storm events when the Grassland Bypass Channel would be bypassed, which may occur at any time during the 2010-2019 period. See Section 4.2.2.4.2.

14.1.1.2 Far-Field Impacts

Water quality in the San Joaquin River downstream of the Merced River for selenium, boron, molybdenum, and salinity would improve relative to existing conditions. Occasional exceedances of water quality criteria for selenium are predicted; however, by 2015 concentrations are predicted to be below benchmark values in all months in all year types. Boron concentrations are predicted to meet the monthly mean WQOs for all years and Water Year types. Predicted TDS concentrations met the Vernalis salinity objective due to dilution effects. Molybdenum concentrations at Crows Landing are predicted to decrease and meet WQOs during all Water Year types through 2019.

14.1.2 Groundwater

For both alternatives, seepage to unlined canals decreases by 75 percent. Soil salinity in the GDA doubles but the soil remains productive. Groundwater salinity would decrease. Soil selenium and boron concentrations increase over the existing condition in both the short and long terms.

14.1.3 Biological Resources

Short-term impacts are associated with both Action Alternatives. Short-term impacts would occur to Mud Slough and to special status-species who may use the SJRIP facility that can be substantially mitigated, to promote long-term benefits. Consultations with the U.S. Fish and Wildlife Service will determine if the Project would affect special-status species due to construction and selenium bioaccumulation impacts and what mitigation measures may be required. Impacts below are long term and occur over the 2010–2019 period.

14.1.3.1 Special-Status Species

Drainwater volumes and selenium concentration would be reduced over the life of the Project, a positive effect for surface waters previously receiving discharges from the GDA under the Grassland Bypass Project. In the lower portion of Mud Slough (North), listed species such as the giant garter snake and the splittail would be at greater risk from Se concentrations under the Grassland Bypass Project, 2010–2019, than under the No Action Alternative, but less than under existing conditions.

Lower Se concentrations in the Federal and state wetlands may also beneficially impact other special status birds, reptiles, and amphibians that forage in wetlands, including the tricolored blackbird, greater sandhill crane, western pond turtle, giant garter snake, and California tiger salamander as compared to the No Action Alternative, but there would be no significant change compared to existing conditions.

Special status species that forage in the SJRIP reuse area may experience significant adverse impacts as compared to existing conditions, due to increases in Se soil concentrations and potential increase in ponding. These species include the San Joaquin kit fox, American peregrine falcon, bald eagle, Swainson’s hawk, northern harrier, tricolored blackbird, greater sandhill crane, loggerhead shrike, and mountain plover. However, these species may be positively affected as compared to the No Action Alternative (where unmanaged flows into wetland channels would degrade these areas).

14.1.3.2 Bioaccumulation and Food Chain Impacts

Potentially significant beneficial effects are expected for aquatic and associated upland communities in and near Mud Slough and the San Joaquin River above its confluence with the Merced River in the short and long terms as the discharges to Mud Slough are reduced. However, expansion of the SJRIP reuse area to up to 6,900 acres could result in additional selenium bioaccumulation impacts as explained above.

14.1.4 Land Use

For all three land uses - agriculture, wildlife habitat, and recreation - no short-term effects of concern would occur for either alternative. Over the long term, no changes in land use or any inconsistencies with county land use policies are predicted.

14.1.5 Socioeconomic Resources

No immediate adverse short-term impacts to the local agricultural activity or the regional economy would occur. Rather, farm profits and personal income/employment in the region increase until treatment costs are incurred starting in 2015. The composition of crops grown change slightly. Employment increases (from crop production) from 68 jobs in 2010 to 145 jobs in 2014 and remains steady after that.

14.1.6 Cultural Resources

There are no short-term or long-term impacts to historical resources. Over the long term, construction of the treatment facility could result in possible disturbance of known and unknown subsurface artifacts or archaeological cultural resources.

14.1.7 Energy Resources

Energy requirements increase from 1,680,250 kWh/yr (existing condition) to 23,415,880 kWh/yr when the SJRIP facility is completed in the long term. In the short term, energy use associated with sump management and recirculation would continue (1,680,250 kWh/yr).

14.1.8 Indian Trust Assets

No Indian Trust Assets are identified in the Project Area, so no short-term impacts would occur to the detriment of long-term protection of these assets for Native Americans.

14.1.9 Greenhouse Gases

The emission of greenhouse gases in the short term has the potential to affect climate change (contribute to global warming) over the long term. The Action Alternatives would produce 465 tonnes per year of carbon dioxide equivalents in the short term. When the SJRIP facility is fully operational, an additional 8,695 tonnes per year would be generated.

14.1.10 Environmental Justice

No environmental justice impacts would occur in the short term or in the long term, because increases in farm profits that could affect local jobs in agriculture and the Hispanic community are positive but not substantial (in the short term) and are higher than No Action over the long term.

14.2 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF NATURAL RESOURCES

Irreversible impacts are those that 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 Grassland Bypass Project 2010-2019 and 2001 Requirements Alternative, these potential irreversible impacts are associated with consumption of the following resources: land and energy.

Land resource consumption involves the commitment of up to 6,900 acres of land to the SJRIP reuse facility, an increase of 2,900 acres over presently planted lands of 4,000 acres. Crops would be converted to salt tolerant, and a small part of the area would be developed with a treatment facility that would permanently take some land out of production. Most of the area would remain in production and could be restored to its original condition (including the flushing of salts from the soil) but with drainage added to maximize consumption of drainwater (rather than crop production).

Use of electrical energy to operate sumps and pumps is ongoing. The principal change is the new Phase III treatment element, which includes construction of a treatment facility that would increase energy use for drainage management operations from 1,680,250 kWh to 23,415,880 kWh annually.

14.3 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts are those that cannot be mitigated. There are the following unavoidable adverse impacts for the two action alternatives.

- Within the GDA, soil selenium and boron concentrations would increase.
- Annual farm profits are less than existing conditions due to treatment costs beginning in 2015.

14.4 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.

Sections 7.2.1 and 8.2.2 discuss the effects of the Proposed and Alternative Actions on the regional economy and employment and agricultural land use. Neither alternative would stimulate the economy to a significant level. Changes in agricultural land use, including acreages associated with the SJRIP facility, are described in Section 7.2.1. It is concluded that the acreage was unlikely to convert to urban uses due to its consistency with county policies to preserve agricultural land, and the Williamson Act program and its distance from cities experiencing significant urbanization. Also, neither alternative would make additional water available to serve municipal and industrial development. Water conserved due to the treatment/reuse of drainwater would still be used as irrigation water (i.e., not affect total deliveries), because the affected districts anticipate receiving less than 100 percent of their long term contract deliveries from the Central Valley Project and have experienced water shortages in recent years. The conserved/recycled water would help to reduce future shortages for irrigation water supplies in the Grassland Drainage Area.

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SECTION 15

Mitigation Monitoring and Reporting Program

The requirement for a mitigation monitoring or reporting program is introduced in Section 15091 of Title 14, California Code of Regulations, Section 3, Guidelines for Implementation of the California Environmental Quality Act. This section directs the public agency approving or carrying out the Proposed Project (San Luis & Delta-Mendota Water Authority [Authority]) to make specific written findings for each significant impact identified in the EIR. When making the required findings, the agency will also adopt a program for reporting on or monitoring the changes that 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 that 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 (Authority) remains responsible for ensuring that implementation of the mitigation measures occurs in accordance with the program.

The Authority 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 that have readily measurable or quantitative mitigation measures or that already involve regular review.
- Monitoring is generally an ongoing or periodic process of project oversight. It is suited to projects with complex mitigation measures that are expected to be implemented over a period of time.

This mitigation program report is comprised of a matrix of impacts and mitigation for the proposed Grassland Bypass Project followed by a description of the two principal mitigation monitoring activities: the Grassland Bypass Project Compliance Monitoring Plan and *A Storm Event Plan for Operating the Grassland Bypass Project* (GAF 1997). The mitigation monitoring program for the Final EIS/EIR is recommended to be a monitoring program similar to the current plan and a reporting program on the Monitoring Plan and other mitigation measures if required.

15.1 MATRIX

The mitigation monitoring and reporting program for meeting the Grassland Bypass Project objectives for the 2010 Use Agreement is provided in Table 15-1. Table 15-1 includes all impacts for the proposed Grassland Bypass Project/2010 Use Agreement that were identified as significant or potentially significant. Impacts that are significant or potentially significant, but unavoidable, are those where no mitigation is feasible. For impacts that are less than significant, mitigation is not required by CEQA. The text of each impact and mitigation measure is taken from the previous chapters of this 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 Grassland Bypass Project Oversight Committee and its member agencies (U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, California Department of Fish and Game, Central Valley Regional Water Quality Control Board, and U.S. Environmental Protection Agency) are responsible for evaluating monitoring data and compliance with the selenium load reduction requirements. The Oversight Committee makes recommendations to the draining parties, U.S. Bureau of Reclamation, and/or the Central Valley Regional Water Quality Control Board, as appropriate, regarding all aspects of the Project. These aspects include modifications to the Project operations, appropriate mitigative actions, and termination of the Use Agreement if necessary. Required functions under the Use Agreement include determining the occurrence and extent of load exceedances, whether unforeseen and uncontrollable conditions contributed to these exceedances, the amount of drainage incentive fees that are payable for exceedances, and actions and programs to be funded by the incentive fees.

15.2 COMPLIANCE MONITORING PLAN

Compliance with the terms and conditions in the 2010 Use Agreement requires a monitoring plan and reporting of the results. Section V, paragraph A of the Draft Use Agreement states that the Authority shall be responsible for implementing a comprehensive monitoring program that meets the following objectives:

- to provide water quality data for purposes of determining the Draining Parties' compliance with Selenium Load Values and Salinity Load Values as set forth in this Agreement;
- to provide biological data to allow an assessment of whether or not any environmental impacts constitute Unacceptable Adverse Environmental Effects that have resulted from this Agreement; and
- to provide data on sediment levels, distribution, and selenium content.

The proposed 2010 Use Agreement (Appendix A) provides that on a regular basis, and in no event less frequently than monthly, the results of the monitoring program, including the monitoring results pertaining to the discharges of selenium and salts being delivered from the San Luis Drain to Mud Slough, will be submitted to the U.S. Bureau of Reclamation, the Oversight Committee, and other interested parties. (Section V, Paragraph B)

Table 15-1 Mitigation Monitoring and Reporting Program for Grassland Bypass Project, 2010-2019

Identified Impact	Mitigation Measures	Implementation Action	Timing Requirements	Reporting Responsibility
4.2.4.2.4 Additional sediment would accumulate in the Drain over the duration of the Proposed Action, 2010-2019. This is a potentially significant impact compared to existing conditions. After mitigation, the impact is less than significant.	Mitigation is to monitor the accumulation and remove the sediments in accordance with a Sediment Management Plan (Appendix B)	Approve Sediment Management Plan. Consult with RWQCB on preferred application area.	Complete Plan by 2008. Sediment removal to be determined.	Lawrence Berkeley Lab/Grassland Area Farmers to provide progress reports to Oversight Committee.
6.2.2.2.1 Special status species: Special status species that forage in the SJRIP reuse area may experience significant adverse impacts as compared to existing conditions, due to increases in Se soil concentrations and potential for increased ponding resulting in increased Se bioaccumulation. These species include the San Joaquin kit fox, bald eagle, Swainson's hawk, burrowing owl, northern harrier, tricolored blackbird, loggerhead shrike, and mountain plover, giant garter snake, and pallid and western red bats.	To be identified in Endangered Species Act Section 7 consultation with the U.S. Fish and Wildlife Service. Measure 2: Reduce exposure potential by reducing attractiveness of irrigation ditches for nesting (Section 6.2.2.4) Measure 3: Reduce exposure potential by hazing birds from nesting near, and foraging in, irrigation ditches. (Section 6.2.2.4) Measure 4: Implement flooded field contingency plan. Measure 5: Provide compensation breeding habitat if other measures fail.	As required by the U. S. Fish and Wildlife Service consistent with the Biological Opinion. As required by CDFG.	To be determined.	Grassland Area Farmers to provide progress reports to Oversight Committee.
6.2.2.2.1 Special Status Species: Construction and ground disturbance activities associated with the expansion of the reuse facilities could reduce the breeding success of burrowing owl or San Joaquin kit fox if burrows or dens that are utilized by these species are present within ground disturbance areas. Therefore, the reuse facilities would have unlikely but potentially significant adverse impacts to burrowing owl and San Joaquin kit fox, if these species are present, compared to existing conditions.	To be identified in Endangered Species Act Section 7 consultation with the U.S. Fish and Wildlife Service. Measure 1: Avoiding burrowing owls through preconstruction survey and buffer area (Section 6.2.2.4)	As required by the U. S. Fish and Wildlife Service consistent with the Biological Opinion. As required by CDFG.	To be determined.	Grassland Area Farmers to provide progress reports to Oversight Committee.

Table 15-1 Mitigation Monitoring and Reporting Program for Grassland Bypass Project, 2010-2019

Identified Impact	Mitigation Measures	Implementation Action	Timing Requirements	Reporting Responsibility
6.2.2.2.4. Bioaccumulation: The effects from the Proposed Action on waterbirds and terrestrial birds utilizing reuse areas would be potentially significantly adverse relative to existing conditions, but can be mitigated to less-than-significant by the measures discussed in Section 6.2.2.1.4 and those in Section 6.2.2.4.	To reduce impacts to nesting shorebirds in reuse areas: 1. Dredging the bottom of open drains that had been consistently used by shorebirds to eliminate potential feeding and nesting substrates. 2. Discharging cracker shells to discourage shorebird use where shorebird nesting had been concentrated in the past. 3. Enhancing habitat for nesting shorebirds outside the project site at a site with clean (non-seleniferous) water. To avoid or minimize the potential for ponding, careful management of irrigation water and tailwater may be sufficient. These practices include: 1. Installation of subsurface drains. 2. Draining tailwater into the Grassland Bypass Channel. 3. Application rates that handle crop needs and avoid overwatering. 4. Drainage treatment. 5. Cessation of irrigation (temporary). 6. Development of a contingency plan.	As required by the U. S. Fish and Wildlife Service consistent with the Biological Opinion.	To be determined.	Grassland Area Farmers to provide progress reports to Oversight Committee.

Results of the monitoring program will be reviewed quarterly, or more frequently as required to implement this Agreement, by the Oversight Committee. If unacceptable problems or impacts are identified, appropriate mitigative actions to address the problems will be identified by the Oversight Committee. The definition and identification of “unacceptable” problems or impacts and need for mitigative action will consider applicable laws (e.g., Migratory Bird Treaty Act, Endangered Species Act, Clean Water Act) as well as the impacts in all channels affected by implementation of the Project. Appropriate mitigative actions, depending on the situation, would include, but not necessarily be limited to, interruption of a specific identified contamination pathway through hazing or habitat manipulation; increased management, enhancement, and recovery activities directed at impacted species in channels cleaned up as a result of the Project, and/or establishment and attainment of more stringent contaminant load reductions. The costs of mitigation, as well as any required cleanup, will be borne by the draining parties.

A summary of key features of the monitoring plan is provided as follows:

- Daily compliance monitoring for flow and water quality (daily data at Station B and Station N). Weekly water quality data at ten stations in the receiving waters to identify project impacts
- Annual and bimonthly water quality data at one station each
- Quarterly sediment and biota quality monitoring for selenium in receiving waters upstream and downstream of the Project
- Annual sediment volume estimates in the San Luis Drain
- Monthly whole effluent toxicity testing using three freshwater (saline tolerate) species in chronic screening design
- Quality assurance, data management, and reporting program
- Data collection and reporting team meetings and coordination
- Under the No Action Alternative, there would be no compliance monitoring program. The Regional Board may continue weekly sampling of wetland water supply channels, the sloughs and lower San Joaquin River. It is unlikely that the US FWS or CDFG will continue biological monitoring. Under the No Action Alternative, Mud Slough would not be contaminated with drainwater from the GDA and the selenium objective would be met in the Slough. Reclamation will monitor the quality of seepage water for Se in the San Luis Drain, but not Mud Slough. Reclamation may monitor the river under the San Joaquin River Restoration Program.
- Under the Proposed Action, the compliance monitoring program will continue. It will be revised by the Data Collection and Review Team based on the 1996–2009 results and the requirements of the 2010 WDR. The WDR will include the Storm Management Plan. Due to federal and state budget restrictions, the monitoring program will focus more on the areas directly impacted by the GBP (Mud Slough) and less background monitoring (Salt Slough). Furthermore, there will be more monitoring of the SJRIP. Biological and toxicity monitoring may be reduced or eliminated.
- The 1998 Basin Plan specifies a water quality objective for selenium in Mud Slough and the San Joaquin River based on a four-day average. This will require daily sampling in the slough (Site D or E) and river (Site H) using autosamplers, plus lab analysis. Under the

Proposed Action, Reclamation and the Authority would be responsible for daily measurements of Se in Mud Slough and the river as a condition of the Waste Discharge Requirement (WDR). Reclamation could operate the autosamplers or reimburse the Regional Board. Reclamation would continue to fund flow, salinity, temperature, and biological monitoring in the slough and river.

The Sediment Management Plan (Appendix B) includes the following monitoring protocol to be applied to all land application sites until selenium levels have decreased to unrestricted use (in areas where applied sediments exceeded ecological or human health risk criteria). In areas where revegetation was conducted as part of the application of sediments, monitoring will continue until the predetermined success criteria for the revegetation program is met (i.e. percent cover or establishment of a particular vegetation community).

- Quarterly monitoring of soil water and groundwater to confirm that soluble selenium is not migrating toward the water table.
- Biannual soil sampling to monitor selenium displacement and solubility.
- Annual plant sampling and analysis at agriculture and open space sites to confirm that selenium is not being accumulated to levels of concern. Selenium uptake may change as selenium solubility increases.
- Installation of either neutron probe access pipes and/or tensiometers in agricultural sites to measure soil water movement.

15.3 STORM EVENT PLAN

A storm event management plan has been developed describing how the Project will operate during storm events (GAF and the Authority 1997). The major concerns with allowing high flows into the San Luis Drain are related to excess sediment loading and accumulation in the Drain and scour of previously accumulated sediment from the Drain into the receiving waters due to high water velocities. In addition, structural integrity of the bypass channel is of concern. The major components of the storm event plan include the following:

- Notification of regulatory and system users to inform them of the intent to operate under the storm event plan when Project flows are to be affected by impending storm events
- Opening of gates to Grassland Water District supply channels (Agatha Canal and Camp 13 Ditch) when anticipated flows exceed 100 cubic feet per second and precipitation is imminent
- In-field decisions on how much to divert to Grassland Water District and how much to allow into the Project during event conditions
- Closing gates to Grassland when flow falls below 100 cubic feet per second and no further threat of imminent precipitation exists
- Daily monitoring of bypassed flows to the Grassland Water District for quantity and quality
- Modification of sump pump operations as practical to minimize the production of drainwater.

15.4 OTHER MITIGATION AND ENVIRONMENTAL COMMITMENTS

Section III, paragraph H of the Draft Use Agreement (Appendix A) contains environmental commitments pertaining to operations, spill prevention, downstream users notification, regional archaeology, protection of China Island, Mud Slough, sediment, and load reduction assurances. In addition, the Authority will implement those commitments contained in the Record of Decision.

The Grassland Bypass Project proposes to complete the development of the SJRIP reuse facility on up to 6,900 acres of agricultural land. The Negative Declaration on Phase I (and subsequent Negative Declaration in August 2007 on expansion of the facility) commits the Grassland Area Farmers/Panoche Drainage District to a biological monitoring program that would be capable of detecting migratory bird impacts and, if necessary, capable of providing the data for project adjustments to avoid such impacts.

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SECTION 16

Consultation and Coordination

This Section reviews agency consultation and coordination performed by the U.S. Bureau of Reclamation (Reclamation) and the San Luis & Delta-Mendota Water Authority (Authority) that occurred prior to and during preparation of this Environmental Impact Statement/Environmental Impact Report (EIS/EIR). It also includes the list of agencies and individuals that received the Draft EIS/EIR.

16.1 PUBLIC SCOPING AND HEARINGS

Reclamation and the Authority distributed a Notice of Preparation of a joint Environmental Impact Statement/Environmental Impact Report (EIS/EIR) on the Continuation of the Grassland Bypass Project, 2010–2019, on December 20, 2007, to 205 agencies and individuals. On December 21, 2007, a Notice of Intent to prepare a joint EIS/EIR was published in the *Federal Register*. The notices announced the public scoping meeting and requested that comments on the content of the EIS/EIR and the project be submitted by January 25, 2008. Furthermore, notices were placed in two newspapers of general circulation in the project area: the *Merced Sun-Star* on December 22, 2007, and the *Fresno-Bee* on December 23, 2007. The scoping meeting was held at the San Luis & Delta-Mendota Water Authority boardroom on January 17, 2008, from 1:30 pm to 3:30 pm.

The Regional Board is preparing an amendment to the 1998 Basin Plan, under the selenium control program, to modify the effective date of the conditional prohibition of discharge of subsurface drainage to Mud Slough (North) for an additional nine years. The Regional Board held two public scoping meetings on the Basin Plan amendment in 2008 and is relying on this EIS/EIR for CEQA compliance for the Basin Plan amendment.

A report on oral and written comments received during EIS/EIR public scoping is included as Appendix H. Comments addressed the following concerns: project alternatives, water quality/hydraulics/water supply, biological resources including mitigation measures, and cumulative impacts.

16.2 AGENCY CONSULTATION AND INVOLVEMENT

Federal, state, and local agencies were involved with Reclamation and the Authority in the development of this EIS/EIR through three committees and through specific consultations and agreements. This section explains how these consultations occurred and the agencies involved. The three committees involved in the development of the EIS/EIR are Oversight Committee (OC), Technical and Policy Review Team (TPRT), and Data Collection and Reporting Team (DCRT).

The Bureau of Reclamation (Reclamation) and the San Luis and Delta-Mendota Water Authority (Authority) began discussions with stakeholders in early 2007 on an extension of the 2001 Use

Agreement. Agencies and organizations participating in the development of the proposed 2010 Use Agreement met monthly between July 2007 and April 2008 to develop terms and conditions dealing with selenium, salt, mitigation, and monitoring for the proposed 2010 Use Agreement. Participating stakeholder agencies and organizations are: Contra Costa County, Contra Costa Water District, Environmental Defense, The Bay Institute, U.S. Fish and Wildlife Service (Service), California Department of Fish and Game (CDFG), U. S. Environmental Protection Agency, and the Central Valley Regional Water Quality Control Board (Regional Board).

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 was the preparation of a Draft EIS/EIR for review by state agencies through the State Clearinghouse. Section 16.4 is a list of all agencies and individuals who were notified of the availability of the Draft EIS/EIR for public review. The Draft EIS/EIR was sent to the State Clearinghouse as required by CEQA on December 19, 2008. The Notice of Availability of the EIS/EIR was to be placed in the *Federal Register* late December 2008 or early January 2009 and in three local newspapers, *Fresno-Bee*, *Merced Sun-Star*, and *Los Banos Enterprise* in late December. NEPA requires that Reclamation consult with Federal cooperating agencies. For the Grassland Bypass Project, the Federal cooperating agencies are the Service, the U.S. Environmental Protection Agency (USEPA), and the U.S. Geological Survey. The responsible agencies are the Regional Board and CDFG.

16.2.1 Fish and Wildlife/Endangered Species Coordination

16.2.1.1 U.S. Fish and Wildlife Service

The Service has assisted Reclamation in the preparation of this EIS/EIR by participating in the negotiations to develop the proposed 2010 Use Agreement. Pursuant to the Fish and Wildlife Coordination Act, Reclamation consulted with the Service throughout this NEPA process. A Fish and Wildlife Coordination Act report will be provided at the conclusion of the NEPA process with recommendations, to Reclamation.

Reclamation has reinitiated consultation with the Service on the existing 2001Use Agreement, and has prepared a draft Biological Opinion (BO) that the Service is reviewing. Preparers of this EIS/EIR requested assistance from the Service in identifying threatened, endangered, proposed, and candidate plant and animal species that may be located in the Project Area. The Service responded on September 10, 2008 with lists of species that may be present in or may be affected by projects in the Grassland Bypass Project Area. This list was included in Section 6.1.3. Reclamation will prepare a Biological Assessment (BA) under Section 7 of the Federal Endangered Species Act (ESA) on the proposed 2010 Use Agreement for submittal to the Service. The BA will be followed by a BO prepared by the Service. Completion of the ESA consultation process will be documented in the Record of Decision on the Project.

The GAF engaged in discussions with the Service on the proposed wetland enhancement on November 26 and December 17, 2007, and again on January 11, 2008.

16.2.1.2 National Marine Fisheries Service

With respect to consultation requirements under the ESA, anadromous fish species are under the jurisdiction of NMFS, and the Magnuson-Stevens Fishery Conservation and Management Act requires federal agencies to consult with NMFS on projects that may affect managed species or their Essential Fish Habitat (EFH). EFH has been determined for Pacific Salmon. Informal consultation is continuing with NMFS concerning the Grassland Bypass Project, 2010–2019. Completion of the consultation process will be documented in the Record of Decision on the Project.

16.2.1.3 California Department of Fish and Game

The CDFG has also been consulted at several stages during negotiations on the 2010 Use Agreement as stakeholders and the preparation of the EIS/EIR. CDFG biologists were consulted pursuant to the Fish and Wildlife Coordination Act and the California Endangered Species Act by the Authority in February 2007. CDFG were consulted again on July 25, 2008, on Mud Slough habitat issues. CDFG representatives have attended meetings of the Grassland Bypass Project Working Group. In addition, Reclamation and the Authority met with CDFG on June 11, 2008, to review a draft Memorandum of Understanding (MOU) between the Authority and CDFG addressing continuing cooperation with respect to the use of Mud Slough within China Island.

16.2.2 Oversight Committee

The OC is responsible for evaluating all operations of the Grassland Bypass Project, including monitoring data, compliance with selenium load reduction goals, and other relevant information. The OC is assigned specific functions under the 2010 Use Agreement. These functions include determining the occurrence and extent of load exceedances, the amount of the drainage incentive fees that are payable, and actions or programs to be funded by the incentive fees. The OC is comprised of senior level representatives from Reclamation, the Service, CDFG, Regional Board, and the USEPA. It reviews the status, progress, and monitoring results of the Grassland Bypass Project.

16.2.3 Technical Policy Review Team

The OC formed the TPRT to assist them in their functions. The TPRT is responsible for obtaining and providing the necessary information, developing alternatives, and formulating recommendations to the OC for all issues and decisions regarding the Grassland Bypass Project. Members of the TPRT reviewed the Administrative Draft EIS/EIR and other materials used in its preparation.

16.2.4 Data Collection and Reporting Team

The DCRT is comprised of the agency representatives and contractors responsible for data collection and reporting. It is responsible for coordinating monitoring activities, identifying and resolving any issues involving data collection and reporting, and making recommendations for revision of data collection and reporting procedures as appropriate. The DCRT prepared the initial Monitoring Plan as well as the associated Quality Assurance Project Plan.

16.3 ENVIRONMENTAL COMMITMENTS

Environmental commitments that will be carried out as part of the implementation of the preferred alternative (in order to reduce potentially significant effects to less than significant) are specified in the Draft Use Agreement (Appendix A), including specifically Sections III.G, III.H, IV.A.3 and A.4, V, and VI. See Appendix A for the description of these commitments. Section III commitments include management plans, such as the Sediment Management Plan, operational commitments, and load reduction assurances. Section IV assigns responsibility to the Oversight Committee for identification of additional impact mitigation actions (if necessary). Section V addresses compliance monitoring; Section VI deals with construction, operation, and maintenance of facilities associated with or features of the Drain.

16.4 DISTRIBUTION LIST

The list of agencies, organizations, and individuals that were mailed a copy of the Draft EIS/EIR is provided on the following pages.

1. Miller, Congressman George
   7th Congressional District
2. Barcellos, Arnold
   A-Bar Ag Enterprises
3. Gulesserian, Tanya A.
   Adams Broadwell Joseph & Cardozo
4. Candee, Hamilton
   ALTSHULER BERZON LLP
5. Self, Deb
   BayKeeper
6. Block, David
   Block Environmental Services
7. Maddow, Robert B.
   Bold, Polianer, Maddow, Nelson, and Judson
8. McCurry, Jim
   Britz Farming
9. Buck, Byron
   Byron Buck and Associates
10. EWA Program Manager
    CALFED Bay-Delta Program
11. Beam, John
    California Department of Fish & Game
12. Dunne, Mary
    California Department of Fish & Game
13. Loudermilk, W.E.
    California Department of Fish & Game
14. McCamman, John
    California Department of Fish & Game
15. Mensch, Jerry
    California Department of Fish & Game
16. Murray, Nancee
    California Department of Fish & Game
17. Huddleston, Robert
    California Department of Fish & Game, Mendota Wildlife Area
18. Gordus, Andrew
    California Department of Fish & Game, San Joaquin Valley and Southern Sierra Region
19. Coordinator, CEQA
    California Department of Parks and Recreation
20. Karlton, Joanne
    California Department of Parks and Recreation
21. Kreutzberg, Hans
    California Department of Parks and Recreation
22. Office of Historic Preservation
23. Bradbury, Michael
    California Department of Water Resources
24. Johns, Jerry
    California Department of Water Resources
25. Polgar, Robert
    California Department of Water Resources
26. Potter, Robert
    California Department of Water Resources

27. Gayou, Nadell
California Department of Water Resources
Environmental Review Unit

28. Lind, Al
California Department of Water Resources

29. Dabbs, Paul
California Department of Water Resources

30. Sazaki, Marc
California Energy Commission

31. Osteen, Mary
California Farm Bureau

32. DuBois, Bill
California Farm Bureau Federation

33. Sheehan, Becky
California Farm Bureau Federation

34. Meyers, Larry
California Native American Heritage Commission

35. Buford, Pamela
California Regional Water Quality Control Board, Central Valley Region

36. Chilcott, Jeanne
California Regional Water Quality Control Board, Central Valley Region

37. Cismowski, Gail
California Regional Water Quality Control Board, Central Valley Region

38. Schnagl, Rudy
California Regional Water Quality Control Board, Central Valley Region

39. O'Quin, Pam
California Research Bureau California State Library

40. Lester, Aric
California Resources Agency

41. Baiocchi, Robert J.
California Sportfishing Protection Alliance

42. Crenshaw, Jim
California Sportfishing Protection Alliance

43. Galgiani, Honorable Cathleen
California State Assembly, 17th District

44. Villines, Honorable Michael
California State Assembly, 29th District

45. Arambula, Honorable Juan
California State Assembly, 31st District

46. Sanders, Dwight
California State Lands Commission, Environmental Planning and Management

47. California State Library

48. Hill, Stephen
California State Parks

49. Denham, Honorable Jeff
California State Senate, 12th District

50. Cogdill, Honorable David
California State Senate, 14th District

51. Florez, Honorable Dean
California State Senate, 16th District

52. Machado, Honorable Michael
California State Senate, 5th District

53. California Urban Water Agencies, Executive Director

54. Stokely, Tom
California Water Impact Network

55. California Waterfowl Association

56. Cory, Dave
Camp 13 Drainers

57. Moore, David L.
Capital Agricultural Property Services

58. O'Banion, Jim
Central California Irrigation District

59. White, Chris
Central California Irrigation District

60. Central Valley Project Water Association

61. LaRiviere, Florence M.
Citizens Committee to Complete the Refuge

62. Compomizzo, Yuril
Citizens for Safe Drinking Water

63. City of Stockton Department of Municipal Utilities

64. Houk, Randy
Columbia Canal Company

65. Young, Terry
Consultant

66. Mongan, P.E., Dr. Thomas R.
Consulting Engineer

67. Steiner, Daniel B.
Consulting Engineer

68. Uilkema, Gayle
Contra Costa County

69. Barry, Dennis
Contra Costa County Director of Community Development

70. Kopchik, John
Contra Costa County Fish and Wildlife Committee Community Development Department

71. Morgan, W. G.
Contra Costa Resource Conservation District Contra Costa County Farm Bureau

72. Gartrell, Gregory
Contra Costa Water District

73. Shih, Lucindo
Contra Costa Water District

74. Bishop, Walter J.
Contra Costa Water District

75. Goodwin, Barbara
Council of Fresno County Governments Metropolitan Planning Organization

76. Locke, Danny
D.T. Locke Ranch, Inc.

77. Donahue, Tim
Delta Group, San Francisco Bay Chapter of the Sierra Club

78. Clamurro, Lauri
Delta Protection Commission

79. Aramburu, Margit
Delta Protection Commission, Executive Director

80. Port, Patricia S.
Department of the Interior, Office of Environmental Policy and Compliance

81. Faria, Jose
Department of Water Resources

82. McCants, Kerrie
Development Sevices Manager Fresno County Planning Department

83. Wallace, Doug
East Bay Municipal Utility District

84. Hayden, Ann
Environmental Defense

85. Graff, Thomas J.
Environmental Defense Fund

86. Hanf, Lisa
Environmental Protection Agency Region 9 Office of Federal Activities (CMD-3)

87. Meier, Chrystal L.
Environmental Review Office San Joaquin Valley Air Pollution Control District

88. Bryant, Jeff
Firebaugh Canal Water District

89. Stearns, Mike
Firebaugh Canal Water District

90. Grossi, Mark A.
Fresno Bee

91. Salazar, Victor E.
Fresno County Clerk

92. Weaver, Alan
Fresno County Dept. of Public Works and Planning

93. Fresno County Public Library Government Publications

94. Jacobsma, Ron
Friant Water Authority

95. Widell, Dave
Grassland Water District

96. Harrigfeld, Karna E.
Herum, Crabtree, Brown, Dyer, Zolezzi, and Terpstra

97. Fio, John L.
HydroFocus

98. Maher, Joan
Imported Water Program Manager Santa Clara Valley Water District

99. Moore, Carlton D.
Interim Director California Department of Boating and Waterways

100. Halstead, Jeff A.
Kings River Conservation District Chief, Environmental Division

101. Robinson, Eric N.
Kronick, Moskovitz, Tiedemann & Girard Attorneys at Law

102. Walter, Hanspeter
Kronick, Moskovitz, Tiedemann & Girard Attorneys at Law

103. Benson, Sally
Lawrence Berkeley Laboratory Geochemistry Group. Earth Sciences Div., 50E

104. McMurray, Phil
Linneman Law Offices

105. Potter, Tiffany
Linneman Law Offices

106. Rathmann, Diane
Linneman Law Offices

107. Brown, Jesse
Merced County Association of Governments

108. O'Banion, Jerry
Merced County Board of Supervisors

109. Jones, Stephen
Merced County Clerk

110. Renteria, Charlene
Merced County Library

111. Inman, Allan D.
Merced County Mosquito Abatement District

112. Lewis, Robert
Merced County Planning Department

113. Smith, Robert
Merced County Planning Dept.

114. Merced County Public Library

115. Krause, Garith W.
Merced Irrigation District

116. MacCarthy, Dr. John
Merced Sierra Club

117. Bragg, Tim
Merced Sun-Star

118. Minasian, Paul
Minasian, Spruance, Baber, Meith, Soares & Sexton

119. Short, Allen
Modesto Irrigation District

120. Stern, Gary
National Marine Fisheries Service

121. Miller, William G.
Natural Resource Strategic Services

122. Norris, Larry
Natural Resources Conservation Service

123. Schmidt, Monty
Natural Resources Defense Council

124. Rea, Maria
NOAA Fisheries

125. Dillon, Joe
NOAA Habitat Conservation Division

126. Northern California Water Association

127. O'Laughlin, Tim
O'Laughlin & Paris

128. Knell, Steve
Oakdale Irrigation District

129. Lanich, Steve
Office of Congressman George Miller, Resources Committee

130. Chapman, Sam
Office of Senator Barbara Boxer Chief of Staff

131. Cooley, Heather
Pacific Institute

132. Laclerque, Bruce
Pajaro Valley Water Management Agency

133. Falaschi, Dennis
Panoche Water and Drainage District

134. Gardner, Mike
Panoche Water District

135. Porgans, Patrick
Porgans and Associates

136. Wooten, Ramona
Ramacciotti Investments

137. LaCompte, Susan
Redfern Ranches

138. Creedon, Pamela
Regional Water Quality Control Board Central Valley Region

139. Resources Agency Library

140. Denton, Richard
Richard Denton & Associates

141. Connor, Mike
San Francisco Estuary Institute

142. Davis, Jay
San Francisco Estuary Institute

143. San Francisco Public Library

144. Manager
San Francisco Public Library Government Documents Department

145. Holt, Waldo
San Joaquin Audubon

146. Takar, Paul
San Joaquin County Department of Public Works

147. Landis, Paula
San Joaquin District California Department of Water Resources

148. Mosebar, Doug
San Joaquin Farm Bureau Federation

149. Chedester, Steve
San Joaquin River Exchange Contractors Water Authority, Executive Director

150. Westcot, Dennis W.
San Joaquin River Group Authority

151. Freeman, Dennis
San Luis & Delta-Mendota Water Authority

152. Mizuno, Frances
San Luis & Delta-Mendota Water Authority

153. Mussett, Susan
San Luis & Delta-Mendota Water Authority
154. Nelson, Dan
San Luis & Delta-Mendota Water Authority
155. McIntyre, Martin
San Luis Water District
156. Forrest, Kim
San Luis Wildlife Refuge
157. Herrick, John
South Delta Water Agency
158. Hildebrand, Alex
South Delta Water Agency
159. Lundrigan, Lee
Stanislaus County Clerk
160. Stanislaus County Library
161. Freitas, Director, Ron
Stanislaus County Planning Dept
162. Director
State Clearinghouse, Office of Planning and Research
163. Shaffer, Director, Steve
State of California, Department of Food and Agriculture
164. Vargas, Al
State of California, Department of Food and Agriculture
165. Erlewine, Terry
State Water Contractors
166. Ford, Bob
State Water Resources Control Board Division of Water Quality
167. Wilcox, Nick
State Water Resources Control Board, Division of Water Rights
168. Kauffman, Kevin
Stockton East Water District General Manager
169. Linneman, Chris
Summers Engineering Inc.
170. McGahan, Joseph C.
Summers Engineering, Inc.
171. Bobker, Gary
The Bay Institute
172. Swanson, Christina
The Bay Institute
173. Wade, Dan
Tranquility Irrigation District General Manager
174. Reed, Rachel
Trust for Public Land Western Region
175. Fodge, Giner
U.S. Army Corps of Engineers Regulatory Section
176. Monroe, James
U.S. Army Corps of Engineers Sacramento District Attention Regulatory Section
177. Hayden, Mitchell
U.S. Army Corps of Engineers Sacramento District Regulatory Branch
178. Delamore, Mike
U.S. Bureau of Reclamation
179. Eacock, Chris
U.S. Bureau of Reclamation
180. Kleinsmith, Doug
U.S. Bureau of Reclamation
181. Aaron, Patti
U.S. Bureau of Reclamation
182. Environmental Review Office
U.S. Bureau of Reclamation
183. Fry, Sue
U.S. Bureau of Reclamation
184. U.S. Bureau of Reclamation, Denver Office Library
185. U.S. Bureau of Reclamation, Mid-Pacific Regional Office Library
186. Cardoza, Honorable Dennis
U.S. Congress, California, 18th District
187. Nunes, Honorable Devin
U.S. Congress, California, 18th District
188. Radanovich, Honorable George
U.S. Congress, California, 19th District
189. Costa, Honorable Jim
U.S. Congress, California, 20th District
190. Marcus, Felicia
U.S. Environmental Protection Agency
191. McNaughton, Eugenia
U.S. Environmental Protection Agency, Region IX
192. Sayer, Jim
U.S. Environmental Protection Agency, Region IX
193. Yale, Carolyn
U.S. Environmental Protection Agency, Region IX, Office of Federal Activities (C-I)

194. Hagler, Tom
U.S. Environmental Protection Agency, Region IX

195. Louis, Gail
U.S. Environmental Protection Agency, Region IX

196. Boots, Michael
U.S. Environmental Protection Agency, Region IX

197. Schwinn, Karen
U.S. Environmental Protection Agency, Region IX

198. Beckon, Bill
U.S. Fish & Wildlife Service

199. Garrison, Dale
U.S. Fish & Wildlife Service

200. Jones, Susan
U.S. Fish & Wildlife Service

201. Knight, Jan
U.S. Fish & Wildlife Service

202. Moore, Susan
U.S. Fish & Wildlife Service

203. Saiki, Mike
U.S. Fish & Wildlife Service

204. Skorupa, Joseph
U.S. Fish & Wildlife Service, Division of Environmetal Quality

205. Goude, Cay
U.S. Fish & Wildlife Service, Sacramento Fish & Wildlife Office

206. Maurer, Tom
U.S. Fish & Wildlife Service, Sacramento Fish & Wildlife Office

207. Hoover, Michael
U.S. Fish & Wildlife Service, Sacramento Fish and Wildlife Office

208. Sanchez, Ken
U.S. Fish & Wildlife Service, Sacramento Fish and Wildlife Office

209. Welch, Dan
U.S. Fish & Wildlife Service, Sacramento Fish and Wildlife Office

210. Winckel, Joy
U.S. Fish & Wildlife Service, Sacramento Fish and Wildlife Office

211. Dubrovsky, Neil
U.S. Geological Survey

212. Presser, Theresa S.
U.S. Geological Survey Water Division

213. Schwarzbach, Steven
U.S. Geological Survey, Western Ecology Research Center

214. Miller, Honorable George
U.S. House of Representatives Committee on Natural Resources

215. Boxer, Honorable Barbara
United States Senate

216. Vida-Sunnen, Linda
University of California, Berkeley Water Resources Center Archives

217. University of California, Berkeley, Water Resources Archive

218. University of California, Davis, Shields Library, Documents Department

219. Letey, Dr. John
University of California, Riverside

220. Birmingham, Thomas
Westlands Water District

221. Loyd, Denis
Westlands Water District

222. Sagouspe, Jean
Widren Water District

223. Aghazarian, Honorable Greg

224. Delgado, George

225. Denham, Honorable Jeffrey

226. Feinstein, Honorable Dianne

227. Fourchy, Dick

228. Howard, Penny

229. Nomellini, Dante John

230. Sloan, Steve

231. Smith, Felix

232. Thomas, Roy

233. Tuma, D.A.

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SECTION 17

Compliance Requirements

This Environmental Impact Report/Environmental Impact Statement (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.

17.1 FEDERAL

17.1.1 National Environmental Policy Act

This EIS/EIR was prepared pursuant to regulations implementing the National Environmental Policy Act (NEPA) (42 United States Code 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 Federal legislation and other major Federal actions with the potential to significantly affect the quality of the human environment. This EIS/EIR provides detailed information regarding No Action, Proposed Action, and Alternative Action, and for each of the alternatives, the environmental impacts, potential mitigation measures, and adverse environmental impacts that cannot be avoided are identified (Reclamation 1997a).

17.1.2 Endangered Species Act

The Federal Endangered Species Act (ESA) most recently amended in 1988 (16 United States Code 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 U.S. Fish and Wildlife Service (Service) and/or National Marine Fisheries Service (NMFS) on any activities that may affect any species listed as threatened or endangered (16 USC 35 §1531 et seq.).. Section 6.2.2 provides detailed discussions of any potential impacts and mitigation for terrestrial and aquatic resources that may result from the Proposed or Alternative Actions. Consultation activities conducted with these agencies are addressed in Section 16.2. Reclamation will prepare and submit a Biological Assessment to the Service and NMFS, addressing the potential impacts of the proposed federal action (as ultimately defined based on comments received on the DEIS) on species listed and critical habitat designated under the federal Endangered Species Act. The Service and NMFS will prepare a Biological Opinion.

17.1.3 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act requires consultation with the Service and consideration of these views and recommendations when any waterbody is impounded, diverted, controlled, or modified for any purpose. Based on surveys and investigations as conducted by the Service and state agencies charged with administering wildlife resources, the Service will complete and provide a report addressing the potential impacts to fish and wildlife species and appropriate mitigation measures. 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 with the Coordination Act will be coordinated with consultation for ESA, as described above. Section 6.2.2 provides detailed discussions of any potential impacts and mitigation for terrestrial and aquatic resources that may result from the Proposed or Alternative Actions. Section 16.2.1.1 addresses coordination with the Service.

17.1.4 Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918 is the domestic law that affirms, or implements, the United States' commitment to four international conventions (with Canada, Japan, Mexico, and Russia) for the protection of a shared migratory bird resource (16 United States Code 703 et seq.). Each of the conventions protects selected species of birds that are common to both countries (i.e., they occur in both countries at some point during their annual life cycle). Section 6.2 provides a discussion on the potential impacts and mitigation for bird resources or habitat that may result from the Proposed or Alternative Actions.

17.1.5 Environmental Justice

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 U.S. (Reclamation 1997a). This EIS/EIR evaluates the environmental, social, and economic impacts on minority and low-income populations in Section 13.

17.1.6 Indian Trust Assets

The U.S. 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 are legal interests in property and rights held in trust by the U.S. for Native American tribes or individuals. Indian reservations, rancherias, and allotments are common Indian Trust Assets. Section 11 concludes there are no impacts to Indian Trust Assets from the Proposed or Alternative Actions.

17.1.7 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 will, 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 public scoping for this EIS/EIR. If sites are identified in the future, U.S. Bureau of Reclamation (Reclamation) will comply with Executive Order 13007.

17.1.8 National Historic Preservation Act

This Project requires compliance with Section 106 of the National Historic Preservation Act of 1966, as amended and its implementing regulations, 36 Code of Federal Regulations 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 traditional cultural properties) 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. Reclamation must also comply with the Native American Graves Protection and Repatriation Act.

Cultural resources are not known to exist but could be discovered by construction activity associated with the completion of the SJRIP facility for the Proposed Action or Alternative Action. While no historic resources would be affected, if any buried resources are discovered, compliance under Section 106 would require that a survey be conducted (Reclamation 1997a). Section 9.2 provides a discussion on any potential impacts and mitigation for cultural resources that may result from the Proposed or Alternative Action.

17.1.9 Floodplain Management

Executive Order 11988 requires Federal agencies to evaluate the potential effects of any actions they might take in a floodplain and to ensure that planning, programs, and budget requests reflect consideration of flood hazards and floodplain management. If a Federal agency program will affect a floodplain, the agency must consider alternatives to avoid adverse effects in the floodplain or to minimize potential harm (Reclamation 1997a). Section 4.2.2 provides a detailed discussion on any potential impacts and mitigation for surface water resources that may result from the Proposed or Alternative Actions. These actions would not affect floodplains; however, storm events could cause localized flooding and enable drainwater to reach the Grassland Wetlands.

17.1.10 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 (Reclamation

1997a). Section 6.2.2 provides a detailed discussion of any potential impacts and mitigation for terrestrial resources that may result from the Proposed or Alternative Actions.

17.1.11 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 (Reclamation 1997a).

17.1.12 Clean Water Act of 1977

The Clean Water Act (Public Law 95-217), through implementation by the U.S. Environmental Protection Agency (USEPA), seeks to restore and maintain the chemical, physical, and biological integrity on the nation’s waters. The significant features of the Act include:

- National Pollutant Discharge Elimination System
- 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
- 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 USEPA (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). Section 4.2.2 provides a detailed discussion of potential impacts and mitigation that may result from the Proposed or Alternative Actions, and Section 15.2 discusses how the USEPA has been involved in the development of the 2010 Use Agreement and review of this EIS/EIR.

17.1.13 Memorandum on Farmland Preservation and the Farmland Protection Policy Act

The Farmland Protection Policy Act of 1981 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). Sections 7.2.1 and 8.2.2 discuss potential impacts for farmlands (cropping pattern changes and fallowing) that may result from the Proposed or Alternative Actions.

17.1.14 Federal Agriculture Improvement and Reform Act of 1996

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. Section 7.2.1 provides a discussion of potential impacts for conservation of farmlands that may result from the Proposed or Alternative Actions.

17.2 STATE

17.2.1 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.
- 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.
- 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 No Action, Proposed Action, and Alternative Action, and for each alternative describes the environmental impacts, potential mitigation measures, and adverse environmental impacts that cannot be avoided.

17.2.2 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 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.
- 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 must identify and provide for Athe regional or area wide protection and perpetuation of natural wildlife diversity, while allowing compatible and appropriate development and growth, Natural community conservation plans are intended to provide comprehensive management and conservation of multiple wildlife species including, but not limited to, species listed pursuant to CESA, Section 2050 et seq. (CALFED 1998, California and Federal Endangered Species Act Compliance Technical Appendix) See Section 6.2.2 for an evaluation of impacts to state-listed species and Section 15.2 describes CDFG's involvement in the development of the 2010 Use Agreement and review of this EIS/EIR.

17.2.3 State Historic Preservation Officer

Under any alternative involving a Federal undertaking, Reclamation will consult with the California State Historic Preservation Officer about meeting the requirements of 36 Code of Federal Regulations 800. Consultation with Reclamation and State Historic Preservation Officer will address cultural resources identification, evaluation, effects, and possible mitigation needs.

Historic resources would not be affected, but any other cultural resources that could exist in undisturbed areas could be impacted by construction activities associated with the completion of the SJRIP element of the Proposed Action or Alternative Action. Section 9.2 provides a detailed discussion of potential impacts and mitigation for cultural resources that may result from the Proposed or Alternative Actions.

17.2.4 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 (State Board) and the Central Valley Regional Water Quality Control Board (Regional Board) since the passing of this Act (CALFED 1998). Section 4.2.2 provides a detailed discussion on any potential impacts and mitigation for surface water resources that may result from the Proposed or Alternative Action. Water quality impacts to the Delta would be small under the Proposed and Alternative Actions due to the small volume of drainwater compared to the other sources (estimated at 1 percent of the total flow at Vernalis for Water Year 1999). The exception is selenium, for which a significant portion of the load at Vernalis is due to the Grassland Drainage Area. Under the Action Alternatives, selenium loads would be progressively reduced, and selenium water quality objectives would be met at Crows Landing during the final years of the Project.

17.2.5 Porter-Cologne Act

In 1967, the Porter-Cologne Act established the State Board 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 the State Board 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. The Regional Board implements the Act through various tools, including the issuance of WDRs. WDRs have been issued for the 2001 Use Agreement and will be issued as well for the 2010 Use Agreement. Sections 4.2 and 5.2 provide a detailed discussion on any potential impacts and mitigation for surface water and groundwater resources that may result from the Proposed or Alternative Action. The Proposed and Alternative Actions comply with water quality objectives and implementation schedules for selenium as designated in the 1998 Basin Plan. Exceedances of the boron water quality objective occur in some portions of tributaries to the San Joaquin River during portions of the year. This issue is a valley-wide concern and is currently being addressed by the Regional Board through a Basin Plan amendment process addressing salts and boron.

17.2.6 Water Quality Control Plan (Bay-Delta Plan)

The Water Quality Control Plan (Bay-Delta Plan) for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary was adopted in May 1995 (State Board 1995) and incorporated several elements of USEPA, NMFS, for the San Francisco Bay/Sacramento-San Joaquin Delta Esthary and Service regulatory objectives for salinity and endangered species protection. The major changes associated with the WQCP in relation to the 1978 and 1991 WQCPs and associated D-1485 requirements are as follows:

- 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 AX2", the position of the 2-part-per-thousand 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).

The Bay-Delta Plan was amended December 13, 2006, and addresses declines in the populations of Delta Smelt and other pelagic organisms. It did not change the San Joaquin River flow objectives due to a lack of scientific information (State Board 2006). Section 4.2.2 provides a detailed discussion on any potential impacts and mitigation for surface water resources that may result from the Proposed or Alternative Action. These actions would not adversely affect the San Joaquin River and subsequently salinity or water supplies in the Delta.

17.2.7 1996 and 1998 Basin Plan Amendment

Beneficial uses, WQOs, and the implementation program for achieving the WQOs for the Project Area are stipulated in the *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins* (1998 Basin Plan) (Regional Board 1998a).

In May 1996, the Central Valley Regional Water Quality Control Board (Regional Board) adopted a Basin Plan amendment to address selenium concentrations in agricultural drainage discharges from the Project Area (Regional Board Resolution No. 96-078). The amendment adopted recommendations in the 1995 Consensus Letter sent to the Regional Board’s chairman by the Authority, U.S. Bureau of Reclamation, Mid-Pacific Region (Reclamation), U.S. Environmental Protection Agency (USEPA), and the U.S. Fish and Wildlife Service (Service). The amendment included identification of beneficial uses for Mud Slough (North), Salt Slough, and the wetland water supply channels; and selenium WQOs for the lower San Joaquin River, Mud Slough (North), Salt Slough, and the wetland water supply channels of the Project Area. The amendment prohibits the discharge of agricultural subsurface drainage to the wetland supply channels and to Salt Slough unless WQOs are met, and prohibits discharges in excess of 8,000 pounds of selenium per year, from agricultural subsurface drainage for all water year types, beginning January 10, 1997. Pursuant to the Section 303(d) listing of the San Joaquin River for selenium, the Regional Board prepared the Total Maximum Daily Load (TMDL) report for selenium in the lower San Joaquin River in August 2001 (Regional Board 2001c) and the TMDL for selenium in Grassland Marshes in April 2000 (Regional Board 2000c).

In September 2004, the Regional Board adopted the Basin Plan amendment for salinity and boron for the lower San Joaquin River (Regional Board Resolution No. R5-2004-0108) due to the impact of these constituents on beneficial uses in the lower San Joaquin River and Southern Delta. Load allocations were established for irrigated lands and waste load allocations were established for point sources. Time schedules for implementation and compliance were established by subregion. The lower San Joaquin River has been designated an impaired waterbody for salinity and boron under CWA Section 303(d). Pursuant to the Section 303(d) listing, the Regional Board prepared the Total Maximum Daily Load (TMDL) for the control of salt and boron discharges into the lower San Joaquin River in July 2004 (State Board 2006b).

WQOs and performance goals from the 1998 Basin Plan for the Project Area for selenium, boron, molybdenum, and electrical conductivity (EC) are summarized in Table 17-1.

Table 17-1 Water Quality Objectives, Performance Goals, and Compliance Dates for the Lower San Joaquin River

Waterbody	Selenium	Boron	Molybdenum	Electrical Conductivity
Salt Slough and Wetland Water Supply Channels	▪ 2 ppb, monthly mean, October 1, 1996 ▪ 20 ppb, maximum		▪ 0.050 ppm, maximum ▪ 0.019 ppm, monthly mean	
Mud Slough (North) and the San Joaquin River from Sack Dam to the Merced River	▪ 5 ppb, 4-day average, October 1, 2010 ▪ 20 ppb, maximum		▪ 0.050 ppm, maximum ▪ 0.019 ppm, monthly mean	
San Joaquin River, from mouth of Merced River to Vernalis	<u>Normal/Wet Year</u>: ▪ 5 ppb, 4-day average, October 1, 2005 ▪ 12 ppb, maximum <u>Critical/Dry/Below normal Year</u>: ▪ 5 ppb, monthly mean (performance goal), October 1, 2005 ▪ 5 ppb, 4-day average, October 1, 2010 ▪ 12 ppb, maximum	<u>Wet Season</u>: ▪ 2.6 ppm, maximum, September 16 through March 14 ▪ 1.0 ppm, monthly mean, September 16 through March 14 <u>Dry Season</u>: ▪ 2.0 ppm, maximum, March 15 through September 15 ▪ 0.8 ppm, monthly mean, March 15 through September 15 <u>Critical Year</u>: ▪ 1.3 ppm, monthly mean	▪ 0.015 ppm, maximum ▪ 0.010 ppm, monthly mean	
San Joaquin River at Airport Way Bridge, Vernalis				<u>All water years</u>: ▪ 0.7 mmhos/cm, April-August, maximum 30-day running average of mean daily ▪ 1.0 mmhos/cm, September-March, maximum 30-day running average of mean daily

Source: 1998 Basin Plan.(Regional Board 1998a)

17.2.8 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. The Proposed and Alternative Actions would not affect water rights of legal users.

17.2.9 Greenhouse Gases and Climate Change

The Global Warming Solutions Act of 2006 (AB 32) requires that CEQA documents contain a quantitative assessment of greenhouse gas emissions caused directly or indirectly by the project, an evaluation of the significance of project-related emission from a cumulative perspective, and provisions for mitigation of significant project effects. Although AB 32 directs the Air Resources Control Board (ARB) to develop appropriate regulations and establish a mandatory reporting system to track and monitor global warming emission levels, the ARB has not yet been able to comply with theses directives. The State Attorney General’s Office reviews EIRs to determine their adequacy.

Climate change refers to long-term fluctuations in temperature, precipitation, wind and other elements of the Earth's climate system. The United Nations have defined climate change as " a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. Currently, there are no specific requirements in place for NEPA or CEQA documents relative to climate change. This document addresses the effects of the Project on greenhouse gases in Section 12.

17.3 LOCAL

The Proposed Action will take place on the San Joaquin River system and adjacent farmlands in the following counties: Stanislaus, Merced, and Fresno. 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.

Appendix F of this EIS/EIR presents key goals and policies in these counties, where most of the Proposed Action of drainwater management and discharge occur and could impact local communities. Since the Proposed Action does not involve urban development, key issues are whether the drainwater management actions 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 within the Project Area.

SECTION 18

Preparers of EIS/EIR

The following personnel were directly involved in the preparation of the EIS/EIR:

BUREAU OF RECLAMATION

Michael Delamore .... Project Manager

Chris Eacock .... Soil Scientist/Natural Resources Specialist

Judi Tapia .... Natural Resources Specialist, NEPA Review

Patricia Rivera .... Archaeologist

SAN LUIS AND DELTA-MENDOTA WATER AUTHORITY

Joe McGahan, Summers Engineering, Inc. .... Project Manager

Chris Linneman, Summers Engineering, Inc. .... Project Engineer

Technical and support personnel from ENTRIX, Inc., URS Corporation, and Hydrofocus, Inc., who were involved in document preparation are listed in Table 18-1.

Table 18-1 List of Technical and Support Personnel

Preparers	Degree(s)/Years of Experience	Role in Preparation	Experience and Expertise
ENTRIX, Inc.			
Boyes, B.	M.B.A., Project Management B.S., Environmental Engineering 29 Years	Climate Change (Greenhouse Gas) Analysis	Environmental Engineering
Brice, D.	B.S., Geography and Environmental Planning 15 years	GIS Manager	GIS/Graphics
Cover, K.	M.S., Environmental Studies B.S., Geography 2 years	Technical Editor	NEPA/CEQA Compliance Technical Editing Biological Resources
Dillon, R.	M.A., Medieval History and Literature B.A., History, German and English minors 35 years	Senior Technical Editor	Technical Editing
Hootkins, S.	M.U.P., Urban and Regional Planning B.A., Human Biology 35 years	Project Manager	CEQA/NEPA Compliance Public Scoping Alternatives, Other Impacts
Johnson, R.	M.S., Marine Biology B.S., Aquaculture & Fisheries 6 years	Aquatic Biology	Fisheries Salmonid Conservation
Lewis, K.	B.A., Cultural Anthropology 6 years	Land Use	CEQA/NEPA Compliance
Paul, D.	Ph.D., Agricultural Economics M.S., Agricultural Economics B.S., Agricultural Management 38 years	Senior Review	Socioeconomics

Table 18-1 List of Technical and Support Personnel

Preparers	Degree(s)/Years of Experience	Role in Preparation	Experience and Expertise
Schwartz, M.	M.E.S.M., Coastal and Marine Resource Management B.A. Biological Anthropology 4 years	Sediment Management Plan	CEQA/NEPA Compliance, Watershed Management
Tormey, D.	Ph.D., Geology and Geochemistry B.S., Civil Engineering and Geology 19 Years	Sediment Management Plan	Geology Surface Water and Groundwater Hydrology Sediment
Wise, L.	M.A., Marine Biology B.S., Marine Biology and Limnology 22 years	Aquatic Ecology/Fisheries Biology	Fisheries
Wyse, B.	M.S., Environmental and Natural Resource Economics B.S., Environmental Science and Policy 4 years	Socioeconomics Land Use Environmental Justice	Economics
URS			
Cooke, T.	M.S., Marine Science B.A., Chemistry 24 years	Senior Water Quality Specialist	Alternatives, Surface Water
Hudson, J.	B.S., Civil Engineering 9 years	Senior Engineer	Surface Water
Hunt, L.	M.S., Environmental Engineering B.S., Environmental Systems Engineering 12 years	Senior Water Resources Engineer	Surface Water Bioaccumulation Ecological Risk Assessment
Leach, S.	M.A., Vegetation Ecology B.S., Physical Geography 9 years	Senior Biologist	Biological Resources
Martorana, D.	M.A., Anthropology B.A., Social Psychology 4 years	Cultural Resources Indian Trust Assets	Anthropology
Mineart, P.	M.S., Civil Engineering B.S., Environmental Resources 22 years	Senior Water Resources Engineer	Surface Water
Verity, R.	M.S., Oceanography M.S., Environmental Microbiology B.S., Marine Biology 12 years	Biologist	Biological Resources Heavy Metal Bioremediation
HydroFocus, Inc.			
Deverel, S.	Ph.D., Soil & Water Chemistry M.S., Soil-Plant-Water Relations B.S., Agricultural Science & Management B.A., Zoology 15 years	Consulting Hydrologist - Wetlands	Soil and Groundwater Resources
Fio, J.	M.S., Civil Engineering B.S., Soil and Water Science 13 years	Consulting Hydrologist - Groundwater	Soil and Groundwater Resources

SECTION 19

References

Anderson, F., and R.L. Snyder. 2005. Twitchell Island's restored wetland crop coefficients. Letter report to the U.S. Geological Survey from UC Davis.

Ayars, J.E., R. Schoneman, R. Mead, R. Soppe, F. Dale, and B. Meso. 1996. Shallow groundwater management project final report. USDA-ARS Water Management Research Laboratory, Fresno, CA.

Ayers, R.S., and R. K. Branson. 1975. *Water Quality: Guidelines for Interpretation of Water Quality for Agriculture*. University of California Cooperative Extension Service, Davis.

Beckon, W., and T. Maurer. 2008. Potential Effects of Selenium Contamination on Federally-Listed Species Resulting from Delivery of Federal Water to the San Luis Unit. Prepared by the U.S. Fish and Wildlife Service Environmental Contaminant Division for Bureau of Reclamation. Fresno, CA

Beckon, W. N., M. Dunne, J. D. Henderson, J. P. Skorupa, S. E. Schwarzbach, and T. C. Maurer. 1999. Biological effects of the reopening of the San Luis Drain to carry subsurface irrigation drainwater. Chapter in *Grassland Bypass Project Annual Report, October 1, 1997 through September 30, 1998*. Bureau of Reclamation, Sacramento, CA.

Beedy, E.C., and W. J. Hamilton III. 1999. Tricolored Blackbird (*Agelaius tricolor*). In *The Birds of North America*, No. 423, A. Poole and F. Gill, eds. The Birds of North America, Inc., Philadelphia, PA.

Belitz, K., and F. J. Heimes. 1990. Character and evolution of the groundwater-flow system in the central part of the western San Joaquin Valley, California. *U.S. Geological Survey Water-Supply Paper* 2348.

Belitz, K., S.P. Phillips, and J.M. Gronberg. 1993. Numerical simulation of groundwater flow in the central part of the western San Joaquin Valley, California. *U.S. Geological Survey Water-Supply Paper* 2348.

Bloom, P.H. 1980. The status of the Swainson's hawk in California. Final Report.1979. U.S. Department of the Interior, Bureau of Land Management, Sacramento, CA. Project W-54-R-12, Job 11-8.

Brown, B.T. 1993. Bell's Vireo (*Vireo bellii*). In *The Birds of North America*, No. 35, A. Poole, P. Stettenheim, and F. Gill, eds. Academy of Natural Sciences, Philadelphia, PA and American Ornithologists Union, Washington, DC.

Brown, L.R. 1998. Assemblages of fishes and their associations with environmental variables, lower San Joaquin River drainage, California. *U.S. Geological Survey Open-File Report* 98-77.

Brown, L.R., and P.B. Moyle. 1992. Native fishes of the San Joaquin drainage: Status of a remnant fauna and its habitats.

Brush, C.F., K. Belitz, S.P. Phillips, K.R. Burow, and D.L. Knifong. 2006. MODGRASS: Update of a Ground-Water Flow Model for the Central Part of the Western San Joaquin Valley, California: *U.S. Geological Survey Scientific Investigations Report* 2005-5290.

Buchnoff, K. 2006. Engineer, Department of Water Resources, Fresno Office. Personal communication with Lisa Hunt, Senior Environmental Engineer, URS Oakland. February.

Buonicore, A.J., and W.T. Davis, eds. 1992. *Air Pollution Engineering Manual (AP-40)*. Air & Waste Management Association. Van Nostrand Reinhold, New York.

Bureau of Economic Analysis. 2008. Regional Economic Accounts. Accessed October 6. Available at http://www.bea.gov/regional.

Bureau of Reclamation (Reclamation). 1991a. Draft Environmental Impact Statement, San Luis Unit Drainage Program, Central Valley Project, California.

Bureau of Reclamation (Reclamation). 1991b. Supplement to Environmental Assessment Proposed Use Agreement Allowing Use of the San Luis Drain For Conveyance of Agricultural Drainage Waters Through the Grassland Water District and Adjacent Grassland Areas. April.

Bureau of Reclamation (Reclamation), Mid-Pacific Region. 1995. Finding of No Significant Impact (FONSI No. 96-01-MP) and Supplemental Environmental Assessment. Grassland Bypass Channel Project. Interim use of a portion of the San Luis Drain for conveyance of drainage water through the Grassland Water District and adjacent Grassland Areas. Sacramento, CA. November 3.

Bureau of Reclamation (Reclamation). 1997a. Central Valley Project Improvement Act Programmatic Environmental Impact Statement, Technical Appendix, Volume Four. Draft. September.

Bureau of Reclamation (Reclamation). 1997b. Draft PEIS, Central Valley Project Improvement Act, Technical Appendix, Volume 6: Visual Resources, Air Quality, Cultural Resources, Delta as a Source of Drinking Water.

Bureau of Reclamation (Reclamation), Mid-Pacific Region. 1999. Grassland Bypass Project Annual Report. October 1, 1997 through September 30, 1998. Sacramento, CA. June.

Bureau of Reclamation (Reclamation). 2000a. Biological Assessment. Central Valley Project Improvement Act Long-Term Refuge Water Supply Water Service Agreement for the San Joaquin River Basin Federal Wildlife Refuges, State Wildlife Areas, and Grasslands Resource Conservation District, Merced and Fresno Counties, California. (In prep.) September.

Bureau of Reclamation (Reclamation). 2000b. NEPA Handbook.

Bureau of Reclamation (Reclamation). 2001. Agreement for Use of the San Luis Drain for the Period October 1, 2001 through December 31, 2009. Agreement No. 01-WC-20-2075. Bureau of Reclamation and the San Luis & Delta-Mendota Water Authority. September 28.

Bureau of Reclamation (Reclamation). 2007a. Record of Decision for San Luis Drainage Feature Re-Evaluation. March. Available at http://www.usbr.gov/mp/mp150/envdocs/San_Luis_Drainage_Feature_Re-evaluation_ROD.pdf.

Bureau of Reclamation (Reclamation). 2007b. Concepts for Collaboration Drainage Resolution. February 15. Available at http://www.usbr.gov/mp/headlines/2007/feb/san_luis_unit_congressional_021507.pdf.

Bureau of Reclamation (Reclamation). 2008. Delta-Mendota Canal Water Quality Monitoring Program Monthly Report of Flows, Concentrations and Loads, November 2007. January 24.

Bureau of Reclamation (Reclamation), and U.S. Fish and Wildlife Service (Service). 1999. Central Valley Project Improvement Act, Final Programmatic Environmental Impact Statement. Sacramento, CA. October.

Bureau of Reclamation Mid-Pacific Region (Reclamation), Friant Water Users Authority, and Natural Resources Defense Council. 2006. Joint Press Release: "Agreement Signals Start to Historic San Joaquin River Restoration." September 13.

Bureau of Reclamation (Reclamation), U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, U.S. Geological Survey, Central Valley Regional Water Quality Control Board, California Department of Fish and Game, and San Luis Delta-Mendota Water Authority. 1996. *Compliance Monitoring Program for Use and Operation of the Grassland Bypass Project*. September.

Bureau of Reclamation (Reclamation), U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, U.S. Geological Survey, Central Valley Regional Water Quality Control Board, California Department of Fish and Game, and San Luis Delta-Mendota Water Authority. 2002. Monitoring Program for the Operation of the Grassland Bypass Project. Phase II. Prepared by the Grassland Bypass Project Data Collection and Reporting Team for the Grassland Bypass Project Oversight Committee. June.

Bureau of Reclamation (Reclamation), U.S. Fish and Wildlife Service, and California Department of Fish and Game. 1995. San Joaquin Basin Action Plan – Wetlands Development and Management Plan in the North Grasslands Area, Merced County, California. April.

Bureau of Reclamation (Reclamation), U.S. Fish and Wildlife Service, U.S. Geological Survey, and U.S. Bureau of Indian Affairs. 1998. Guidelines for Interpretation of the Biological Effects of Selected Constituents in Biota, Water, and Sediment. National Irrigation Water Quality Program Information Report No. 3. Denver, CO.

CALFED Bay-Delta Program. 1998. Draft Programmatic EIS/EIR. March.

CALFED Bay-Delta Program. 1999. Draft Programmatic EIS/EIR. June.

CALFED Bay-Delta Program. 2000. Final Programmatic EIS/EIR. CD-ROM, Disk 1. July.

California Air Pollution Control Officers Association (CAPCOA). 2008. CEQA and Climate Change. January. Available at http://www.capcoa.org/.

California Air Resources Board (ARB). 2008. Greenhouse Gas Inventory Data - 1990 to 2004. Available at http://www.arb.ca.gov/cc/inventory/data/data.htm.

California Data Exchange Center (CDEC). 2008. Historical Data Selector. Accessed January 21, 2008. Available at http://cdec.water.ca.gov.

California Department of Finance. 2007. E-1, Population Estimates for Cities, Counties and the State with Annual Percent Change—January 1, 2006 and 2007. May. Sacramento.

California Department of Finance. Various years. E-1, City/County Population Estimates with Annual Percentage Change; E-2, California County Population Estimates and Components of Change by Year, July 1; and E-4, Population Estimates for Cities, Counties, and the State. Available at http://www.dof.ca.gov.

California Department of Fish and Game (CDFG). 1985. California's Wildlife, Amphibians, and Reptiles, Western Pond Turtle. California Wildlife Habitat Relationships System.

California Department of Fish and Game (CDFG). 1988. California's Wildlife, Amphibians, and Reptiles, Western Spadefoot. California Wildlife Habitat Relationships System.

California Department of Fish and Game (CDFG). 1992. Annual Report on the Status of California Listed Threatened and Endangered Animals and Plants. State of California, The Resources Agency, Department of Fish and Game, Sacramento, CA.

California Department of Fish and Game (CDFG). 2002. California Wildlife Habitat Relationships – Version 8.0 Sacramento, CA. [[tricolored blackbird]]

California Department of Fish and Game (CDFG). 2007. San Joaquin Valley Giant Garter Snake Trapping Effort 2006. Final Report. Los Banos Wildlife Area Publication. Los Banos, California. July.

California Department of Fish and Game (CDFG). 2008a. Table 1. California Bird Species of Special Concern. Available at http://www.dfg.ca.gov/wildlife/species/ssc/docs/Table1_FIN.pdf.

California Department of Fish and Game (CDFG). 2008b. Los Banos Wildlife Area – Merced County. Available at http://www.dfg.ca.gov/lands/wa/region4/losbanos.html.

California Department of Fish and Game (CDFG). 2008c. North Grasslands Wildlife Area – Merced & Stanislaus County. Available at http://www.dfg.ca.gov/lands/wa/region4/northgrasslands.html.

California Department of Water Resources (DWR). 2000. San Joaquin Valley Drainage Monitoring Program 1997. March.

California Department of Water Resources (DWR). 2007. Water Year Hydrologic Classification Indices. Accessed February 1, 2008. Available at http://cdec.water.ca.gov/cgi-progs/iodir/wsihist.

California Department of Water Resources (DWR). 2008. Water Data Library. Station Number KA007089, California Aqueduct, Check 13, O'Neill Outlet (San Luis Canal). Data downloaded February 6. Avai at http://wdl.water.ca.gov/wq-gst/

California Department of Water Resources (DWR). Undated. *Evaluation of San Luis/Delta-Mendota Water Authority West Side Regional Drainage Plan Proposal*. Integrated Regional Water Management Implementation Proposition 50, Chapter 8, IRWM Implementation Step 2 Proposals. Accessed January 2007. Available at http://www.grantsloans.water.ca.gov/docs/prop50/round1/step2/9601.pdf.

California Department of Water Resources (DWR) and Bureau of Reclamation (Reclamation). 2005. South Delta Improvement Program (SDIP) Draft Environmental Impact Statement/ Environmental Impact Report (DEIS/EIR). October.

California Employment Development Department. 2008. Employment by Industry Data. Accessed October 6. Available at http://www. labormarketinfo.edd.ca..gov.

California Native Plant Society (CNPS). 2008. Inventory of Rare and Endangered Plants (online edition, v7-08c-interim). California Native Plant Society. Sacramento, CA. Accessed on Sat, Oct. 4, 2008. Available at http://www.cnps.org/inventory.

California Natural Diversity Data Base (CNDDB). 2000. Records from the Gustine 7.5 minute USGS quadrangle. Natural Heritage Division, California Department of Fish and Game, Sacramento, CA.

California Natural Diversity Data Base (CNDDB). 2008. Natural Heritage Division, California Department of Fish and Game, Sacramento, CA.

California Regional Water Quality Control Board, Central Valley Region (Regional Board). 1996. Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins, Third Edition.

California Regional Water Quality Control Board, Central Valley Region (Regional Board). 1998a. Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins, Fourth Edition. September 15.

California Regional Water Quality Control Board, Central Valley Region (Regional Board). 1998b. Order No. 98-171. Waste Discharge Requirements for San Luis & Delta-Mendota Water Authority and United States Department of the Interior Bureau of Reclamation, Grassland Bypass Channel Project, Fresno and Merced Counties. Adopted July 24.

California Regional Water Quality Control Board, Central Valley Region (Regional Board). 2000a. Selenium TMDL for Grassland Marshes. April.

California Regional Water Quality Control Board, Central Valley Region (Regional Board). 2000b. Review of Selenium Concentrations in Wetlands Water Supply Channels in the Grassland Watershed. Staff Report. May.

California Regional Water Quality Control Board, Central Valley Region (Regional Board). 2000c. Development of a Basin Plan Amendment Addressing Salinity and Boron in the Lower San Joaquin River – A Status Report. Staff Report. April.

California Regional Water Quality Control Board, Central Valley Region (Regional Board). 2001a. Total Maximum Daily Load for Selenium in the Lower San Joaquin River. San Joaquin River TMDL Unit. August.

California Regional Water Quality Control Board, Central Valley Region (Regional Board). 2001b. Waste Discharge Requirements for San Luis & Delta-Mendota Water Authority and United States Department of the Interior Bureau of Reclamation Grassland Bypass Project (Phase II). Fresno and Merced Counties. Order No. 5-01-234.

California Regional Water Quality Control Board, Central Valley Region (Regional Board). 2001c. Grassland Bypass Project Annual Report. October 1, 1998 through September 30, 1999. Sacramento, California. June.

California Regional Water Quality Control Board, Central Valley Region (Regional Board). 2004a. Amending the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Salt and Boron Discharges to the lower San Joaquin River. Resolution Number R5-2004-0108.

California Regional Water Quality Control Board, Central Valley Region (Regional Board). 2004b. Appendix 1: Technical TMDL Report. Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basin for the Control of Salt and Boron Discharges into the Lower San Joaquin River. Draft Final Staff Report. San Joaquin River TMDL Unit. July.

California Regional Water Quality Control Board, Central Valley Region (Regional Board). 2005. Revised Monitoring and Reporting Program No. 5-01-234 for San Luis and Delta Mendota Water Authority and United States Department of the Interior Bureau of Reclamation. Grassland Bypass Project (Phase II). Fresno and Merced Counties.

California Regional Water Quality Control Board, Central Valley Region (Regional Board). 2008. Grassland Bypass Project Data and Site Descriptions. Last updated June 7, 2008. Accessed January 24, 2008. Available at http://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_studies/surface_water_ambient_monitoring/sjr_swamp.shtml.

California State Water Resources Control Board (State Board). 1995. Water Quality Control Plan for the San Francisco Bay/ Sacramento-San Joaquin Delta Estuary. Resolution No. 95-24. Sacramento, CA. May.

California State Water Resources Control Board (State Board). 2006a. Clean Water Act Section 303(d) List of Water Quality Limited Segments. Approved October 25, 2006.

California State Water Resources Control Board (State Board). 2006b. Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. December 6.

CH2M Hill and Lawrence Berkeley National Laboratory. 2000. Ecological risk Assessment for Kesterson Reservoir. Prepared for Bureau of Reclamation, Mid-Pacific Region. December.

CH2M Hill, H.T. Harvey and Associates, and G.L. Horner. 1993. Cumulative Impacts of Agriculture Evaporation Basins on Wildlife. Technical report prepared for California Department of Water Resources. February.

Climate Register (CR). 2008. The Climate Registry General Reporting Protocol, Version 1.0, Chapter 14. March. Available at http://theclimateregistry.org/.

Combustion Engineering, Inc. 1967. Steam Tables: Properties of Saturated and Superheated Steam. Winsor, CT.

Corwin, D.L, J.D. Rhaodes, and P.J. Vaughan. 1991. GIS applications to the basin-scale assessment of soil salinity and salt loading to groundwater. In *Applications of GIS to the Modeling of Non-Point Source Pollutants in the Vadose Zone*, Corwin and Loague, eds. Soil Science Society of America, Madison, WI.

Corwin, D.L., M.L.K. Carillo. P.J. Vaughan, J.D. Roades, and D.G. Cone. 1999. Evaluation of a GIS-linked model of salt loading to groundwater. *Journal of Environmental Quality* 28: 471-480.

Council for Agricultural Science and Technology (CAST). 1994. Risk and benefits of selenium in agriculture. Issue Paper No. 3. Council for Agricultural Science and Technology, Ames, IA.

Davis, G.H., and J.F. Poland. 1957. Groundwater conditions in the Mendota-Huron area, Fresno and Kings Counties, California. In *Contributions to the Hydrology of the United States*. *U.S. Geological Survey Water-Supply Paper* 1360-G: 409-588.

Deverel, S.J., and J.L. Fio. 1991. Groundwater flow and solute movement to drain laterals, western San Joaquin Valley, California, 1, Geochemical assessment. *Water Resource Research* 27: 2233-2246.

Deverel, S.J., and R. Fujii. 1988. Processes affecting the distribution of selenium in shallow groundwater of agricultural areas, western San Joaquin Valley, California. *Water Resources Research* 24: 516-524.

Deverel, S.J., and S.K. Gallanthine. 1989. Distribution of salinity and selenium in relation to hydrologic and geochemical processes, San Joaquin Valley, California. *Journal of Hydrology* 109: 125-149.

Deverel, S.J., and S.P. Millard. 1988. Distribution and mobility of selenium and other trace elements in shallow groundwater of the western San Joaquin Valley, California. *Environmental Science and Technology* 22: 697-702.

Deverel, S.J., R.J. Gilliom, R. Fujii, J.A. Izbicki, and J.C. Fields. 1984. Distribution of selenium and other inorganic constituents in shallow groundwater of the San Luis Drain Service Area, San Joaquin Valley, California: A preliminary study. *U.S. Geological Survey Water Resources Investigation Report* 84-4319.

Dickert. 2005. Giant garter snake surveys at some areas of historic occupation in the Grassland Ecological Area, Merced Co. and Mendota Wildlife Area, Fresno Co., California. *California Fish and Game* 91: 255-269.

Donahue, R.L., R.W. Miller, and J.C. Shickluna. 1977. *Soils: An Introduction to Soils and Plant Growth.* Fourth Edition. Englewood Cliffs, New Jersey: Prentice-Hall.

duPont, E.I., du Nemours & Co., Inc. 1971. *Condensed Laboratory Handbook*. Wilmington, DE.

Eacock, C. 2008a. Data received via written communication, dmc ch 13 & 21 monthly data.xls.

Eacock, C. 2008b. Data received via written communication, GBP all selenium data.xls, gbp summary data in rb layout_2.xls. April 4.

Eacock, C. 2008c. Data received via written communication, SLD mass balance - differences in flows loads and conc betw A & B.xls. November 25.

Ehrlich, P.R., D. S. Dobkin, and D. Wheye. 1988. *The Birder's Handbook.* New York: Simon and Schuster Inc.

Eisler, R. 1985. Selenium hazards to fish, wildlife, and invertebrates: a synoptic review. *Contaminant Hazard Reviews Repo*rt 5. Patuxent Wildlife Research Center, U.S. Fish and Wildlife Service, Laurel, MD.

Eisler, R. 1988. Arsenic hazards to fish, wildlife, and invertebrates: a synoptic review. *Biological Report 85(1.12), Contaminant Hazard Reviews*. January.

Eisler, R. 1989. Molybdenum hazards to fish, wildlife, and invertebrates: a synoptic review. *Biological Report 85(1.19), Contaminant Hazard Reviews*. August.

Eisler, R. 1990. Boron hazards to fish, wildlife, and invertebrates: a synoptic review. *Biological Report 85(1.20), Contaminant Hazard Reviews*. April.

Engberg, R.A., D.W. Westcott, M. Delamore, and D.D. Holz. 1998. Federal and state perspectives on regulation and remediation of irrigation-induced selenium problems. In *Environmental Chemistry of Selenium*, W.T. Frankenberger and S. Benson, eds. New York: Marcel Dekker.

Eriksen, C.H. and D. Belk, 1999. *Fairy Shrimps of California's Puddles, Pools, and Playas*. Eureka, CA: Mad River Press.

59 Federal Register. 1994.

Fio, J.L. 1994. Calculation of a water budget and delineation of contributing sources to drainflows in the western San Joaquin Valley, California. *U.S. Geological Survey Open-File Report* 94-45: 39.

Fio, J.L., and S.J. Deverel. 1991. Groundwater flow and solute movement to drain laterals, western San Joaquin Valley, California, II. Quantitative hydrologic assessment. *Water Resources Research* 27: 2247–2257.

Fresno County. 2000. Fresno County General Plan. Adopted October 3.

Fujii, R., S.J. Deverel, and D.B. Hatfield. 1988. Distribution of selenium in soils of agricultural fields, Western San Joaquin Valley, California. *Soil Science Society America Journal* 52: 1274-1283.

Gaines, D. 1977a. Current status and habitat requirements of the yellow-billed cuckoo in California. California Department of Fish and Game, Sacramento.

Gaines, D. 1977b. *Birds of the Yosemite Sierra*. Oakland: California Syllabus.

Gilliom, R.J. 1989. Preliminary assessment of sources, distribution, and mobility of selenium in the San Joaquin Valley, California. *U.S. Geological Survey Water-Resources Investigations Report* 88-4186: 129.

Grassland Area Farmers. 1997. A Storm Event Plan for Operating the Grassland Bypass Project.

Grassland Area Farmers and San Luis and Delta-Mendota Water Authority (GAF and Authority). 1998. Long-Term Drainage Management Plan for the Grassland Drainage Area. September 30.

Grassland Bypass Project Oversight Committee. 2002. Monitoring Program for the Operation of the Grassland Bypass Project. Phase II. Prepared by the Grassland Bypass Project Data Collection and Reporting Team for the Grassland Bypass Project Oversight Committee. June.

Grassland Steering Committee. 2000. Personal communication with Susan Hootkins, URS, October 27.

Grinnell, J., and A. H. Miller. 1944. The distribution of the birds of California. *Pacific Coast Avifauna* 27:1-608.

Grober, L.F., J. Karkoski, and T. Poole. 1995. Water quality impacts of wetlands on San Joaquin River; California. In *Versatility of Wetlands in the Agricultural Landscape*, K.L. Campbell, ed. American Society of Agricultural Engineers, St. Joseph, MO.

Hanson Environmental, Inc. 2003. Performance Assessment of Mitigation Actions Implemented at the Tulare Lake Drainage District Evaporation Basins: 1993–2001. Technical report prepared for Tulare Lake Drainage District for Submittal to California Regional Water Quality Control Board–Central Valley Region. March.

Hagen, S., H.T. Harvey & Associates. 2008. Comments on Administrative Draft EIS/EIR. Provided to Susan Hootkins, ENTRIX, November 17.

Harradine, F.F. 1950. *Soils of Western Fresno County*. Berkeley: University of California Press.

H.T. Harvey & Associates. 2003–2008. Annual Winter Mountain Plover Monitoring Reports to Grasslands Water District.

H.T. Harvey & Associates. 2002. San Joaquin River Water Quality Improvement Project, Phase I Wildlife Monitoring Report 2001. Prepared for Panoche Drainage District.

H.T. Harvey & Associates. 2003. San Joaquin River Water Quality Improvement Project, Phase I Wildlife Monitoring Report 2002. Prepared for Panoche Drainage District.

H.T. Harvey & Associates. 2004. San Joaquin River Water Quality Improvement Project, Phase I Wildlife Monitoring Report 2003. Prepared for Panoche Drainage District.

H.T. Harvey & Associates. 2005. In-Valley Treatment / Drainage Reuse Facility Expansion Biotic Study. S.B. Terrill, B. B. Boroski, J. Seay, D. G. Duke, N. Snow, N.R. Sisk, and H. Clark. Prepared for Panoche Drainage District. December 20.

H.T. Harvey & Associates. 2006. San Joaquin River Water Quality Improvement Project, Phase I Wildlife Monitoring Report 2005. Prepared for Panoche Drainage District.

H.T. Harvey & Associates. 2007. San Joaquin River Water Quality Improvement Project, Phase I Wildlife Monitoring Report 2006. Prepared for Panoche Drainage District.

H.T. Harvey & Associates. 2008. San Joaquin River Water Quality Improvement Project, Phase I Wildlife Monitoring Report 2007. Prepared for Panoche Drainage District.

Heinz, G.H. 1996. Selenium in birds. In *Interpreting Environmental Contaminants in Animal Tissues*, W. N. Beyer, G. H. Heinz, and A. W. Redmon, eds., pp. 453-464. Boca Raton, Florida: Lewis Publishers.

Heinz, G.H., D. J. Hoffman, and L. G. Gold. 1989. Impaired reproduction of mallards fed an organic form of selenium. *J. Wildl. Manage*. 53:418-428.

Holland, D.C. 1994. The Western Pond Turtle: Habitat and History. Final Report. U.S. Department of Energy, Bonneville Power Administration, Portland, OR.

Holland, V.L., and D.J. Keil. 1987. *California Vegetation*. El Corral Bookstore, Polytechnic State University, San Luis Obispo, CA.

Hothem, R.L., and D. Welsh. 1994. Contaminants in eggs of aquatic birds from the grasslands of central California. *Archives of Environmental Contamination and Toxicology* 27:180-185.

HydroFocus, Inc. 1998. Model post audit and projected water-table response to land retirement strategies in the San Luis Unit, western San Joaquin Valley, California. Page 37.

Jennings, B.H. 1970. *Environmental Engineering – Analysis and Practice*. International Textbook Company.

Koller, L.D., and J.H. Exon. 1986. The two faces of selenium – deficiency and toxicity – are similar in animals and man. *Can. J. Vet. Res.* 50:297-306.

Kuchler, A.W. 1977. Appendix: the map of the natural vegetation of California. In *Terrestrial Vegetation of California*, M.G. Barbour and J. Major, eds. John Wiley & Sons.

Lemly, A.D. 1993. Guidelines for evaluating selenium data from aquatic monitoring and assessment studies. *Environ. Monitor. Assess*. 28:83B100.

Lemly, A.D. 1996. Assessing the toxic threat of selenium to fish and aquatic birds. *Environ. Monitor. Assess*. 43:19B35.

Lemly, A.D. 1999. Selenium transport and bioaccumulation in aquatic ecosystems: a proposal for water quality criteria based on hydrological units. *Ecotoxicology and Environmental Safety* 42: 150-156.

Lemly, A.D., and G.J. Smith. 1987. Aquatic cycling of selenium: implications for fish and wildlife. *Fish and Wildlife Leaflet* 12. U.S. Fish and Wildlife Service, Washington, DC.

Lillebo, H.P., S. Shaner, D. Carlson, N. Richard, and P. DuBowy. 1988. Water quality criteria for selenium and other trace elements for protection of aquatic life and its uses in the San Joaquin Valley. SWRCB Order No. W.Q. 85-1, Technical Committee Report, Appendix D. California State Water Resources Control Board, Sacramento, CA.

Linneman, C. 2008a. Comments on District acreage. Written communication, February, 22, 2008.

Linneman, C. 2008b. Data received via written communication, GBP 00_07 Data.xls, SJRIP LOADS by dist 07.xls. February 4 and 5.

Littlefield, C.D., and G.L. Ivey. 2002. *Washington State Recovery Plan for the Sandhill Crane*. Washington Department of Fish and Wildlife, Olympia, WA. Available at http://wdfw.wa.gov/wlm/diversity/soc/recovery/sandhillcrane/finalsandhillcrane.pdf.

Madera County. 1995. Madera County General Plan. Adopted October 24.

Martin, P. F. 1988. The toxic and teratogenic effects of selenium and boron on avian reproduction. MS thesis, University of California, Davis, CA.

Mayer, K.E., and W.F. Laudenslayer, Jr., eds. 1988. *A Guide to Wildlife Habitats of California.* California Department of Forestry, Sacramento, California.

McCaskie, G., P. De Benedictis, R. Erickson, and J. Morlan. 1979. *Birds of Northern California, An Annotated Field List.* 2nd ed. Berkeley: Golden Gate Audubon Society.

McEwan, D. 2001. The effects of the San Joaquin River flows and Delta export rates during October on the number of adult San Joaquin Chinook salmon that Stray. In *Contributions to the Biology of Central Valley Salmonids*, R.L. Brown, ed. California Department of Fish and Game. Fish Bulletin 179(1): 1-43.

McEwan, D., and T.A. Jackson. 1996. Steelhead restoration and management plan for California. CDFG. February 1996.

McGahan, J.G. Summers Engineering. 2000a. Flow and Discharge Data. Fax transmittal to Susan Hootkins, URS, March 20.

McGahan, J.G. Summers Engineering. 2000b. Personal communication with Susan Hootkins, URS, December 6.

McGahan, J.G. Summers Engineering. 2008a. Email communication to Susan Hootkins, ENTRIX, August 20.

McGahan, J.G. 2008b. *Sediment Quantity in the San Luis Drain.* In Grassland Bypass Project Reports. Chapter 10. May.

McGahan, J.G. 2008c. Phase 3 Treatment Energy Use. E-mail transmittal to Susan Hootkins, ENTRIX, April 7.

Merced County. 1990. Year 2000 General Plan. Adopted December 4.

Mesick, C. 2001. The effects of the San Joaquin River flows and Delta export rates during October on the number of adult San Joaquin Chinook salmon that Stray. In *Contributions to the Biology of Central Valley Salmonids*, R.L. Brown, ed. California Department of Fish and Game. Fish Bulletin 179(2): 139-162.

Miller, K., and K. Hornaday. 1999. Draft Recovery Plan for the Giant Garter Snake (*Thamnophis gigas*). U.S. Fish and Wildlife Service Region 1 and The Giant Garter Snake Recovery Team. Sacramento, California.

Miller, R.E., J.H. Green, and G.H. Davis. 1971. Geology of the compacting deposits in the Los Banos-Kettleman City subsidence area, California. *U.S. Geological Survey Professional Paper* 497-E.

Moore, S.B., J. Winckel, S.J. Detwiler, S.A. Klasing, P.A. Gaul, N.R. Kanim, B.E. Kesser, A.B. DeBevec, K. Beardsley, and L.K. Puckett. 1990. Fish and Wildlife Resources and Agricultural Drainage in the San Joaquin Valley, California, Volume I and II. San Joaquin Valley Drainage Program, Sacramento, CA.

Moyle, P.B. 1976. *Inland Fishes of California*. Berkeley CA. University of California Press.

Moyle, P.B. 2002. Inland Fishes of California; revised and expanded. University of California Press. Berkeley, CA.

Moyle, P.B., R.M. Yoshiyama, J.E. Williams, and E.D. Wikramanayake. 1995. Fish Species of Special Concern in California. Second Edition. Prepared by Department of Wildlife and Fisheries Biology, University of California, Davis. June.

National Marine Fisheries Service (NMFS). 1998. ESA threatened listings for lower Columbia River and Central Valley California steelhead; "not warranted" finding for 3 other steelhead populations. 63 FR 13347.

National Marine Fisheries Service (NMFS). 2005. Final ESA listing determinations for 16 ESUs of West Coast salmon, and final 4(d) protective regulations for threatened salmonid ESUs. 70 FR 37160

NRDC vs. Kempthorne. 2007. and Pacific Coast Federation of Fisherman's Associations vs. Gutierrez, 2008.

Odum, E.P. 1978. Ecological importance of the riparian zone. In *Strategies for Protection and Management of Floodplain Wetlands and Other Riparian Ecosystems*, R.R. Johnson and McCormick, tech. coords., pp. 2-4. Proceedings of the symposium, December 11-13, 1978, Washington, D.C. Gen. Tech. Rep. WO-12.

Ohlendorf, H. M., and R. L. Hothem. 1995. Agricultural drainwater effects on wildlife in Central California. In *Handbook of Ecotoxicology*, 2nd edition, D.J. Hoffman, ed., pp. 577-595.

Ohlendorf, H. M., J. Skorupa, M. K. Saiki, and D. A. Barnum. 1993. Food-chain transfer to trace elements to wildlife. In *Management of Irrigation and Drainage Systems: Integrated Perspectives*, R.G Allen and C. M.U. Neals, eds., pp 596-603. Proceedings of the 1993 National Conference on Irrigation and Drainage Engineering, American Society of Civil Engineers, New York, NY.

Oldfield, J.E. 1990. Selenium: its uses in agriculture, nutrition and health, and environment. Special Publication. Selenium-Tellurium Development Association, Inc., Darien, CT.

Pacific Gas & Electric (PG&E). 2006. Pacific Gas & Electric Power Mix for 2006. Available at http://www.pge.com/myhome/edusafety/systemworks/electric/energymix/index.shtml.

Parkhurst, D.L., D.C. Thorstenson, and L.N. Plummer. 1980. PHREEQE – A computer program for geochemical calculations. *U.S. Geological Survey Water-Resources Investigations Report* 80-96.

Phillips, S.A., S.L. Beard, R.J. and Gilliom. 1991. Quantity and quality of groundwater inflow to the San Joaquin River. *U.S. Geological Survey Water-Resources Investigation Report* 91-4019.

Piper, D.Z., and M.D. Medrano. 1994. Geochemistry of the Phosphoria Formation at Montpelier Canyon, Idaho: Environment of deposition. The Phosphoria Formation: Its Geochemical and Biological Environment of Deposition. *U.S. Geological Survey Bulletin* 2023. U.S. Government Printing Office: 1994-583-048/10005.

Presser, T.S., and D.Z. Piper. 1998. Mass balance approach to selenium cycling through the San Joaquin Valley: From source to river to bay. In *Environmental Chemistry of Selenium,* W.T. Frankenberger, Jr. and R.A. Engberg, eds., pp. 153-182. New York: Marcel Dekker.

Presser, T.S., and H.M. Ohlendorf. 1987. Biogeochemical cycling of selenium in the San Joaquin Valley, California, USA. *Environmental Management* 11:805-821.

Presser, T.S., M.A. Sylvester, and W.H. Low. 1994. Bioaccumulation of selenium from natural geologic sources in western states and its potential consequences. *Environmental Management* 18:423-436.

Putnam, D. 1998. Contributions of alfalfa to wildlife and the environment. 28th National Alfalfa Symposium, Bowling Green, KY, February 26-27, 1998.

Quinn, N.W.T., and J. Karkoski. 1998. Real-time management of water quality in the San Joaquin River Basin, California. *Journal of the American Water Resources Association* 34: 1473–1486.

Quinn, N.W.T., and W.M. Hanna. 2002. A decision support system for adaptive real-time management of seasonal wetlands in California. LBNL-49206. Lawrence Berkeley National Laboratory, Berkeley, CA.

Rantz, S.E. 1969. Mean annual precipitation in the California Region. *U.S. Geological Survey Open-File Maps*, 2 sheets.

Remsen, J.V., Jr. 1978. Bird species of special concern in California. California Department of Fish and Game, Sacramento. *Wildlife Management Administrative Report* 78-1.

Rivera, Patricia. 2008a. Bureau of Reclamation email communication to Dean Martorana, URS, April 21.

Rivera, Patricia. 2008b. Review of Bureau of Reclamation GIS regarding ITAs and Public Domain Allotments. Email communication to Judi Tapia, Reclamation, November 21.

Rutter, C. 1908. The fishes of the Sacramento-San Joaquin basin, with a study of their distribution and variation. *Bulletin of U.S. Bureau of Fisheries* 27(637):103-152.

Saiki, M.K. 1984. Environmental conditions and fish faunas in low elevation rivers on the irrigated San Joaquin Valley floor, California. *California Fish and Game* 70(3): 145-157.

Saiki, M.K. 1998. An ecological assessment of the Grassland Bypass Project on fishes inhabiting the Grassland Water District, California. Final Report prepared by the U.S. Geological Survey (WFRC-Dixon Duty Station, Dixon, CA) for the U.S. Fish and Wildlife Service, Sacramento, CA. September.

Sample, B.E., G. W. Suter II, M. B. Sheaffer, D. S. Jones, and R. A. Efroymson. 1997. Ecotoxicological Profiles for Selected Metals and Other Inorganic Chemicals. September.

San Francisco Estuary Institute (SFEI). 2007. Grassland Bypass Project Report 2004–2005. Chapters 5 and 6. Prepared for the Grassland Bypass Project Oversight Committee. May.

San Francisco Estuary Institute (SFEI). 2008. Grassland Bypass Compliance Monitoring Program, Water Quality Data from CVRWQCB in ASCII text format. Data downloaded January 18. Available at http://www.sfei.org/grassland/reports/navbar/start.htm.

San Joaquin River Exchange Contractors Water Authority, Broadview Water District, Panoche Water District, and Westlands Water District. 2003. *Westside Regional Drainage Plan*. May.

San Joaquin River Riparian Habitat Restoration Program. 1998. Historical Riparian Habitat Conditions of the San Joaquin River – Friant Dam to Merced River. April.

San Joaquin River Restoration Program (SJRRP). 2007. Implementing the Stipulation of Settlement in Natural Resources Defense Council, et al., v. Kirk Rodgers, United States Bureau of Reclamation,et al. Case No. S-88-1658-LKK/GGH, United States District Court. Program Management Plan. May 1.

San Joaquin Valley Drainage Implementation Program. 1998. Drainage Management in the San Joaquin Valley: A Status Report. February.

San Joaquin Valley Drainage Program (SJVDP). 1990. A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley. Final Report. September.

Sawyer, J. O., and T. Keeler-Wolf. 1995. *A Manual of California Vegetation*. California Native Plant Society, Sacramento, CA.

Schmidt, K.D. 1988. Letter to Firebaugh Canal Company describing water quality in shallow monitoring wells in Broadview Water District and Firebaugh Canal Company, Fresno, California.

Seiler, R.L. 1997. Methods to identify areas susceptible to irrigation-induced selenium contamination in the western United States. *U.S. Geological Survey Fact Sheet* FS-038-97. Carson City, NV.

Shuford, W.D. G., G. Page, and J. Kjelmyr.. 1998. Patterns and dynamics of shorebird use of California's Central Valley. *Condor* 100:227-244.

Skorupa, P. 1998. Selenium poisoning of fish and wildlife in nature: lessons from twelve real-world examples. In *Environmental Chemistry of Selenium*, W. T. Frankenberger, Jr. and R. A. Engberg, eds., New York: Marcel Dekker, Inc.

Skorupa, P., and H. M. Ohlendorf. 1991. Contaminants in drainage water and avian risk thresholds. In *The Economics of Management of Water and Drainage in Agriculture*, A. Dinar and D. Zilberman, eds. Boston, MA: Kluwer Academic Publishers.

Skorupa, P., S.P. Morman, and J. S. Sefchick-Edwards. 1996. Guidelines for Interpreting Selenium Exposures of Biota Associated with Nonmarine Aquatic Habitats. Prepared for the U.S. Department of the Interior, National Irrigation Water Quality Program, by the Sacramento Field Office of the U.S. Fish and Wildlife Service. March.

Smallwood, K.S., and S. Geng. 1993. Alfalfa as Wildlife Habitat. 23rd California Alfalfa Symposium, December 8-9, 1993, Visalia, CA. Department of Agronomy and Range Science Extension, University of California, Davis, CA 95616.

Sorensen, E.M.B. 1991. *Metal Poisoning in Fish*. Boca Raton, FL: CRC Press.

Southern California Edison (SCE). 2006. Southern California Edison Power Mix for 2006. Available at http://www.sce.com/NR/rdonlyres/C4468BF5-EB3B-4A60-B6CC-BB42B9C080C5/0/PowerContentLabel.pdf.

Stanislaus County. 1994. Stanislaus County General Plan. Adopted October.

Stanley, T.R., Jr., G.J. Smith, D.J. Hoffman, G.H. Heinz, and R. Rosscoe. 1996. Effects of boron and selenium on mallard reproduction and duckling growth and survival. *Environ. Toxicol. Chem*. 16:1124-1132.

Stebbins, R.C. 2003. *Field Guide to Western Reptiles and Amphibians*: Third Edition. Boston, MA: Houghton Mifflin Co.

Stone, R.D., W.B. Davilla, D.W.Taylor, G.L. Clifton, and L. Stebbins. 1988. Status survey of the grass tribe *Orcuttieae* and *Chamaesyce hooveri* in the Central Valley of California. U.S. Fish and Wildlife Service, Sacramento, CA.

Summers Engineering. 2008a. Personal communications with Chris Linneman, April 29, May 23, June 10.

Summers Engineering. 2008b. Personal communication with Brad Boyes, Senior Environmental Engineer, ENTRIX. April 7.

Sumner, L., and J.S. Dixon. 1953. *Birds and Mammals of the Sierra Nevada*. University of California Press, Berkeley.

Thelander, C.G., editor. 1994. *Life on the Edge: a Guide to California's Endangered Natural Resources*. Volume I: Wildlife. Santa Cruz, CA: Biosystems Books.

United States Census Bureau. 2006. American Community Survey. Available at http://www.census.gov/acs/www/.

United States Environmental Protection Agency (USEPA). 1995 (revisions 1996, 2006). Compilation of Air Pollution Emission Factors (AP-42), Fifth Edition. www.epa.gov/ttn/chief/ap42/index.html.

United States Environmental Protection Agency (USEPA). 2000. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California. 40 CFR Part 131: 31681-31719. May 18.

United States Environmental Protection Agency (USEPA). 2002. Inventory of U.S. Greenhouse Emissions and Sinks: 1990–2000. Office of Atmospheric Programs. EPA 430-R-02-003. April. www.epa.gov/globalwarming/publications/emissions.

United States Environmental Protection Agency (USEPA). 2008a. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. Office of Atmospheric Programs. EPA 430-R-08-005. April. Available at www.epa.gov/globalwarming/publications/emissions.

United States Environmental Protection Agency (USEPA). 2008b. Environmental justice homepage. Available at http://www.epa.gov/compliance/basics/ejbackground.html.

United States Fish and Wildlife Service (Service). 1990. A Management Plan for Agricultural Subsurface Drainage and Related Problems of the Westside San Joaquin Valley. Final Report of the San Joaquin Valley Drainage Program.

United States Fish and Wildlife Service (Service). 1993. Endangered and threatened wildlife and plants, status for the giant garter snake. Final Rule. 58 FR, Vol. 201, 54053-54066. October 20.

United States Fish and Wildlife Service (Service). 1995. Compensation Habitat Protocol for Drainwater Evaporation Basins. Sacramento, CA.

United States Fish and Wildlife Service (Service). 1996. Birds of San Luis, Merced, and Kesterson National Wildlife Refuges and Grasslands Wildlife Management Area, California. Unpaginated. Jamestown, ND: Northern Prairie Wildlife Research Center Online.

United States Fish and Wildlife Service (Service). 1998. Recovery plan upland species of the San Joaquin Valley, California. Sacramento, California.

United States Fish and Wildlife Service (Service). 1999. Endangered and Threatened Wildlife and Plants; Listing the Sacramento Splittail as Threatened. 64 FR 5963.

United States Fish and Wildlife Service (Service). 2003. Endangered and Threatened Wildlife and Plants; Notice of Remanded Determination of Status for the Sacramento splittail (*Pogonichthys macrolepidotus*); Final Rule. 68 FR 55139.

United States Fish and Wildlife Service (Service). 2006. Giant Garter Snake (*Thamnophis gigas*) 5-Year Review: Summary and Evaluation. Sacramento, California. September.

United States Fish and Wildlife Service (Service). 2008. San Luis National Wildlife Refuge Complex. Accessed August 19. Available at http://www.fws.gov/sanluis/.

Universal Industrial Gases, Inc (UIG). 2008. *Air: Its Composition and Properties*. Easton, PA. Available at http://www.uigi.com/air.html.

URS Corporation (URS). 2001. Final Grassland Bypass Project Environmental Impact Statement/Environmental Impact Report. Prepared for Bureau of Reclamation, Sacramento and Fresno, CA, and San Luis & Delta-Mendota Water Authority, Los Banos, CA. May 21.

URS Corporation (URS). 2007a. Initial Study for San Joaquin River Water Quality Improvement Project Phase I, Part 2, for Panoche Drainage District. Oakland, CA. April.

URS Corporation (URS). 2007b. Draft Mitigated Negative Declaration and Initial Study for San Joaquin River Water Quality Improvement Project Phase I, Part 2. Prepared for Panoche Drainage District.

URS Greiner Woodward Clyde. 1999. Alternatives Report for the Grassland Bypass Project EIS/EIR.

Warner, R.E. 1979. California riparian study program, background information and proposed study design. Prepared for California Department of Fish and Game, Sacramento, CA. Unpublished report.

Water Environment Federation. 1997. The Clean Water Act 25th Anniversary Edition. Alexandria, Virginia.

Westman, V. 2008. Written communication from Victoria Westman, Regional Board, to Elizabeth Nielsen, URS. Email with attached file, Preproject data 85-95 flat file.xls. February 13.

Wichelns, D. 1989. Economic Analysis and Farm-Level Implications of Regional Drainage Policies. Report to the San Joaquin Valley Drainage Program, Sacramento, CA.

Wichelns, D., and L. Houston. 1995a. Potential Economic Impacts of Selenium Load Restrictions in the Grassland Basin. Report prepared for the Grassland Basin Drainers.

Wichelns, D., and L. Houston. 1995b. Potential Economic Impacts of Selenium Load Restrictions in the Grassland Basin. Technical Appendix to a report prepared for the Grassland Area Drainers.

Wichelns, D., and L. Houston. 1996. Economic issues regarding water quality objectives in the Grassland Basin. Paper presented at the North American Water and Environment Congress, sponsored by the American Society of Civil Engineers, Anaheim, CA.

Wichelns, D., and M. Weinberg. 1990. Economics of agricultural drainage policies. *California Agriculture* 44 (4).

Wilber, C.G. 1980. Toxicology of selenium: a review. *Clin. Toxicol.* 17:171-230.

Williams, D.F. 1986. Mammalian species of concern in California. *California Department of Fish and Game Report* 86-1. Sacramento, CA.

Woolington, D. 2000. Wildlife Biologist, U.S. Fish and Wildlife Service, San Luis National Wildlife Refuge. Personal communication with Marla Macoubrie, U.S. Fish and Wildlife Service, June 16.

Zeiner, D.C., W.F. Laudenslayer, K. Mayer, and M. White, ed. 1988–1990. *California's Wildlife. Volume I-III, Amphibians and Reptiles*. California Department of Fish and Game, Sacramento.

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